Chapter 81: Oral Cavity and Oropharyngeal Reconstruction

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Reconstructive head and neck surgery is an art dictated by the extent of a surgeon's knowledge, perception, and vision. The efforts of earlier pioneers, despite being restricted by the quality and number of reconstructive options, demonstrated remarkable ingenuity and understanding of wound healing. Their experiences engendered the sound surgical principles and management guidelines that are the cornerstones of head and neck reconstruction today.

The foremost principle is that total tumor removal cannot be compromised. A preconceived notion about how to reconstruct or a limited experience in reconstruction will influence an operator's aggressiveness and thoroughness in ablating a large cancer. This indiscretion may then adversely affect a patient's survival and quality of life.

Head and neck surgical defects can be physically mutilating and functionally assaulting to such things as breathing, eating, speaking, smelling, tasting, hearing, and seeing. The surgeon is faced with restoring a patient's esthetic integrity and recreating the very essence of day-to-day living (Conley, 1976). Only after the final surgical defect is created can reconstructive planning and design be finalized. The multitude of techniques developed over the last decade allows for a very individualized and refined approach to reconstruction.

The second major lesson is that all patients with major resections in the oral cavity and oropharynx will have some degree of dysphagia and aspiration. Most patients can overcome the loss of up to 50% of any single region without debilitating morbidity. Larger resections can encompass adjoining regions, which may lead to serious disability. The finest, state-of-the-art reconstruction cannot recreate the complex neuromuscular interactions necessary for a normal swallow. Rehabilitation and patient training are of paramount importance to the ultimate success of the reconstructive effort.

The art of head and neck reconstruction, therefore, begins with synthesizing all the pertinent preoperative factors: the patient, the tumor, the defect, the surgeon, and the hospital. A workable plan is developed and instituted. Intense rehabilitation and support is then provided to the patient to maximize his physical integrity, self-esteem, and quality of life.

Preoperative Considerations

Patient factors

The general health and mental stamina of a patient greatly influence a surgeon's choice for reconstruction. A vibrant 70-year-old will probably have several more productive years and should be treated a such. A 50-year-old with significant heart disease incurs greatly increased perioperative risk with longer anesthesia times, which will limit options. Diabetes, peripheral vascular disease, and malnutrition adversely affect wound healing and decrease the reliability of musculocutaneous and free-flap survival. A patient with limited mental fortitude will not tolerate his cosmetic/functional deformity and will resist rehabilitation. Delaying an elaborate reconstruction on such may prove beneficial to their motivation. Limited mental faculties also will severely hinder postoperative rehabilitation and make aspiration a significant concern.

Patients who are fortunate enough to have a supportive family tend to accept their disability and rehabilitate better. A surgeon should involve the family in preoperative discussions whenever a major reconstruction is contemplated.

Last and most important is the assessment of just what the patient's rehabilitative potential is. For example, can he expect to return to work, resume his hobbies, or fulfill a lifelong ambition? A surgeon must understand precisely the donor morbidity associated with each of the reconstructive options chosen. For example, golfing, tennis, and swimming all involve different actions of the trunk and shoulder girdle. If a patient has a strong desire to maintain or pursue a skill or hobby, every effort should be made to preserve the necessary muscle function. On the other hand, a public figure or model may desire a more cosmetic but functionally inferior option.

Tumor factors

Obviously, the size and location of the primary tumor greatly influences any need for elaborate reconstruction. Specific examples will be discussed later in the chapter. The presence of significant neck or distant metastasis greatly reduces long-term survival and simpler, more functional reconstructions are appropriate. Tumor recurrences, especially in previously irradiated areas, generally require a more aggressive resection. Previous exposure to radiation therapy will negate the jaw periosteum as a reliable oncologic barrier (McGregor and MacDonald, 1988) and will make frozen sections unreliable. This will often cause a surgeon to delay a reconstruction.

Lastly, the biologic behavior of the tumor will dictate the need for combination therapy. When postoperative radiation therapy is necessary, it should be instituted within 4 to 6 weeks for maximum effect. The reconstructive plan must allow for this so that prognosis is not adversely affected.

Defect factors

Specific defects will be dealt with later in this chaper; however, several general factors must be considered. When vital structures such as the carotid artery or brain parenchyma are exposed, it is imperative that the reconstruction provide adequate protection. The condition of the remaining oral cavity/oropharyngeal tissue is a key factor. A densely irradiated or scarred recipient bed generally requires vacularized tissue for closure. A control fistula or even a delayed reconstruction is sometimes necessary. Exposed bone, especially mandible, must be covered if radiation is planned.

A systematic analysis of what regions have been removed or affected by the ablation will help delineate the extent of the dysphagia expected. Surgery or irradiation involving the pterygoids will promote scarring and trismus. This may be severe enough to interfere with prosthesis or denture insertion or even oral intake. Consideration or coronoidectomy and subperiosteal detachment of the medial pterygoid, temporalis, and masseter is sometimes appropriate.

Oral competence is the next requisite in an orderly swallow. Any lip reconstruction should be done with local tissue of the face maintaining muscular integrity if at all possible. An incompetent lip or one lacking bony support must be suspended.

Bolus preparation and transport are the next considerations. The action of the tongue against the hard palate is crucial. In general, the tongue and floor of mouth (FOM) are reconstructed as separate structures with care to maintain a lingual vestibule and restore sufficient height to the FOM. Tongue mobility, not necessarily bulk, should be a primary goal of any reconstructive technique.

The oropharyngeal complex begins the involuntary portion of swallowing. The tongue base moves posteriorly and the hyoid moves anteriorly and superiorly as a result of submental muscular activity (Logemann, 1990; Shaker et al, 1990). This leads to laryngeal movement forward and up under the base of the tongue. The velopharynx will concomitantly seal of to prevent reflux. When a radical resection interferes with this sequential reflex, significant dysphagia will result. Laryngeal suspension from the anterior jaw can sometimes help postoperative deglutition and should be a consideration (Calcaterra, 1976). When soft palate competence is lost, velopharyngeal narrowing via a palatal or pharyngeal flap will help reduce nasal regurgitation.

The last part of the swallowing act is cricopharyngeal or upper esophageal sphincter (UES) relaxation. This relaxation occurs in conjunction with laryngeal elevation, which moves the cricoid anteriorly and superiorly, pulling the cricopharyngeal region open maximally (Logemann, 1990; Shaker et al, 1990). The vocal cords and arytenoids approximate as soon as fluid contacts the anterior mouth. The arytenoids then contact the base of the epiglottis during the pharyngeal swallow, providing maximum airway protection while the bolus passes. The cords then open just after the UES closes. This whole action takes place in just over 2 seconds (Shaker et al, 1990). The surgeon must understand that if bolus transport and/or oropharyngeal contraction are hindered, the UES relaxation and cricopharyngeal opening will not be synchronized. This causes pharyngeal pooling and aspiration. Any compromise of laryngeal function secondary to the ablation increases the risk of aspiration substantially. A cricopharyngeal myotomy is often an essential part of the reconstructive effort if swallowing rehabilitation is to be successful.

Surgeon factors

The surgeon ultimately chooses the reconstructive option to be applied. This choice should be based on a careful analysis of all the points already discussed. The next influential factor is the surgeon's preference. This is based on the surgeon's level of training, experience, perception, and basic understanding of the art. Any surgeon involved with this type of reconstruction should have a keen understanding of the expected morbidity and the ability to provide a contemporary rehabilitation. The reconstruction often can be more technically demanding and take longer to perform than the ablation. It can often tax the stamina and capabilities of a single surgeon attempting a primary repair. An elaborate reconstruction can always be delayed so that it can be approached with the necessary enthusiasm. Many centers have instituted a team approach, splitting resection and reconstruction. However, such an approach also divides the responsibility for patient care and has the potential for alienating a patient and his family. Remember that the most important "team" is the partnership between surgeon and patient.

Hospital factors

The success or failure of any reconstruction is rarely based simply on whether the defect heals but rather on how well the patient can ultimately get on with his day-to-day living. Success therefore requires the availability and input of several other departments including radiation therapy, oncology, dentistry, speech/swallowing, nursing, prosthodontics, and social work. The surgeon should orchestrate the efforts of all these specialties and the surgeon is ultimately responsible if complications or problems arise.

Specific situations

Reconstruction of small defects of the tongue and floor of mouth (FOM)

The method used in tumor ablation plays a key role in determining reconstruction. The laser excision is the preferred method for T1 and T2 cancers of the tongue and FOM because it causes limited thermal injury to adjacent tissues, which greatly reduces postoperative edema. Wounds can be left to granulate, with little worry about slough, infection, pain, or significant scar formation with secondary contracture (Panje et al, 1989b). Wounds produced by the cold knife or diathermy should either be closed primarily if no significant reduction of oral function will result, or covered with a split-thickness skin graft (STSG).

Ablation or reconstruction can sometimes compromise the patency of Wharton's duct. A ductoplasty should be performed if needed. However, if the cancer encroaches on Wharton's duct the entire submandibular system should be removed in continuity with the FOM via a pull-through approach.

Rehabilitation is generally limited to the immediate postoperative period. With open laser wounds a clear liquid diet is usually initiated on the first postoperative day if tolerated. The diet is advanced to soft foods as tolerated and yogurt, 1 cup per day, is added. Proper mouth care is critical and includes brisk rinsing with a half-strength peroxide solution after any oral intake. Skin grafted patients should take nothing by mouth until the bolster is removed after 8 to 10 days.

Split-thickness skin graft (STSG) technique. A dermatome can be used to harvest a 0.012-in (0.46-0.51 mm) graft from the anterolateral thigh. Alternative donor sites include the postauricular, cervical, supraclavicular, or triceps skin. Usually a full-thickness skin graft is harvested from these alternative sites and the donor defect is closed primarily. The full-thickness skin can then be converted to a STSG, which is sutured into the defect both at its peripheral margin and centrally. Multiple pie-crust incisions are placed in the graft after it is secured. A bolster of sponge or rolled adaptic is also used to fix the graft when reconstructing a high-motion area or one that is subject to excessive trauma. The intraoral bolster is also important in creating a new paralingual sulcus (Fig. 81-1).

Reconstruction of through-and-through defects of the tongue/FOM with or without marginal mandibulectomy

A marginal mandibulectomy is generally included in a FOM resection solely to provide a more adequate excision margin. Whenever a submandibular or more formal neck dissection is done in conjunction with the primary tumor, a pull-through (in-continuity) approach provides an oncologically sound resection (Barton and Ucmakli, 1977). Soft tissue replacement is all that is required because mandibular continuity is maintained. The key to reconstructing the through-and-through oral cavity defect is to reestablish the muscular support for the FOM. The extent of the defect will dictate the appropriate options.

Primary closure of the mylohyoid defect can be done on small defects with excellent preservation of function. Another method is to detach the hyoglossus muscle from the hyoid and attach it to the mandibular periosteum or mylohyoid remnant (Barton and Ucmakli, 1977). This method requires removal of the digastric muscle but provides excellent rehabilitation. Larger defects can be managed easily by rotating in a superiorly based sternocleidomastoid muscle flap (Haymaker, 1986; Marx and McDonald, 1985; Tiwari, 1990).

The intraoral recnostruction is generally done with a bolstered STSG as previously described. Great care is taken to recreate an adequate paralingual sulcus to avoid tethering the tongue. The exposed bone is covered with a buccoalveolar mucosal advancement flap. When covering the exposed bone is problematic, other methods can be applied. The mylohyoid can be rotated superiorly on its periosteal attachments to cover the bone. Larger defects can be covered with a temporoparietal fascial flap tunneled intraorally (Antonyshyn et al, 1988; Horowitz et al, 1984). Lastly, a posteriorly based tongue flap has limited usefulness for this situation (Komisar and Lawson, 1985).

Musculocutaneous flaps tend to be too bulky to be a wise choice in this situation. The one exception would be the platysma musculocutaneous flap, which can be quite useful in oral cavity reconstruction (Coleman et al, 1982; Futrell et al, 1978). Neck incisions must be appropriately designed and great care must be taken to avoid compromising the blood supply during submandibular triangle dissection, which greatly limits its unplanned use.

Many authors advocate a free radial forearm flap for these defects (Muldowney et al, 1987; Takato et al, 1987; Urken et al, 1990). The flap has an excellent success rate (90%0 and holds up well to postoperative radiation. Utilization of this flap requires microvascular expertise, increased operative time, and possibly a two-team approach. There is generally limited donor site morbidity; however, some significant and unacceptable complications have occurred (Bardsley et al, 1990; Swanson et al, 1990). These drawbacks must be considered in light of the excellent availability of local/regional tissue to rebuild these relatively minor defects.

Superiorly based sternocleidomastoid flap (SBSF) technique (Haymaker, 1986; Marx and McDonal, 1985; Tiwatri, 1990). The sternocleidomastoid muscle receives its dominant blood supply from a branch of the occipital artery and a regular and necessary contribution of blood from a branch of the superior thyroid artery. The inferior supply from the thyrocervical trunk is of lesser significance, making a superiorly based flap the most reliable. The arc of utilization of a SBSF is ideal for oral cavity and oropharyngeal reconstruction. The muscle is released from its sternal and clavicular attachments and dissected superiorly. Dissection never proceeds any higher than is necessary to provide the arc needed for the reconstruction. The spinal accessory nerve may restrict the forward rotation of the muscle and the superior thyroid artery should be preserved if at all possible. Once the muscle is rotated into the surgical defect, it is tacked down both in the neck and intraorally. The mucosal edges of the defect are sutured to the muscle so that a 'vest over pants' type of overlapping is created. The wound can then be left to granulate or a split-thickness skin graft can be applied intraorally as previously described. Adequate drainage and a pressure dressing are essential for successful healing.

An alternative method is to develop a sternocleidomastoid musculocutaneous flap. The amount of cervical skin that can be transferred is limited to the width of the muscle and can be extended below the clavicle for 1 to 2 cm. In previously irradiated patients, island-type cutaneous pedicles are discouraged due to their poor reliability. Skin over the entire muscle is left intact and the muscle is mobilized as described, carefully preserving the superior thyroid artery supply. The skin covering that portion of the muscle tunnelled through the neck is then deepithelialized. The donor site is closed primarily (Fig. 81-2).

Another mucsculocutaneous flap based on collateral vessels from the occipital scalp and nape of neck is useful for external resurfacing of large defects of the lateral face and temporal bone.

Temporoparietal fascial flap (TFF) technique (Antonyshyin et al, 1988; Horowitz et al, 1984). The temporoparietal fascia is a 2- to 4-mm thick connective tissue that is the lateral extension of the galeal layer of the scalp. It joins the epicranius muscle anteriorly and posteriorly, the tendinous galea superiorly, and blends with the superficial musculoaponeurotic system inferiorly. There is a vascular plexus composed of branches from the occipital and superficial temporal arteries that supply the fascia in an axial pattern. This tissue is very vascular, thin, and quite pliable, making it ideal for intraoral reconstruction.

Flap dissection begins with a careful mapping of the superficial temporal artery and its branches. A curvilinear scalp incision is placed over the lateral scalp and dissection begins inferiorly. Bipolar cautery is essential in maintaining hemostasis because numerous perforating vessels will be encountered. The edges of the flap are incised down to the deep temporal fascia and the flap quickly elevated off of it. The vascular pedicle can be carefully narrowed at the zygoma and traced 2 to 6 cm caudally if needed. The donor area can then be closed primarily over a suction drain. The TFF is delivered into the oral cavity/oropharynx and is used to bridge the surgical defect (Fig. 81-3). A STSG can be applied intraorally or the tissue can be left exposed to granulate. This flap can easily reach the anterior floor of mouth, posterior cranial fossa, and into the neck for carotid coverage.

Platysmal flap technique (Coleman et al, 1982; Futrell et al, 1978). The submental branch of the facial artery is the major arterial supply to this flap. It has a fairly protected position under the mandible with numerous anastomoses with the ipsi- and contralateral labial arteries, the superior thyroid artery, and the superior labial artery. Ligation of the facial artery distal to the submental artery branching (eg, where it courses over the mandible) does not compromise the flap. The platysma muscle can even be incised superior to this take-off to improve mobility and axis of utilization if needed. An added advantage to this flap is its innervation by the facial nerve. This motor innervation can be preserved and used advantageously in rehabilitating an incompetent lip. The flap also has the capacity for sensory nerve reanastomosis providing sensation to the reconstructed area.

The platysmal flap must be designed and raised before any neck surgery is performed. The cutaneous paddle is designed as an ellipse up to 6 to 7 cm x 10 to 12 cm as dictated by the defect. A minimum of a 5-cm ellipse is required to ensure an adequate number of perforators are included. The inferior aspect of the cutaneous paddle coincides with the inferior segment of the neck incision. This is carried through skin and platysma and continued superiorly to the mastoid tip. The incision along the superior edge of the skin paddle is carried down to platysma only. The musculocutaneous flap is then elevated in the subplatysmal plane commonly used in neck surgery. If a cutaneous branch from the superior thyroid artery is encountered, it should be preserved if possible. Once mobilized the flap is turned 180 degrees through the defect into the oral cavity (Fig. 81-4).

Radial forearm flap (RFF) technique (Bardsley et al, 1990; Muldowney et al, 1987; Swanson et al, 1990; Takato et al, 1987; Urken et al, 1990). The RFF is a ready source of thin, pliable, relatively hairless skin ideally suited for intraoral reconstruction. The radial artery provides the arterial supply for the flpa. It travels within the lateral intermuscular septum of the forearm and gives off multiple branches to the forearm muscles, the volar skin, and the periosteum of the radius. The venous drainage for the flap can be through either a venae comitantes or a cutaneous vein (usually the cephalic). The medial and lateral cutaneous nerves can be harvested with the RFF permitting a reinnervation of the tissue at the recipient site. A segment of radius comprising 40% of its circumference and up to about 12 of its length can be included with the RFF. This allows this flap to reconstruct composite defects of the jaw with relative ease.

Preoperative assessment must include an Allen test to verify adequate collateral hand perfusion by the ulnar artery. The radial artery is located by palpation or Doppler and the flap is designed as dictated by the reconstructive situation. A tourniquet is applied to the upper arm to reduce operative blood loss and oozing. The distal skin and underlying fascial septum are incised and the radial artery is located and ligated. The flap is then raised in a distal to proximal direction. The vascular pedicle is isolated proximal to the cutaneous paddle and can be developed for several centimeters if desired. This allows great flexibility for reanastomosis at the recipient site (Fig. 81-5).

Adapting the RFF to the surgical reconstruction is generally quite easy. The workability of the tissue allows it to readily conform to the defect. Microvascular reanastomosis techniques will not be discussed.

The donor site can be covered with a STSG or closed primarily. The morbidity of the RFF is usually minor and well accepted by the patient. If a STSG is used there is often a problem with skin breakdown over the exposed forearm tendons. This can be minimized by covering all tendons with muscle before applying the graft and never using a meshed STSG. An ulnar transposition flap can often permit primary closure and avoid the problem of delayed healing altogether. A minor loss of sensation centered over the snuffbox is common and painful neuromas of the radial nerve develop infrequently. A significant loss of hand function can occur postoperatively although this is quite rare. It can consist of either stiffness or actual contracture and is due to inadequate collateral perfusion from the ulnar artery after radial artery sacrifice. Some surgeons advocate reestablishing the radial artery with an interposition graft after harvesting the RFF. This has proven to be unreliable and is not routinely recommended.

This reconstructive technique is widely applied and has become popular with head and neck surgeons. One must remember that there are several other excellent techniques available that do not require microvascular expertise and do not entail the risk of rendering a hand nonfunctional.

Reconstruction of defects in the oropharynx and base of tongue with an intact mandibular arch

Small defects (up to 3 to 4 cm) secondary to transoral laser resection o oropharyngeal, tongue base, retromolar trigone, or palatal tumors can be left to granulate. Postoperative care is as described for oral cavity defects.

A STSG or dermal graft is a rapid and useful technique for reconstructing smaller defects of the oropharynx and retromolar trigone. Partial graft loss is common and may result in scarring and eventual tethering of the tongue.

Larger defects, especially those with exposed mandible, require a vascularized flap for adequate reconstruction. The temporalis musculofascial flap (Koranda and McMahon, 1988; Shagets et al, 1986) or temporoparietal fascial flap (Antonyshyn et al, 1988; Horowitz et al, 1984) are excellent, readily available alternatives. Other less useful local flaps include a laterally or posteriorly based tongue flap (DeSanto et al, 1975; Komisal and Lawson, 1985), a masseter crossover flap (Tiwari and Snow, 1989), and a hard palatal mucosal flap (Gullane and Arena, 1977). The extent and nature of the defect to be closed will determine the applicability of these secondary options.

Regional musculocutaneous flaps generally have too much bulk for these defects. A pectoralis major musculofascial flap avoids the problem of bulkiness and provides ample tissue to reconstruct large oropharyngeal defects (Moloy, 1989). One potential misuse of this method is to apply it to defects that include a significant portion of the tongue base. As previously stressed, the tongue must be reconstructed separately from the floor of the mouth and/or oropharynx if at all possible so as to maximize postoperative function. Regional flaps whose pedicles are buried subcutaneously will contract and atrophy substantially over time. This can easily lead to significant tethering of the tongue. A secondary procedure to release the tongue from the pedicle is then needed to limit the patient's dysphagia. Large defects limited to the base of the tongue can be closed with a set back tongue flap (Panje, 1987). This method maintains maximum tongue mobility and posterior bulk and generally leaves the patient with excellent function.

Several different free flaps have been used successfully to reconstruct these defects. The radial forearm flap is perhaps the most popular but cutaneous flaps from the groin (Panje et al, 1977) and dorsum of the foot (Acland and Flynn, 1978), and mucosal flaps (Reuther et al, 1984) (primarily split-jejunum) have been used. The same drawbacks discussed previously apply to this situation. The need for increased operative time and microvascular expertise plus an ample supply of excellent locally available tissue limits the widespread application of free flaps to this reconstructive situation.

Temporalis flap technique (Koranda and McMahon, 1988; Shagets et al, 1986). The temporalis muscle receives its blood supply from the internal maxillary artery via the anterior and posterior deep temporal arteries. These vessels arborize within the temporalis in such a way that the muscle can be split coronally into anterior and posterior segments or sagittally into medial and lateral halve. The deep temporal fascia, which is frequently harvested with the temporalis muscle, has a separate axial supply arising from the superficial temporal artery - the middle temporal artery.

The coronoid process is identified transorally and the temporalis insertion is elevated off of the medial surface, taking care to preserve the vascular supply to the muscle. The coronoid process is then transected at its base. A curvilinear incision is placed in the temporal scalp and carried down through the superficial temporal fascia to expose the deep fascia. Scalp flaps are reflected anteriorly and posteriorly, exposing the full extent of the muscle. The fascial attachments to the zygomatic arch are incised and the bony arch is removed. Exposure for the anterior osteotomy can sometimes require a second incision, especially if replacement of the arch is planned. The musculofascial flap is elevated off of the temporal squama distally to proximally. Once adequate mobilization has been accomplished, a tunnel is developed bluntly into the oral cavity. The flap is then delivered through the tunnel for use in the reconstruction. The mucosal edges of the defect are sewn to the deep temporal fascia so that there is a 'vest-over-pants' overlap (Fig. 81-6).

This muscle is locally available, fairly thin, and supple, making it quite useful in intraoral and oropharyngeal reconstruction. The ability to split the muscle sagittally or coronally allows the operator a degree of latitude as well. Functional donor morbidity is minor and the cosmetic appearance of the defect can be improved with the intraoperative implantation of Instant collagen. The zygomatic arch can be replaced after rotating the flap intraorally but this is oten unnecessary. The bulk of the muscle turned on itself will adequately recreate the arch contour. If the arch is to be replaced it can be wired or plated at the conclusion of the case. There is paralysis of the temporal branch of the facial nerve as much as 20% of the time with the temporalis flap. The nerve function is probably lost secondary to stretch injury so surgical technique must be refined.

Laterally based tongue flap (LBTF) technique (DeSanto et al, 1975; Komisar and Lawson, 1985). The tongue offers an excellent source of tissue for reconstructing defects of the posterior oral cavity and oropharynx. Advantages of this flap include local accessibility, well vascularized and reliable tissue, no donor site defect, and limited operative time for reconstruction. The major disadvantage is the unavoidable reduction of tongue function. This morbidity is relatively minor as long as only one half of the tongue is used. The LBTF can survive when the ipsilateral lingual artery has been ligated if it is carefully dissected. Previous irradiation does not seem to influence the reliability or usefulness of this flap.

The LBTF is pedunculated on the remaining loor of mouth. A midline mucosal cut is made from the tongue base to the tongue tip. This incision is carried into the tongue musculature for 1 to 2 mm. The myomucosal flap is then dissected laterally, unrolling the mobile tongue. The flap can then be rotated into the surgical defect for primary closure. The remaining anterior hemitongue is closed by approximating the dorsal and ventral surfaces. This narrowed mobile tongue will hypertrophy over time, minimizing any functional morbidity (Fig. 81-7).

Hard palate mucosal flap technique (Gullane and Arena, 1977). The mucoperiosteum of the hard palate can be pedunculated on a single greater palatine artery. This can be up to 24 sq cm of locally available thin well-vascularized tissue. The arc of utilization is somewhat limited but defects of the buccal mucosa, retromolar trigone, tonsillar region, or soft palate can be easily covered. The tissue is not very pliable and does not tolerate tension. Previous irradiation to the oral cavity should be considered a relative contraindication to the use of this flap because the denuded palatal bone is predisposed to develop osteitis.

An incision is placed approximately 1 cm medial to the maxillary alveolus circumferentially around the hard palate. The greater palatine artery is protected within a 1-cm pedicle at the flap's base. The flap is then rotated into the surgical defect. The vascular pedicle can be skeletonized further to increase the arc of utilization but this increases the risk for vessel torsion and subsequent total flap loss. The donor defect is left to granulate. A palatal prosthesis can be placed to cover the denuded bone until healing has progressed (Fig. 81-8).

Reconstruction of defects in the buccal area

As in other sites, smaller wounds can be left to granulate or closed primarily. STSGs or mucosal grafts are easily applied to this area as well. Bolstering is seldom necessary for the success of these grafts provided they are peripherally fixed and quilted appropriately. More extensive tissue loss generally requires replacement of adequate bulk to prevent dimpling of the cheek or restriction of mouth opening subsequent to wound contracture. The temporalis muscle flap (Koranda and McMahon, 1988; Shagets et al, 1986) or temporoparietal fascial flap (Antonyshyn et al, 1988; Horowitz et al, 1984) offer the same advantages describing for oropharyngeal defects. The internal surface of the flap can be easily skin-grafted, providing an excellent reconstruction of the area.

Through-and-through defects provide more of a surgical challenge because both internal and external coverage is required. The lateral scalp flaps already discussed can be skin-grafted on both surfaces; however, this would be a cosmetically inferior option. Combining a cervical rotation flap (Patterson et al, 1984; Wallis and Donald, 1988) externally with a lateral scalp flap internally would be a good option.

Musculocutaneous flaps such as the pectoralis major (Ariyan, 1979; Moloy, 1989), latissimus (Maves et al, 1984), or trapezius (Netterville et al, 1987) have some applicability to large through-and-through buccal defects. Separate skin islands can be made and the muscle turned on itself to provide both an internal lining and external coverage. An alternative would be to skin-graft the internal surface of the muscle and use the cutaneous portion of the flap externally.

Any of the cutaneous or musculocutaneous free flaps can be applied to this situation as well. The free scapular flap (Barwick et al, 1982; Granick et al, 1986) deserves special mention because the vascular anatomy allows the dissection of two separate cutaneous paddles. This allows the surgeon a three-dimensional flexibility that is ideally suited for through-and-through defects.

Cervical rotation advancement flap (CRAF) technique (Patterson et al, 1984; Wallis and Donald, 1988). The CRAF is a cosmetically excellent option for reconstructing the external aspect of a through-and-through buccal defect. The internal lining can be reestablished with a temporalis muscle STSG covered flap. This combination provides excellent bulk and cosmesis. An alternative would be to apply a STSG to the undersurface of the CRAF.

Flap design is influenced by the size of the buccal defect but generally involves an incision running from the posterior aspect of the facial defect to the ear. The incision then curves under the lobule of the ear onto the neck about 1 to 2 cm behind the anterior border of the trapezius. The incision can be continued onto the chest wall when maximum rotation is needed. This incision affords exposure to allow radical neck dissection if necessary. A subplatysmal plane is developed and the flap is elevated just enough to provide a tension-free closure. The neck incision can usually be closed primarily (Fig. 81-9).

Latissimus dorsi musculocutaneous flap (LDMF) technique (Maves et al, 1984). The LDMF can be harvested as a free flap or transferred transaxillary into the head and neck for reconstructive uses. The dominant blood supply to the flap is via the thoracodorsal artery, which is a branch of the circumflex scapular artery. The vascular pedicle enters the latissumus on its medial surface about 8 to 10 cm distal to its humeral insertion. The artery usually bifurcates after entering the muscle, sending a dominant branch parallel and about 2 cm posterior to the free lateral border of the muscle. The upper branch courses transversely parallel and about 3.5 cm inferior to the upper border of the muscle. Numerous perforating vessels arise off these musculocutaneous arteries to supply the subdermal plexus of the overlying skin. The density of perforating vessels is greater in the proximal two thirds of the muscle, making this skin more reliable to transfer with the flap. The LDMF has a potential of 40 x 25 cm of tissue available for transfer if needed. The arc of utilization is quite substantial, reaching to the vertex of the skull if necessary. The thoracodorsal nerve travels with the vascular bundle giving the flap the ability to be reinnervated at the recipient site.

The patient must be in the lateral position to use this flap, which necessitates preoperative planning and coordination. Preoperative marking of the anterior border of the latissimus facilitates easy intraoperative location. The ipsilateral arm must be sterilely draped and mobile and is supported on a Mayo stand during flap dissection. Flap design is dictated by the defect to be reconstructed but it must be remembered the cutaneous perfusion over the distal one third of the muscle can be tenuous. A Doppler can be used to locate perforators and allow flap design to be modified accordingly. The dissection begins with an incision through skin and subcutaneous tissue along the previously marked anterior border of the muscle. The plane between the latissimus and serratus is bluntly developed and the vascular pedicle is located by Doppler and palpation. The cutaneous island is incised down to the muscle circumferentially. The inferior and medial muscular incisions are made as distal from the edge of the cutaneous island as possible. Dissection proceeds posteromedially toward the axilla. The neurovascular pedicle exits from the muscle well beore it inserts onto the humerus, so great care must be taken when dissection approaches this area. To isolate the thoracodorsal pedicle the branches to the serratus must be ligated. The pedicle can be traced proximally to the circumflex scapular artery. The tendonous insertion is then separated from the humerus, totally isolating the vascular pedicle. A plane is developed transaxillary superficial to the pectoralis minor muscle. The pectoralis major muscle is separated from the clavicle far enough to allow the flap to be passed unrestricted into the neck (Fig. 81-10). If the lifted flap cannot reach the surgical defect the pedicle can be exteriorized or the pedicle can be separated and the tissue transferred as a free flap. The donor site can usually be closed primarily or an STSG can be applied. The patient's arm is placed in a shoulder immobilizer for 4 to 5 days after which physical therapy is instituted.

When both an internal and external lining is required there are a few options available to the surgeon. The undersurface of the muscle can obviously be skin-grafted as has been previously described for other flaps. A second option would be to remove a strip of skin from the center of the cutaneous island to create two islands. This would have to be planned according to the distribution of the perforators. Another alternative would be to develop two separate musculocutaneous segments supplied by either branch of the thoracodorsal. Incorporation of the flap into the defect should employ the vest-over-pants overlap previously described. This is possible by harvesting muscle distal to the cutaneous island.

Scapular free flap (SFF) technique (Barwick et al, 1982; Granick et al, 1986). The SFF is based on branches from the circumflex scapular artery (CSA). This artery arises from the subscapular artery, which is a major branch of the axillary artery. The CSA can be located externally within the triangular space bounded by the teres minor above, teres major below, and the long head of the triceps laterally. The CSA traverses this space and divides into a transverse and descending branch. This system supplies the skin from the posterior axillary fold to the midline and from the scapular spine to its tip. The nutrient arteries form a rich fascial plexus that sends vertical branches into the subdermal plexus of the skin allowing peripheral debulking of excess fat and subcutaneous tissue with this flap. Two separate cutaneous flaps can be developed on the CSA allowing great flexibility to the surgeon.

The patient must be rotated enough to allow access to the midline of the back. Tissure requirements are diagrammed on the patient and incorporated within an ellipse. The elliptical defect can be closed primarily if it is less than 10 to 12 cm. If only one paddle is required the transverse branch is the preferred pedicle. The skin and subcutaneous tissue is incised and dissection started in a medial to lateral direction in the avascular plane of loose areolar tissue superficial to the fascia of the intraspinatus muscle. Dissection proceeds medially until the triangular space is reached where the CSA is easily located by palpation or Doppler. Pedicle dissection can proceed proximally to the subscapular or axillary artery as needed, creating a length of up to 10 cm. The CSA is usually between 2 to 3 cm, which makes microvascular anastomosis relatively easy (Fig. 81-11).

Reconstruction of defects of the hard palate

Hard palate mucosal defects can be closed with STSG, mucosal graft, or left to granulate as previously described. Small through-and-through palatal defects can be closed with palatal rotation flaps. When surgical reconstruction has been delayed and palatal edges have healed, nasal mucosa can be back-dissected and turned into the defect. This tissue will provide a first layer of closure that can be covered with a palatal rotation flap. Larger through-and-through defects are best managed with prosthetics. Prosthetics allow for rapid rehabilitation and careful monitoring for tumor recurrence. The hard palate serves only a passive function in deglutition and speech so obturation is a physiologically suitable alternative. The surgeon should always underestimate the amount of palate and the number of teeth to be removed. This will allow construction of a temporary obturator that is sure to fit the eventual defect. The surgeon should attempt to retain as much anterior palate and bone lateral to the midline of the defect side as possible to provide ledges for stabilizing a prosthesis. A dental prosthesis is not suitable for a retarded or senile person or for anyone not competent to manage it. These patients will often require flap reconstruction of their palates. The radial forearm flap and temporalis flap have been used with success in these situations.

Total palatectomy defects present unique and complex reconstructive problems. Attempts to replace bone is usually fraught with difficulty. In general the upper lip should be reconstructed with adjacent soft tissues and the palate and nose replaced with a prosthesis. Special fixation techniques are required to provide adequate support for these large prostheses. Osseointegration (Albrektsson et al, 1987) of the remaining maxilla and skull base will provide multiple sites for prosthesis support but the process takes multiple operations and several months to complete. Another much simpler technique (Panje and LaVelle, 1984) is the placement of a stainless steel Steinmann's pin between the zygomatic arches. A small metal tray containing rare earth magnets is then attached to the pin. Counter-attaching magnets are placed within the prosthesis to provide a firm fixation point.

Reconstruction of composite defects of the lateral jaw oropharynx

When the oncologic ablation requires the removal of a segment of the jaw, the surgeonis faced with a much more difficult reconstructive decision. He must decide if rebuilding a jaw is in the best interests of the patient. Several excellent sources of vascularized bone grafts have been discovered over the last several years and have added to the options available to the surgeon. These flaps all provide excellent restoration of contour and an improved cosmetic result; however, one must remember that functional rehabilitation is generally of greater concern to the patient. The benefits gained by reconstructing the jaw must be established clearly before surgery. The patient must understand that the added surgical time, expense, risk for failure, and need for reoperation inherent in jaw restoration may actually be detrimental to his postoperative function. In fact, reconstruction of the ramus/bony defect common with lateral composite resections leads to increased trismus and limited mandibular motion postoperatively (Komisar, 1990). This can have a direct impact on the patient's quality of life by reducing his chances for adequate oral function. Advocates of immediate jaw reconstruction cite mandibular drift as a significant postoperative concern; however, this worry seems unfounded. Drift is minimal as long as the soft-tissue defect is adequately replaced and isometric exercises are instituted in the immediate postoperative period. These exercises include having the patient practice bringing his remaining dentition into occlusion. External pressure on the jaw is often required to align it properly. Internal maxillary fixation (IMF) is another method for maintaining occlusion and is recommended whenever the soft-tissue defect is not replaced with adequate bulk. The surgeon will find that these 'unreconstructed' people will open their jaw along a deviated plane o motion but will generally have good function. They will also have an acceptable cosmetic appearance.

With the understanding that the functional rehabilitation of this lateral defect is most dependent on the soft-tissue reconstruction, a few specific techniques will be discussed. Specific methods for reconstructing the jaw defect are discussed elsewhere in the book and will be mentioned in the next section.

The pectoralis major musculocutaneous flap (PMF) technique (Ariyan, 1979; Moloy, 1989). The PMF is certainly a workhorse and the most familiar musculocutaneous flap for reconstructive surgeons. The muscle receives a dominant blood supply from the thoracoacromial artery, which arises from the axillary artery under the superior edge of the pectoralis minor muscle. The lateral thoracic artery is a second arterial supply to the pectoralis muscle. These arteries travel in the clavipectoral ascia allowing a safe and bloodless plane of dissection between the pectoralis major and pectoralis minor muscles.

The flap does have limitations in application. Too much bulk and hair-bearing skin can be a problem in reconstruction of the tongue and the floor of the mouth. This is not a problem, however, when a lateral composite defect is reconstructed. The bulk provides excellent contour for the patient and ample tissue to avoid excessive mandibular drift. Postoperative radiation therapy will deter any hair growth.

An island musculocutaneous flap, a musculofascial, or simply a muscular flap can be developed. If a PMF is needed, the skin requirements are carefully diagrammed on the patient's chest and the arc of flap utilization is simulated with a sponge. It is most desirable to place the entire cutaneous paddle over the muscle; however, random skin over the sternum, xyphoid, or rectus is sometimes needed to reach the surgical defect. The cutaneous paddle is circumferentially incised down to the pectoralis ascia with care to bevel the cuts outward from the skin edges. Tacking sutures are placed to reduce the shearing of skin and subcutaneous tissue over muscle. The chest incision is continued from the superior aspect of the cutaneous paddle, superiorly and laterally to create (and preserve for future use) a deltopectoral flap. The remaining chest skin is rapidly dissected off the pectoralir major, exposing its free lateral border and clavicular insertion. Care is taken not to dissect the chest skin too close to the sternum; the integrity of the internal mammary perforators must be preserved. The avascular plane between the pectorali major and minor muscles is bluntly developed allowing palpation and even visualization of the vascular pedicle. The inferior and medial margin of the muscle is separated, obtaining as much muscle beyond the cutaneous paddle as possible. The vascular pedicle is then developed by incising the muscle medially and laterally. Care is taken to avoid skeletonizing the pedicle and dissection is continued until enough of an arc is developed to rotate the tissue into the defect without excessive tension (Fig. 81-12). The clavicular fibers of the pectoralis major are preserved if at all possible to lessen donor morbidity to the patient. The vascular pedicle is turned over the clavicle and the cutaneous paddle is used or the mucosal closure. The donor site can usually be closed primarily with undermining.

The gastroomental free flap (GOFF) technique (Panje et al, 1987). The GOFF replaces the resected mucosa with antral mucosa giving it a distinct advantage over alternative methods. This mucosa is soft, pliable, and moist, allowing easy molding to complex defects. By providing a secreting mucosal surface deglutition and xerostomia are improved postoperatively. Prior gastric surgery may negate the use of the GOFF. Preoperative planning should include an upper GI series and consultation with a general surgeon.

The harvesting of a GOFF can proceed simultaneously with the cancer excision. An upper abdominal incision is made and the peritoneum entered. A GIAR stapler is used to remove a portion of the greater curvature mucosa and simultaneously close the stomach. Up to 144 sq cm of non-acid-secreting mucosa can be harvested without interfering with normal gastric function. A variable amount of omentum can be included with the gastric mucosa depending on the vessel arcades and the gastroepiploic pedicle. A pedicle of up to 10 to 12 cm can usually be developed (Fig. 81-13). A feeding jejunostomy is placed before closing the abdomen.

Following microvascular anastomosis in the neck the gastric patch easily reconstructs the internal defect. The major problem encountered with the use of gastric mucosa is the occasional production of excessive mucus. This can be severe enough to cause significant aspiration. For this reason, tracheostomy is recommended in all patient undergoing this procedure.

Controlled fistula technique. Some wounds or reconstructive situations require the creation of a controlled fistula for safety. A MacFee type of neck incision is ideal for developing a fistula. The upper horizontal incision should be placed at least 3 to 4 cm from the jaw. This create an upper cervical-facial flap that can be turned under the lower border of the jaw and approximated to the alveolar, buccal, or lateral floor of mouth mucosa. If secondary reconstruction is planned within 7 to 10 days, the wound is simply packed with bacitracin-coated adaptic. The central cervical flap provides coverage for the carotid system. If a regional flap is needed it can be attached to the medial aspect of the oral defect and brought externally to over the cervical skin defect (Fig. 81-14). When fistula closure is possible the turn-in flap is released. The regional flap is then incised where it had been previously attached to the cervical skin. This edge is then brought into the oral cavity and attached to the lateral floor of mouth, alveolar ridge, or buccal mucosa. The cervical skin flaps are then closed in their normal anatomic position.

Reconstruction of composite defects of the anterior jaw/floor of mouth

Composite resection of the anterior floor of mouth and jaw produces devastating functional and cosmetic morbidity for a patient. There are instances when not attempting to reconstruct the jaw is the appropriate option even for these defects. Severely debilitated or elderly patients will not tolerate the extended operating time or degree of postoperative rehabilitation necessary. If tongue function is significantly compromised, any hope of pleasurable oral intake is remote and gastrostomy feeding will be necessary. The lower lip can be suspended from the zygomas to provide oral competence, making jaw restoration solely a cosmetic concern. The cosmetic impact of an "Andy Gump" appearance, on the other hand, can be socially crippling for a patient. In general, adequate rehabilitation following this type of ablation will require a continuous jaw arch to support the lower lip and prevent oral incompetence. By replacing the lost bone, the patient also has the potential for dental rehabilitation with osseointegration.

The decision of whether to reconstruct the jaw primarily or in a second operation depends in large part on the resources available to a surgeon. The failure rate of bone grafts in primary reconstruction is too great to recommend their routine use. Vascularized autologous bone, on the other hand, can tolerate limited exposure to oral contamination without becoming irreversibly infected. As long as the vascularized bone is well stabilized and protected from the oral cavity by adequate soft tissue, there is an acceptable success rate with primary reconstruction. It is unreasonable, however, for a single surgeon to perform a large anterior composite resection and then undertake a complicated reconstruction that includes a vascularized bone flap. This superhuman effort will surely produce compromises that not only risk complication and failure, but can reduce the quality of postoperative function for the patient. This is one circumstance where a surgical team approach is probably the best option. While one group of surgeons remove the cancer another group harvests the tissue for reconstruction. This maximizes the efficient use of time and best serves the patient.

Another option is to reconstruct the defect at a second operation. Surgical margins are often in question when resecting large tumor recurrences especially in an irradiated failure. Frozen sections are notoriously inaccurate in these patients and often it is in the patient's best interest to delay elaborate reconstruction until margins are cleared by permanent microscopic review. The surgical defect can be packed for the 2 to 3 days necessary for confirmation of margins. Additional tissue can be resected if needed or the wound can be freshened and the reconstruction performed. This allows the single operator to be well rested and well prepared for the best reconstruction possible.

The last approach is to reconstruct the soft-tissue defect and use a metal plate to span the mandibular defect to stabilize the remaining jaw segments. The final mandibular reconstruction can then be delayed for several weeks to months following radiation therapy and rehabilitation. By delaying the reconstruction the surgeon can rebuild the jaw without entering the oral cavity. Bone grafts are much more successful in this circumstance and are an acceptable alternative to vascularized bone. A full-thickness calvarial bone graft is preferred if appropriate for the defect.

Mandibular reconstruction bar technique. Maximizing success with mandibular plating requires a systematic approach and attention to detail. A minimum of three-screw fixation is required on each fragment plated. If possible, plates are always adjusted and preliminary marking holes drilled before any jaw is resected. Titanium or vitalium (cobal-chromium alloy) is the preferred plating material. Drilling is done at extremely slow speeds (25 to 50 rpm) under copious cool saline irrigation. Anterior defects are always underprojected when using plates. This can be accomplished quite simply by applying the bar to the lingual surface of the reminaing jaw. When plates are to be left for long periods of time all screw holes are manually tapped. The hollow screw reconstruction plate system should also be considered for this situation (Vuillemin et al, 1988).

The trapezius osteomusculocutaneous flap (TOF) technique (Netterville et al, 1987; Panje and Cutting, 1980). The TOF can provide up to 12 x 2.5 cm o vascularized bone for mandibular reconstruction. The posteromedial scapular spine is the bone portion of the flap and it is combined with either a superiorly based or island-type trapezius flap.

The anterior incision for the superiorly based flap follows the anterior border of the trapezius muscle. The posterior incision is roughly parallel to this traveling to the midline at about C5 or C6. Here the incision crosses the midline and turns cephalad only enough to allow the necessary arc to reach the surgical defect. The superiorly based flap can be successfully used even where previous neck surgery has sacrificed the transverse cervical and/or occipital vessels. The paraspinous perforators are the key supply to the flap. The caudal incision is placed below the scapular spine. The muscular attachments to the scapular spine are carefully preserved. The bone cuts are made with care to preserve the integrity of the acromion. The remaining attachments of the trapezius to the clavicle and acromion are separated and the flap is rotated superiorly. The transverse cervical vessels are divided if necessary. The muscle pedicle can be externalized to improve the arc of utilization. The scapular spine must be rigidly fixed into the jaw defect. This is accomplished with metal plating or by transcutaneous suspension wires connected to an external acrylic bar.

The island flap is based on the transverse cervical vessels. The integrity of these vessels must be verified before the flap is dissected. The transverse cervical vein usually dictates the arc of utilization of this flap. Once the vessels have been isolated and clearly identified, the flap can be designed. The cutaneous paddle is usually centered over the acromion and up to 40% of the skin can be over the deltoid. The distal skin is elevated superiorly to the spine. The bone is harvested as discussed for the superiorly based flap. The anterior, superior, and posterior skin incisions are made down to the trapezius fascia. Blunt dissection under the vascular pedicle provides the necessary undermining. The posterior and superior muscle cuts are made and the flap rotated superiorly (Fig. 81-15).

Sacrificing the function of the trapezius muscle solely for reconstructive purposes is not recommended because the resultant shoulder morbidity is too great. The flap is ideal for those situations where the spinal accessory nerve is sacrificed as part of a radical neck dissection. It is noteworthy that these flaps can be dissected without having to cut the spinal accessory nerve; however, the arc of utilization will be restricted without its sacrifice.

Donor defects can be closed primarily or an STSG can be applied.

The internal oblique-iliac crest osteomusculocutaneous flap technique (Urken et al, 1989). Including the internal oblique muscle with an iliac bone flap based on the deep circumflex vessels has solved some of the problems previously associated with this donor tissue. The skin paddle and muscle cuffs that comprised the original flap were often inadequate to restore the soft-tissue portion of the defect and were quite unmaneuverable. The internal oblique, which is thin and well vascularized, is ideal for covering the intraoral surface of the bone and provides an excellent bed for an STSG. Deep labial and lingual sulci can be created with the STSG providing maximum tongue mobility and best intraoral contour for denture support. The iliac crest has the largest supply of bone adequate for mandibular reconstruction of any donor area. It is of such quality that immediate osseointegration for total dental rehabilitation is possible. The separate donor areas allows for a two-team approach for the operation. Without this team approach combined ablation and reconstruction with this flap would take an unacceptably long time to perform. Flap dissection is an involved procedure and is in an area unfamiliar to most head and neck surgeons. Donor morbidity associated with this flap is minimal and well tolerated by patients.

The scapular osteocutaneous flap (SOF) technique (Baker and Sullivan, 1988). The lateral border of the scapula provides another source for a vascularized bone flap. A segment of bone 1.5 x 3 cm thick and up to 14 cm long can be pedunculated on the circumflex scapular vessels. A portion of the inferior tip and medial border of the scapula can be included and has an ideal shape for the mandibular angle. The previously described free scapular flap can be developed at the same time providing two separate cutaneous paddles. These cutaneous paddles, which can be positioned virtually independent of the bone, allow great reconstructive versatility. The two-team approach can be applied with this flap as well providing that the patient is positioned properly. Donor site morbidity has been relatively minor.

The major drawback with this donor bone is its thinness (only 1.5 cm) as an alveolar surface. This limits the potential total dental rehabilitation obtainable with osseointegration.

It is noteworthy that the latissimus dorsi musculocutaneous flap can be included on the same vascular pedicle as the SOF, providing the reconstructive surgeon with a tremendous amount of tissue capable of rebuilding virtually any defect imaginable.

The radial forearm-radius flap (RFRF) technique (Bardsley et al, 1990; Swanson et al, 1990; Urken et al, 1990). A portion of the radius can be incorporated into the radial forearm flap to provide another source of vascularized bone. Flap dissection is relatively straightforward and can be completed quickly, which explains the popularity of the RFRF. The amount of donor bone is limited and there is potential for significant morbidity if certain principles are not adhered to. The drawbacks discussed with the radial forearm flap and the fact that the radius is not the best bone available for jaw reconstruction limit the applicability of the RFRF.

Reconstruction of oropharyngocutaneous fistula

Fistulas can occur in the immediate postoperative period secondary to infection and poor wound healing. They can generally be managed conservatively by opening the neck to provide salivary egress and starting local wound care. Often patients cannot afford the extended period of secondary healing because they need to start radiation therapy, or because of family or work needs, and so surgical intervention is needed.

Another situation where a surgical reconstruction may be needed is a chronic fistula that has not responded to conservative treatment and is causing the patient significant morbidity. Many such patients have been irradiated or suffer a medical condition that adversely affects wound healing, such as diabetes or hypothyroidism.

Many separate factors influence the surgical management of a salivary fistula. Previous irradiation, general medical status of the patient, size of the dehiscence, exposure of vital structures, type of neck flaps used, and type of reconstruction previously performed are but a few of the more important factors. In general the surgeon should strive for a three-layer closure consisting of internal mucosa, intervening well-vascularized tissue, and skin. There should be a vest-over-pants type of overlap between the intervening tissue and the mucosal closure. In the acute situation a muscle or musculocutaneous flap is usually necessary. The sternocleidomastoid (Haymaker, 1986; Marx and McDonald, 1985; Tiwari, 1990), pectoralis major (Ariyan, 1979; Moloy, 1989), latissimus (Maves et al, 1984), or superiorly based trapezius flap (Netterville et al, 1987), have all been extremely useful. With a chronic fistula local turn-in flaps can provide the internal closure. A muscle flap provides the intervening tissue and an STSG provides the skin closure.

Free flaps are useful alternatives to local and regional muscle flaps; however, suitable recipient vessels for reanastomosis can be quite hard to find. The omental free flap (Panje et al, 1989a) is perhaps the very best at healing virtually any chronic defect the head and neck surgeon will face.

Omental free flap technique (Panje et al, 1989a). The omentum is the body's best reparative tissue. It will conform to any defect almost like a liquid. Its abundant vascularity is unsurpassed and facilitates the rapid healing of difficult surgical wounds, even osteoradionecrosis. The rich lymphatic network within the omentum may provide conduits to improve the lymphedema commonly found in postsurgey and/or radiation therapy patients.

An upper abdominal incision and dissection as described for the gastroomental flap are used. Work on the recipient site can proceed while the free omental flap is being harvested. The recipient site is thoroughly debrided and the mucosal and skin edges are back-dissected by 1 to 2 cm. The omentum is then tucked into the defect so that there is good vest-over-pants overlap. The internal and external surfaces of the omentum do not need any coverage because any exposed portion epithelializes rapidly. If an STSG is applied it develops into a very supple surface with minimal contraction. The surgeon should remember that the omentum is an option whenever there is a difficult reconstructive situation in a poor recipient bed.