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CONTEMPORARY RECONSTRUCTION OF THE MANDIBLE

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ABSTRACT

Defects of the mandible following ablative surgery can be both disfiguring and disabling.The challenge of the reconstruction is selecting and optimizing these techniques to produce the bestfunctional and aesthetic result that is individualized for the patient. The advent of microvascular surgery revolutionized oro-mandibular reconstruction. Microvascular surgery has afforded the ability to transfer a substantial amount of bone and soft tissue with its own vascular supply to the head and neck, which has permitted successful reconstructive efforts, even in the face of contaminated wounds and previously irradiated recipient sites.Today, osteocutaneous free tissue transfer with titanium plate fixation is the gold standard for mandibular reconstruction.The ability to reliably reconstruct segmental mandibular defects has led to a change in the surgical algorithm when the mandible is involved by the disease process. In addition, dental implants can restore functional mastication, which impacts greatly on patient acceptance of such devastating surgery.

KEYWORDS MANDIBLE, RECONSTRUCTION, RESECTION, REHABILITATION, DENTAL IMPLANT

INTRODUCTION

Defects of the mandible following ablative surgery can be both disfiguring and disabling. Currently there are several well established reconstructive options for restoring mandibular continuity and oro-mandibular function. The challenge of the reconstruction is selecting and optimizing these techniques to produce the best functional and aesthetic result that is individualized for the patient.

The advent of microvascular surgery in the 1980's revolutionized oro-mandibular reconstruction. In two separate reports Taylor, as well as Sanders and Mayou described the deep circumflex iliac artery and vein (DCIA/V) as a reliable and easily utilizable vascular pedicle to transfer iliac bone and the overlying skin as a free tissue transfer. Hidalgo became the first to report the transfer of fibular bone to reconstruct a segmental defect of the mandible. Microvascular surgery has afforded the ability to transfer a substantial amount of bone and soft tissue with its own vascular supply to the head and neck, which has permitted successful reconstructive efforts, even in the face of contaminated wounds and previously irradiated recipient sites.Today, osteocutaneous free tissue transfer with titanium plate fixation is the gold standard for mandibular reconstruction. Since its advent, microvascular transfer has been refined, leading to a high rate of reproducibility and success rates approaching 100%. The ability to reliably reconstruct segmental mandibular defects has led to a change in the surgical algorithm when the mandible is involved by the disease process. In addition, dental implants can restore functional mastication, which impacts greatly on patient acceptance of such devastating surgery.

GOALS OF RECONSTRUCTION

The goals of mandibular reconstruction are to reestablish the form of the lower third of the face and to restore the patient's ability to eat in public, be intelligible to both trained and untrained listeners, and to maintain an unencumbered airway that allows the freedom to perform all activities. Rarely are defects from head and neck malignancies limited to mandibular bone, so the soft tissues involved need to be considered in order to optimize oro-mandibular function. The greater the loss of tongue volume, the greater the negative impact on the patient's prognosis for recovery of oral function. Thus, the approach to the reconstruction should start by addressing the impact of the surgery on the patient's tongue. In most cases, optimizing tongue bulk and mobility is more critical to the post-operative functional recovery than management of the bony defect. Loss of mucosa from the floor of mouth is critical in the assessment of whether to restore this component of the defect with non-native tissue. Preventing the tongue from becoming tethered to the neomandible is vital to preservation of mobility. Restoring tongue bulk and preserving mobility allow for palatoglossal contact which is critical for improving articulation during speech and bolus manipulation during deglutition. Oral reconstruction must also address lower lip function by attempting to achieve oral competence while preserving the expressive motion of the lips that is so important to normal facial movement. Restoring mandibular continuity while maintaining proper occlussal relationships and providing a structure for dental implantation permits the neomandible to produce and withstand the masticatory forces necessary for complete oral function.

There are three main donor sites for vascularized bone used in mandibular reconstruction: fibula, iliac and scapula. While there is a substantial experience in the use of the radial osteocutaneous flap, it is our opinion that it does not provide a sufficient amount of bone stock, and therefore plays very little role in our current approach to oro-mandibular reconstruction.

The scapular osteocutaneous free flap (SOFF) is the most versatile composite flap used for mandibular reconstruction allowing for replacement of bone and restoring large soft tissue defects. The lateral border of the scapula can be harvested in conjunction with a horizontally oriented scapular or vertically oriented parascapular fasciocutaneous flap. The thoracodorsal artery can be included for transfer of the latissimus dorsi muscle with an overlying skin paddle. The angular branch of the thoracodorsal artery supplies the tip of the scapula allowing for separate orientation relative to the bone segment of the more cephalad portion of the scapula supplied by the circumflex scapular artery.

Several series have demonstrated favorable flap survival rates (89–96%) with limited donor site morbidity.

This flap can be especially useful in the setting of salvage surgery after chemoradiation failure by including the latissimus dorsi muscle for coverage of vital vascular structures in the neck. The SOFF is also preferred by the authors for the geriatric patient undergoing a composite resection. The scapular donor site allows for early ambulation and does not further complicate lower extremity venous stasis, or arterial insufficiency, which are common co-morbidities in this patient population.

Disadvantages of the SOFF include decreased range of motion of the shoulder especially with performing tasks above the head. The harvested bone is primarily cancellous bone and is an excellent substrate for implantation due to its substantial height and thickness. The iliac bone can be contoured to fit most segmental mandibular defects. Opening osteotomies performed in the iliac bone allow reliable reconstruction of anterior mandibular defects. The hemi-mandible can be recreated from the ipsilateral ilium using the anterior superior iliac spine to restore the mandibular angle. By including the ascending branch of the DCIA, the internal oblique muscle can be harvested and used for intraoral mucosal defect reconstruction. The internal oblique muscle is thin, pliable and can be maneuvered independent of the bone more easily and more reliably than the overlying skin flap.

The donor site morbidity is a primary concern related to the use of the iliac donor site. However, a critical appraisal of this donor site in patients who underwent harvest has not supported such claims.The issues related to the donor site include the challenge of restoring the abdominal wall to prevent hernia formation, as well as the rehabilitation required to achieve normal ambulation. Vascularized bone flaps are rigidly fixed and form a union to the native mandible allowing the reconstructed mandible to withstand masticatory forces. A variety of hardware systems have been developed to secure bone grafts and maintain occlussal relationships. Our preference is to use a 2.0–2.4 mm locking reconstruction plating system. The plate is bent to fit the contour of the native mandible prior to resection, ensuring three screws placed on either side of the resection for maximum stabilization. In secondary reconstructions and clinical situations where the tumor prevents application of the reconstruction plate prior to resection, the patient can be placed in maxillo-mandibular fixation or an external fixationbridge may be used to maintain proper alignment of the mandible segments. The locking plate functions as an external fixator, as the screw heads lock to the plate, which does not have to be perfectly contoured to the bone while still preventing motion of the bony segments.

When the resection extends proximally to include the condyle and temporo-mandibular joint (TMJ), the goal of reconstruction is to maintain its near normal range of motion, in order to preserve mandibular excursion. Loss of the TMJ can result in malocclusion, difficulty with mastication, trismus and loss of posterior mandibular height.

An ideal reconstruction achieves joint mobility, while withstanding the loading forces during mastication and avoiding ankylosis. Alloplastic materials have been used in joint reconstruction, but have been mostly abandoned due to complications. Proplast and silastic have also been used but can cause problems such as extrusion, foreign body reaction, infection and joint ankylosis. Autogenous grafts such as costochondral bone and cartilage are non-reactive and have the ability to remodel, however in the setting of adjuvant radiation therapy, they can undergo resorption and fracture and the limited amount of non-vascularized bone can lead to complications related to the hardware

DENTAL REHABILITATION

Dental rehabilitation with osseointegrated implants is an integral part of mandibular reconstruction following ablative surgery. Dental rehabilitation supported with endosteal implants helps restore functional mastication, facial aesthetics and support for the lower lip. While several studies have demonstrated that implant supported dental rehabilitation can be performed in a reproducible manner, the ability to restore functional mastication is very dependent on the status of the native or reconstructed tongue with respect to its ability to manipulate food between the opposing incisal surfaces. This requires both intact motor and sensory supply in order to achieve that goal.

Implant placement is done in two stages: fixture placement followed by exposure of the implant and placement of the transmucosal attachment. Following placement, the implant is allowed to integrate for 4 months in the mandible and 6 months for maxillary implants. The trans-mucosal attachment is then placed and two weeks later the denture is attached and load bearing follows. Vascularized bone flaps for mandibular reconstruction have facilitated the use of primary implant placement. Advantages of implanting at the time of the primary reconstruction include having optimal bone exposure in the primary setting, reduced time to dental rehabilitation and avoidance of hyperbaric oxygen therapy if radiation therapy is planned. Primary implantation does not affect external beam treatment planning or delay therapy. It also optimizes the time for integration to occur prior to the onset of the damaging effects of radiation on the bone. Conventional implant stability is determined both clinically and radiographically. An implant is considered a success if it is immobile, does not cause pain with manipulation, and demonstrates no peri-implant radioluceny on radiographic examination. In addition there should be peri-implant vertical bone loss less than 0.2 mm per year, after the first year from implantation.

CONCLUSION

Reconstruction of segmental mandibular defects after ablative surgery is best accomplished using free tissue transfer to restore mandibular continuity and function. Reestablishing occlusion and optimizing tongue mobility are important to post-operative oral function. Persistent problems in oro-mandibular reconstruction relate to the effects of radiation treatment on the native tissue and include xerostomia, dysgeusia, osteoradionecrosis and trismus. These problems continue to plague the oral cancer patient despite the significant advances that allow a far more complete functional restoration than could be accomplished a mere two decades ago.

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