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REVIEW

Management of mandibular invasion: When is a marginal mandibulectomy appropriate?

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Summary There has been a great deal of controversy regarding the appropriate method of management of oral cavity and oropharyngeal tumors that invade the mandible. The inability to acquire intraoperative bone margins can make the decision process complex. Preoperative imaging offers several advantages, however, there is no single modality that has proven accurate. Intraoperative assessment has been suggested as a method of evaluation, however, this approach does not allow for preoperative planning. The following is a review of the current literature regarding mandibular invasion and the indications for a marginal mandibulectomy.

Introduction

The management of tumors invading the mandible has been controversial. Historically, it was assumed that tumors of the oral cavity had the potential to

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spread via the lymphatics within the mandibular periosteum. As a result, tumors abutting the mandible were commonly treated with a segmental mandibulectomy. Subsequently, it was demonstrated that such malignancies spread through local regional lymphatics and not through the periosteum.[1,2] Since then, there has been debate regarding the indications for a marginal mandibulectomy.[3,4]

Prior to the introduction of vascularized bone-containing free flaps (VBCFF), segmental mandibulectomy defects were left unreconstructed. In addition to the cosmetic deformity, failure to reconstruct the hemimandibulectomy defect often resulted in malocclusion, mandibular swing, temporomandibular joint pain, and a diet restricted to soft foods. Arch mandibulectomy defects resulted in the classic ''Andy Gump'' deformity. Patients were frequently tracheostomy dependant as a result of tongue base obstruction and many required a gastrostomy tube for nutrition. The incapacitating repercussions of the unreconstructed segmental mandibulectomy prompted many to consider a marginal mandibulectomy in cases where the medullary canal was free from gross invasion. Unlike the segmental mandibulectomy, a marginal resection preserves the integrity of the bony architecture and most of its muscular attachments resulting in less functional and cosmetic deformity. While appropriate for superficial tumors of the oral cavity overlying the mandible, many have expressed concern regarding the breech in ''en bloc'' oncologic principles.

The introduction of the mandibular reconstruction plate, and subsequently, VBCFF for primary mandible reconstruction, have provided head and neck surgeons with the reconstructive tools to aggressively resect tumors involving the mandible. While these techniques allowed for the restoration of mandibular continuity, the extended operative time and attendant morbidity associated with a VBCFF harvest, reignited the debate regarding the indications for a segmental versus a marginal resection. The controversy regarding this issue is largely centered on the inability to obtain intraoperative margins of the mandible and whether frozen section of the periosteum is an indicator of bone involvement. As a result, surgeons rely on the preoperative imaging and intraoperative clinical assessment to determine the extent of mandibular invasion and therefore the extent of surgery required for appropriate oncologic management of the primary disease.

Pathophysiology of mandibular invasion

A thorough understanding of the histological patterns and routes of tumor invasion into the mandible is a critical component in the decision making process for management of the mandible. Armed with this knowledge, the head and neck surgeon is able to plan an ablative procedure and obtain clear margins yet conserve as much hard and soft tissue to provide the patient with the best possible functional and cosmetic results. Neoplastic invasion into the mandible is most often the result of extension from an oral cancer. Histopathologically, bone destruction is initially mediated by local host osteoclasts eroding bone and then direct tumor cell invasion occurs.[5] There are two distinct histological patterns of tumor invasion into the mandible by oral squamous cell carcinoma.[6] The first pattern is referred to as ''infiltrative'' (or ''invasive''). In this pattern, fingers and islands of tumor advance independently and invade the cancellous spaces (along an irregular tumor front) without the intervening connective tissue layer and with little osteoclastic activity.[6,7] Radiologically, there is an ill-defined and irregular lesion.[8] The second pattern is referred to as ''erosive''. In this pattern, the tumor advances on a broad front with a connective tissue layer and active osteoclasts creating a sharp interface between tumor and bone. Radiographically, there is a well-defined radiolucency with no spicules of bone. In 1995, Brown and Browne[9] published evidence suggesting that there was a progression from the ''erosive'' to the ''infiltrative'' pattern of disease as the extent of bone invasion increased. In 2000, Wong et al.[10] published data comparing patient survival to the pattern of invasion and found the 3 year disease-free survival for the infiltrative and erosive patterns to be 30% and 73%, respectively. This implies that the histological pattern of invasion reflects the biological aggressiveness of the tumor and that the pattern shifts towards the ''infiltrative'' pattern as the tumor becomes more aggressive. Lam et al.[11] using step-serial whole-organ histological sections showed that the tumor front of mandibular invasion by carcinoma of the lower alveolus is usually broad. In the absence of deep invasion, which is defined by invasion reaching the alveolar canal, there is little or no insinuation of cancer cells beyond the tumor front, and no spread along the alveolar canal, providing a rationale for marginal mandibulectomy.

There are multiple routes of tumor entry into the mandible but debate continues as to which of these routes is preferential. Oral cavity carcinoma travels along the surface mucosa and the submucosal soft tissues until it approaches the attached gingiva where tumor cells may come into contact with the periosteum of the mandible. In the dentate patient, tumor cells migrate through the dental