Oromandibular Reconstruction Using Microvascular Composite Free Flaps

Report of 71 Cases and a New Classification Scheme for Bony, Soft-Tissue, and Neurologic Defects

Mark L. Urken, MD; Hubert Weinberg, MD; Carin Vickery, MD;

Daniel Buchbinder, DMD; William Lawson, DDS, MD; Hugh F. Biller, MD

* We describe 71 cases of oromandibular reconstruction using microvascular composite free flaps. There was an overall flap success rate of 94%, while 97% of the patients in this series had their mandibles reconstructed with free vascularized bone flaps. Fifteen patients were rehabilitated with implant-borne dental prostheses. Primary repair of discontinuity defects of the inferior-alveolar nerve using a variety of nerve grafts was performed in 16 patients. A new classification scheme for composite defects of the oral cavity involving bone, soft tissue, and neurologic defects is proposed and applied in the description of each of the patients in this series.

(Arch Otolaryngol Head Neck Surg. 1991;117:733-744)

The restoration of normal oral function following ablative surgery or trauma depends on a variety of factors that include the reconstruction of complex osseous, dental, and soft-tissue anatomy. As all reconstructive surgeons are aware, this is only part of the problem in oral rehabilitation. The mobility of the mandible, tongue, cheeks, and soft palate are also important determinants of a successful outcome. In addition, the functional deficit associated with loss of sensation in the reconstructed oral cavity is readily apparent when oral function is critically assessed.

Microvascular free tissue transfer has afforded the surgeon an opportunity to more critically address the aesthetic and functional outcome of oromandibular reconstruction due to the wide array of tissue that can be used. It is apparent from an analysis of these results that the extent of the deficit impacts greatly on the complexity of the reconstruction and the expectations for a favorable result. With the diverse range of vascularized and non-vascularized reconstructive methods available, it is impossible to form any basis of comparison without being able to accurately define the extent of the defect. A variety of classification schemes for segmental mandibular defects have been described.[1,2] However, as noted above, this greatly understates the magnitude of the problem. We propose a classification scheme for oromandibular defects that accounts for not only the bony, but also for the soft-tissue and neurologic defects. This scheme has been applied in describing 71 cases of oromandibular reconstruction using microvascular composite free flaps. This is the largest series of free flap reconstruction of composite oral defects to be reported in this literature.

Classification of Mandibular Defects

The classification of the bony component of composite oromandibular defects is an easier task than is classifying the soft-tissue component. Two classification schemes have been proposed by David et al[1] and by Jewer et al[2] in their recent large series of free flap reconstructions of the oral cavity. Although we attempted to work with both of these systems in our present series, it was apparent that both had shortcomings.

We propose an alternative classification scheme based on anatomic, functional, and aesthetic considerations, which is demonstrated in Fig 1. The use of the letters C for condyle, R for ramus, B for body, and S for symphysis is more readily committed to memory than are the alternative classifications.[1,2] The symphysis is used to describe that portion of the mandible between the two canine teeth. The central defect is divided into the full symphysis (S) and the hemisymphysis (S^H), which stops at the midline. The rationale for dividing these central defects is based on the functional disturbance that is created by detaching a greater portion of the suprahyoid and tongue musculature when the resection is carried beyond the midline. In addition, the difficulty in bone contouring is greater when the entire symphysis must be reconstructed.

Lateral defects are divided, as is shown in Fig 1, based on the impact on the functional result that occurs when the condyle and the ramus are resected. The successful reconstruction of the condyle has a significant effect of the function of the mandible during mastication. The rationale for subdividing body and ramus defects is based on the functional disturbance that occurs when the masticator muscle sling is completely disrupted. A body (B) defect is defined as a horizontal defect that does not include the posterior border of the ascending ramus. When the entire angle is removed, then the defect is classified as a ramus defect (R) and reflects an almost complete disruption of the masticator sling. Ramus defects extend to the subcondylar region.

Table 1 shows a breakdown of the bony defects in the 71 cases included in this series according to this classification scheme. When a palatal prosthesis is required due to a defect of the hard or soft palate, the classification includes the letter P. It may not be apparent why palatal defects should be included in this scheme of oromandibular defects since rehabilitation is readily achieved with a prosthesis. However, when a prosthesis is in place, it covers a large area of intact, sensate mucosa that provides important feedback to the patient in whom a large area of the reconstructed oral cavity is already anesthetic. Thus, the functional deficit resulting from a palatal defect that requires a prosthesis may be considerable.

Classification of Soft-tissue Defects

The soft-tissue reconstruction of composite oromandibular defects has an equal and sometimes greater impact on the functional result than does the bony reconstruction. Despite this fact, there has been no attempt, in any previous reports, to classify the extent of the soft-tissue defect. This deficiency is a reflection of not only the complexity of the problem, but also the failure to critically examine the functional results. A review of the literature shows any postoperative intraoral photographs to demonstrate the restoration of normal sulcular anatomy or the preservation of tongue mobility.

The classification scheme in Table 2 defines the mucosal defects of the oral cavity and the cutaneous defects of the face and neck that may result following tumor ablation or trauma. We have selected this scheme because it reflects the magnitude and complexity of the functional and aesthetic deficits. Mucosal defects that are classified as labial (L) and buccal (B) are defined as defects that will result in the obliteration of the gingivobuccal or gingivolabial sulci if a flap or graft is not interposed (Figs 2 and 3). Soft-palate (SP) defects are divided into hemi- (SP^H) or total (SP^T) defects. The mucosal defects of the floor of the mouth (FOM) are assessed in a similar fashion. A floor of the mouth is classified as lateral (FOM^L) or anterior (FOM^A) based on whether a flap or skin graft is required to prevent obliteration of the sulcus and preserve the mobility of the tongue.

Tongue defects are very difficult to classify and to reconstruct because they involve mucosa, muscle, and both sensory and motor innervation. The tongue has been divided at the circumvallate papillae into mobile tongue (T^M) and tongue base (T^B)(Table 2). Quantification of the defect is based on the volume as well as the function of the residual tissue. Due to the propensity for mobile tongue cancers to involve the lateral border, the quantification of tongue defects is based on longitudinal divisions in quarters (Fig 4). We recognize the limitations of this scheme given the complex three-dimensional geometry of the tongue and the potential problems of fitting all tongue defects into these categories. If the remaining mobile or tongue base tissue is deemed nonfunctional, it is classified as T^{MNF} or T^{BNF}. Total glossectomy defects are labeled TG.

Pharyngeal defects (PH) are divided into myomucosal defects of the lateral (PH^L) and posterior (PH^P) walls. These defects begin at the anterior faucial arches. The division between lateral and posterior walls is somewhat arbitrary, but it reflects an increasing need for a flap or skin graft to prevent pharyngeal stenosis (Fig 3).

The external cutaneous defects are divided into cheek, mentum, neck, and lips. The cheek and mentum are divided by a vertical line that passes through the lateral oral commisures. The lips (C^L) are subdivided into upper (C^{LU}) and lower (C^{LL}). Further quantification of the amount of lip lost is made with subscripts 1/4, 1/2, 3/4, and T (total)(Fig 5).

Classification of Neurological Deficits

As our reconstructive techniques have become more sophisticated and our assessment of the functional results more critical, the impact of neurologic deficits must be examined. Toward that goal, we have devised a concise classification scheme of the motor and sensory deficits that may result from an ablative procedure (Table 3).

Neurologic defects are divided into hypoglossal, lingual, facial, and inferior-alveolar. In those cases where the defect is bilateral, a subscript B is included. A bilateral inferior alveolar nerve defect is denoted by N^{IAB}.

Although the soft-tissue and neurologic classification schemes are detailed, they reflect several considerations. The first is that each of these soft-tissue and neurologic defects will result in a functional deficit. The reconstruction must address each of these defects to maximize the functional results. Finally, it allows one to predict the magnitude of the functional deficit and to better compare the efficacy of different reconstructive techniques in restoring oral function. As has been noted previously, the final functional result is often affected more by the soft-tissue reconstruction than by the bony restoration.

Materials and Methods

Oromandibular reconstruction procedures using vascularized composite free flap transfers were performed in 71 cases between 1987 and 1990 (Table 4). Seventy-two flaps were transferred in 70 patients. In one patient (patient 13) reconstruction was performed with combined iliac bone and scapular free flaps, and in one patient (listed as patient 21 and 29 in Table 4), the two reconstructions performed on two separate occasions were unsuccessful. The first of these reconstructions was performed at the time of primary tumor ablation, and the second was performed 6 months later. The majority of patients lost their mandibles due to squamous cell cancer. Additional pathologic entities are shown in Table 5. Thirty-two patients had received radiotherapy prior to reconstruction, while 28 patients were treated postoperatively. Primary mandibular reconstruction was performed in 57 cases, while delayed reconstruction was carried out in the remaining 14 cases. In each of the secondary reconstructions, the oral cavity was violated to augment the soft tissues and to improve the intraoral milieu for postoperative function.

A detailed description of the extent of the soft-tissue defect is given in Table 4, and a summary of the composite defects is delineated in Table 6. A soft-tissue flap was introduced into the oral cavity in all but one case. It was the decision by the reconstructive surgeon at the time of surgery as to whether a soft-tissue flap was needed in the oral cavity and pharynx to prevent or correct a postoperative disturbance in function. Seventeen patients had through-and-through defects of the oral cavity. Several of the secondary reconstructions were associated with cutaneous defects due to soft-tissue atrophy and in those cases the inclusion of a cutaneous flap or a muscle flap covered by a skin graft was required.

The bony mandibular defects are listed in Table 1. Forty-five of the 71 defects extended to or past the midline. There were seven cases that required reconstruction of the condyle. It was not necessary to reconstruct the soft-tissue components of the temporomandibular joint in any of the cases. Condylar replacement was achieved with a prosthetic condyle in three cases and with vascularized bone in four cases (Fig 6). In each case of condylar replacement, the patient was placed in maxillomandibular fixation for 2 weeks.

Contouring of the bone grafts was achieved by creating osteotomies (iliac) or ostectomies (scapula) as dictated by the shape of the missing mandible. The number of bone cuts was greater when the anterior arch was reconstructed. Lateral defects reconstructed with the iliac bone rarely required any osteotomies. When an osteotomy was created, the V-shaped defect was filled with corticocancellous bone chips and then covered with soft tissue. With greater experience in using the iliac bone, we made an increased number of osteotomies at shorter distances along the bone to create a gentler curvature.

In two cases of near-total glossectomy (patients 1 and 59), the iliac bone was placed in a horizontal position. This platform of iliac bone extended posteriorly for 4 to 5 cm to support the soft tissues used to resurface the oral cavity. This design maintains the height of the neotongue for apposition to the palate and thus facilitates deglutition and articulation[3,4] (Figs. 7-10).

Bone fixation was achieved in the majority of cases, using a three-dimensional, bendable reconstruction plate that was contoured to the defect prior to mandibulectomy. In select cases of iliac bone and in all cases of scapular reconstructions, fixation was achieved with miniplates.

The different vascularized composite flaps that were utilized in this series are summarized in Table 7. In patients in whom reconstruction was performed with the iliac crest internal oblique osteomyocutaneous flap (ICIOC), the internal oblique muscle was used to resurface mucosal defects.[5-7] A split-thickness skin graft was used in those cases where there was a significant loss of either floor of mouth or buccal mucosa and in all cases of partial glossectomy. The split-thickness skin graft was placed over the internal oblique muscle between the tongue and the neomandible and between the neomandible and the cheek flap to reconstruct the sulci and maintain the mobility of the tongue. When the iliac crest osteocutaneous flap was used, the skin paddle resurfaced the intraoral mucosal defects. The osteocutaneous flap was used in those patients who were very thin and in whom a significant portion of the buccal mucosa required resurfacing. When tumor extended onto the buccal mucosa, the resection resulted in a thinned cheek flap that was not adequately reconstructed with the denervated internal oblique muscle. In these cases, the bulk of the subcutaneous tissue of the skin paddle provided a more symmetric appearance to the lower portion of the face. In all such cases, secondary debulking procedures were needed to further contour the intraoral skin paddles.

The scapular/parascapular osteocutaneous flaps were used in seven cases. The decision to use the scapular donor site was based on a number of factors: (1) the body habitus of the patient; (2) the presence of an external cutaneous cheek defect that extended above the level of the oral commissure[7]; (3) women of child-bearing age in whom we did not want to disturb the integrity of the abdominal wall musculature; and (4) prior inguinal surgery, such as aortobifemoral by-pass procedures. In one patient (patient 40), the deep circumflex iliac vein was found to be inadequate for anastomosis and the iliac flap was abandoned. The reconstruction was completed with a scapular osteocutaneous free flap.

A coronoidectomy was performed at the time of secondary mandibular reconstruction in four patients. One of these patients (patient 59) required bilateral coronoidectomies to obtain adequate mobility of the mandible. One patient who underwent primary mandibular reconstruction required a coronoidectomy secondarily, due to an inadequate oral opening.

An additional adjuvant procedure was the placement of an O-polypropylene (Prolene) suture to resuspend the larynx. This was performed in all cases of bone defects that included the entire symphysis, and, hence, disruption of all of the suprahyoid muscles. The suture was passed around the hyoid and then through either a hole in the fixation plate or a hole drilled through the mandible. Enosseous dental implants were placed primarily at the time of reconstruction in 29 patients. A total of 104 implants have been inserted. Patient interest and financial resources were the primary reasons why implants were not placed in the remainder of the patients in the series.[8]

The recipient vessels used for anastomosis are shown in Table 8. For reasons that have been described in detail in a prior publication,[9] we prefer to use the transverse cervical artery and the external jugular vein. On occasions when there was an additional donor vein that was available, it too was anastomosed to ensure the adequacy of the venous outflow. Vein grafts were used six times in patients who had undergone previous radical neck dissections. In most such cases, the anastomoses were performed to contralateral vessels in the virgin neck by selection of the opposite iliac crest for harvest. This positioned the donor vessels closer to the midline of the neck.[7] On two occasions, the cephalic vein was harvested from the upper arm and transposed over the clavicle for anastomosis to the donor veins.

In the latter part of this series, nerve grafts were used to reconstruct the inferoalveolar nerve to restore sensation to the lower lip. The mental nerve was isolated as it entered the skin, and the inferior-alveolar nerve was unroofed proximally in the canal (Figs 1 through 13). The stumps of both these nerves were checked by frozen section for oncologic clearance. The lateral femoral cutaneous, sural, or the greater auricular nerves were used to bridge the gaps. Microneural anastomoses were performed with 9-0 nylon sutures. Twelve unilateral and four bilateral nerve grafts were placed.

Results

There were 68 successful flap transfers in the 72 flaps included in this series and 68 of the 70 mandibular defects were reconstructed with vascularized bone. Positive bone scans were obtained within the first 5 days on all successful flaps. In 15 patients, the lower dentures have been fitted using enosseous implants and in 14 others they are in various stages of restoration. Twelve of the patients in whom implants were placed primarily received postoperative radiotherapy. In these patients, a delay of 6 months, rather than 4 months, was instituted prior to loading of the implants. To date, one implant in the radiated group and two implants in the nonradiated group have been lost. However, all patients have been able to undergo rehabilitation with either an implant-borne or implant-assisted prosthesis. There have been no cases of implant-associated osteoradionecrosis or infection. A longitudinal study is presently under way to assess the marginal bone loss of implants placed into vascularized bone grafts. Seven patients have been rehabilitated with partial or complete tissue-borne dentures. In patients who underwent partial maxillectomy or soft-palate resection, the defects were fitted with a palatal prosthesis, when needed, to prevent nasal regurgitation. Representative cases are shown in Figs 14 through 28.

In the series of 12 unilateral and four bilateral inferior-alveolar nerve grafts, the preliminary results are extremely encouraging. Seven patients have demonstrated return of sensation to the lower lip, with discrimination between pinprick, light touch, hot, and cold. The earliest signs of return of sensation were detected at 3 months after surgery. The strength of sensation improved for several months following the initial signs of recovery. Patients reported that return of lower lip sensation provided valuable feedback that helped to control drooling. Three patients in this group with inferior-alveolar nerve grafts are greater than 6 months after surgery and have shown no signs of sensory recovery. The remaining 6 patients are all less than 3 months since surgery. The patients in this series who did not undergo inferior-alveolar nerve grafts showed no sign of return of lower lip sensation. There were no cases of painful neuroma or paresthesias in patients who underwent inferior-alveolar to mental nerve grafting.

There were two postoperative deaths. One occurred on the fifth day after surgery due to a myocardial infarction, and the other occurred on the 14th day and resulted from a perforated esophagus with a resultant esophagopericardial fistula. In both patients, the flaps were viable at the time of the patient's demise. The major and minor complications are listed in Table 9. Major recipient site complications included four fistulas that healed with conservative therapy. There were four cervical wound infections that resulted in tissue necrosis requiring a regional flap for coverage in two cases. In the case of a wound infection, the threshold for using a regional flap was low due to a concern for protection of the free flap pedicle. There were three cases of intraoral bone exposure and two cases of fixation plate exposure in the oral cavity. Conservative therapy led to mucosal ingrowth that covered these defects in all cases.

There were a total of four unplanned regional flaps. Two were noted above following skin necrosis from cervical wound infections. One was needed in patient 21 to reconstruct the anterior floor of mouth following flap failure. Another regional flap was required in patient 34 who had a massive defect in the cheek and who experienced partial necrosis of the skin paddle of the iliac crest-internal oblique osteomyocutaneous flap. Bilateral karapanzic flaps were used to restore oral competence in patient 36 following resection of three quarters of the lower lip. Patient 7 required an additional surgical procedure that included a wedge resection of the lower lip and placement of a permanent circumzygomatic suture to correct an everted. atonic lower lip.

There was one cervical hematoma that was evacuated without returning the patient to the operating room. Patient 25 underwent total glossectomy and experienced prolonged aspiration following surgery. A total laryngectomy was performed 12 weeks following reconstruction. There were two cases of immediate facial paralysis following reconstruction. These both occurred in patients undergoing secondary mandibular reconstruction. In both patients, facial nerve exploration was performed at the time of reconstruction to create a soft-tissue pocket in which to place the ramus and condyle of the reconstructed mandible. Postoperative exploration within the first 48 hours after surgery demonstrated an intact facial nerve in one patient whose paralysis resolved spontaneously and was attributed to traction injury. In the second patient, the nerve could not be identified at the initial exploration due to the dense scar tissue that was present following prior surgery and radiotherapy. At reexploration, the nerve was found to be transected and microscopic repair with a sural nerve graft was performed.

There were two major donor site complications. A hernia developed in patient 37 and required reexploration and repair 5 months following reconstruction. There were no other cases of symptomatic abdominal wall weakness or bulging. One patient had a postoperative femoral nerve injury on the side of the flap harvested. Postoperative exploration revealed compression of the nerve in the closure. Following decompression, the patient developed return of function 8 weeks following surgery. There were no cases of prolonged ileus. Minor donor site complications, which resolved with conservative therapy, included two wound infections, three seromas, and one hematoma. Almost all patients experienced temporary or permanent anesthesia in the distribution of the lateral femoral cutaneous nerve that was transected in the majority of cases. There were no patients who complained about this sensory loss. All patients ambulated with an antalgic gait in the early postoperative period. Intensive postoperative physical therapy allowed the majority of patients to leave the hospital without the use of a cane. There were no cases of prolonged gait disturbance in this series.

All patients were closely monitored postoperatively to detect any compromise in the circulation to the flap. In six cases, the patient was returned to the operating room for revision of the microvascular circulation. There were four total flap failures. Two occurred in one patient who required combined iliac crest and scapular free flaps to reconstruct a near-total mandibular defect. The patient became hemodynamically unstable postoperatively, and it was believed that this contributed to the loss of both flaps, as well as the unsuccessful salvage procedure. The other two failures occurred in one patient who failed mandibular reconstruction on two separate occasions. In both situations, the problem appeared to be venous congestion that could not be relieved despite numerous revision attempts. There were two cases of partial skin flap loss. In patient 26, the wound was closed primarily following débridement. In the other (patient 34) the skin paddle was used to resurface a massive cheek defect that extended to the zygoma. Although the entire skin flap was well vascularized at the time of surgery, its circulation became compromised as a result of edema and placing torsion on the musculocutaneous perforators by turning the skin paddle relative to the bone.

The learning curve in microvascular mandibular reconstruction is reflected by the fact that all but one of the revision microvascular procedures and all of the flap failures occurred in the first 30 cases of this series. In addition, the total time of the operative procedures was significantly shortened from an average of 14 to 16 hours early in our experience, to 8 to 10 hours in the latter part of the series. A simultaneous two-team approach was used in all cases of iliac crest reconstructions.

The length of hospitalization has also shortened through the latter portion of this series. The shortest period for a patient undergoing ablation and primary reconstruction was 10 days. Factors that had the greatest impact on the duration of hospitalization were the patient's age, medical condition, and prior radiation therapy.

Comment

... These patients have aggressive malignant disease and a limited life expectancy. This raises the question of whether or not the patient should undergo a large complicated operative procedure with a very limited life expectancy. If a surgical resection is offered to this type of patient, we feel that the reconstruction should be reliable and require minimal hospitalization. Since progressive invasion and erosion of the face by malignant disease is a most unpleasant way of dying, out approach is to offer the resection and reconstruction to the patient if it is expected that the quality of the patient's remaining life will be significantly improved.[10]

The problem of the patient with faradvanced oral cancer who requires a major ablative procedure presents a philosophical dilemma. The ability to perform reconstruction in these patients in a single-stage procedure, and to restore a superior level of oral function than was previously available, has made them candidates for operative intervention even though the chance for cure is limited. We share the philosophy of Duncan et al in offering surgery to this unfortunate group of patients following extensive preoperative counselling and the exhaustion of other therapeutic modalities.

The capability of restoring a patient with oral cancer to a functional and aesthetically acceptable state following a surgical ablative procedure allows us to extend our surgical margins with less fear of the rehabilitative sequelae. One day, this may be shown to have a positive effect on recurrence rates at the primary site. However, there will still be patients who succumb to disease at regional or distant sites, second primary sites, and who die of intercurrent diseases, despite our best surgical efforts and multimodality therapy. Despite this, our goals remains to restore all patients, within the limits of their overall medical condition, to the best possible functional state for whatever period of life they have left.

Most head and neck surgeons agree on the need to primarily reconstruct anterior mandibular defects in patients to prevent the devastating aesthetic and functional sequelae. The merits of restoring lateral bony defects remain controversial. However, the results of our preliminary functional study comparing patients with reconstructed and nonreconstructed defects demonstrate a superior level of function in the patients with primarily reconstructed hemimandibular defects using the microvascular and dental implant techniques described.[11]

It is readily apparent that the spectrum of patients with identical segmental mandibulectomy defects varies greatly depending on the magnitude of the soft-tissue and neurologic defects. These latter defects are all important in determining whether the patient will be left as an oral cripple or have the potential to achieve a near-normal level of oral function. Although the extent to which the tongue is defunctionalized is unquestionably the major determinant, all of the other soft-tissue losses play an important role. One could argue that the proposed classification scheme is too detailed. However, each of the defects has an impact on the nature of the reconstruction, the complexity of postoperative rehabilitation, and, ultimately, the aesthetic and functional outcome that determines the quality of the patient's life. Over time, it may be possible to stage oral defects by grouping a variety of bone, soft-tissue, and neurologic defects into different categories. Although it is tempting to propose such stages at this time, a better approach is to accomplish this retrospectively through functional studies that objectively assess oral function. It is imperative that success or failure in oromandibular function be assessed in a more critical fashion. The only way to realistically compare the efficacy of different reconstructive options is to group patients according to their surgical defects. We believe that this is best accomplished through a universally accepted classification scheme.

The use of a nerve graft to reconstruct the inferior-alveolar nerve has been previously described. Scattered reports[12,13] have appeared in the literature that warrant enthusiasm for application to the rehabilitation of the patient with oral cancer. Our results with this technique are very encouraging, but only preliminary, and patients must be submitted to critical functional evaluation of their condition to assess its merits. Sensory reeducation, as applied to sensory reinnervation in the extremities, may be valuable in improving the quality of lip sensation, as well as the sensation in sensate reconstructive flaps placed in the oral cavity.[14-16]

The use of enosseous dental implants in oromandibular reconstruction has provided the opportunity to rehabilitate the patient with oral cancer to an improved functional state than was previously available.[8,11] One of the major criticisms of mandibular reconstruction in the past was that even when bone continuity could be reestablished, the patients were unable to wear a lower denture with adequate stability and retention for masticatory function. The question of successful osseointegration following primary implant placement and postoperative radiation remains unresolved. Well-controlled animal experiments are needed to adequately address this issue. However, our experience with such patients has been very encouraging. This may be due to several factors. The window period of 5 to 6 weeks prior to the start of radiation may allow a head start on the integration process prior to the onset of radiation bone injury. The bone that is transferred in a composite free flap may have a greater vascularity than the atrophic edentulous mandibles in which dental implants are usually placed. This may have an impact on the rate and degree of radiation injury and the speed of osteointegration. Finally, the prolonged period of 6 months prior to implant loading in the radiated cases allows additional measure of security.

Conclusion

The results of this series clearly demonstrate that vascularized composite free flaps can be transferred to the oral cavity with a high degree of consistency and an acceptable level of complications. Primary oromandibular reconstruction has been refined to the point that it can be offered to virtually all patients who are faced with the devastating prospect of ablative surgery for oral carcinoma. However, the successful transfer of a composite flap is only part of the story. We strongly believe that the optimum level of success in oromandibular reconstruction and rehabilitation is best achieved through a cooperative effort of dedicated individuals representing a number of different disciplines that include a head and neck oncologic surgeon, reconstructive surgeon, oral surgeon, prosthodontist, speech therapist, and physical therapist. The expertise which each of these specialists contributes in this team approach is critical to achieving the best possible outcome for each individual patient. Is also the most effective way for us to continue to modify and improve the methods that are presently available, so that we may come closer to achieving our goal of returning these patients to their predisease state.

References

David D, Tan E, Katsaros J, Sheen R.: Mandibular reconstruction with vascularized iliac crest: a 10 year experience. Plast Reconstr Surg. 1988;82;792-801.

Jewer D, Boyd J, Manktelow R, et al.: Orofacial and mandibular reconstruction with the iliac crest free flap: a review of 60 cases and a new method of classification. Plast Reconstr Surg. 1989; 84;391-403.

Salibian A, Rappaport I, Furnas D, Achauer B.: Microvascular reconstruction of the mandible. Am J Surg. 1980;140:499-502.

Salibian A, Rappaport I, Allison G.: Functional oromandibular reconstruction with the microvascular composite groin flap. Plast Reconstr Surg. 1985;76:819-825.

Urken, ML, Vickery C, Weinberg H, Buchbinder D, Biller HF.: The internal oblique-iliac crest osseomyocutaneous microvascular free flap in head and neck reconstruction. J Reconstr Microsurg. 1989;5:203-214.

Urken ML, Vickery C, Weinberg H, Buchbinder D, Lawson W, Biller HF.: The internal oblique-iliac crest osseomyocutaneous free flap in oromandibular reconstruction: report of 20 cases. Arch Otolaryngol Head Neck Surg. 1989;115:339-349.

Urken ML, Weinberg H, Vickery C, Buvhbinder D, Lawson W, Biller HF.: The internač oblique-iliac crest free flap in composite defects of the oral cavity involving bone, skin and mucosa. Laryngoscope. 1991;101:257-270.

Urken ML, Buchbinder D, Weinberg H, Vickery C, Sheiner A, Biller HF.: Primary placement of osseointegrated implants in microvascular mandibular reconstruction. Otolaryngol Head Neck Surg. 1989;101:56-73.

Urken ML, Vickery C, Weinberg H, Buchbinder D, Biller HF.: Geometry of the vascular pedicle in free tissue transfers to the head and neck. Arch Otolaryngol Head Neck Surg. 1989;115:954-960.

Duncan M, Manktelow R, Zuker R, Rosen I.: Mandibular reconstruction in the radiated patient: the role of osteocutaneous free tissue transfers. Plast Reconstr Surg. 1985;76:829-840.

Urken ML, Buchbinder D, Sheiner A, et al.: Functional evaluation following microvascular oromandibular reconstruction of the oral cancer patient: a comparative study of reconstructed and nonreconstructed patients. Presented at the American Triological Society Annual Meeting, May 3, 1990, Palm Beach, Fla.

Wessberg G, Wolford L, Epker B.: Simultaneous inferior alveolar nerve graft and osseous reconstruction of the mandible. J Oral Maxillofac Surg. 1982;40:384-390.

Hausamen J, Samii M, Schmidseder R.: Restoring sensation to the cut inferior alveolar nerve by direct anastomosis or by free autologous nerve grafting: experiments study in rabbits. Plast Reconstr Surg. 1974;54:83-87.

Dellon AL.: Evaluation of Sensibility and Re-education of Sensation in the Hand. Baltimore, Md:John D Lukas Printing Co; 1988.

Urken ML, Weinberg H, Vickery C, Biller HF.: The neurofasciocutaneous radial forearm flap in head and neck reconstruction: a preliminary report. Laryngoscope. 1990;100:161-173.

Matloub H, Larson D, Kuhn J, Yousif J, Sanger J.: Lateral arm free flap in oral cavity reconstruction: a functional evaluation. Head Neck Surg 1989;11:205-211.