Bone Margin Analysis for Benign Odontogenic Tumors

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KEYWORDS

• Odontogenic tumor • Ameloblastoma • Mandible • Maxilla • Surgical margin

KEY POINTS

- Benign odontogenic tumors can be locally aggressive and may have high recurrence rates if not treated properly.
- Understanding the histology of each subset of tumors can help the surgeon to better understand how recurrence occurs and how best to prevent it.
- When treating benign odontogenic tumors, the surgical margins needed for curative therapy depends on the individual histopathologic diagnosis.
- Although many surgeons opt for conservative therapy, benign odontogenic tumors may need surgical resection.

INTRODUCTION

Benign odontogenic tumors encompass a wide variety of solid and cystic growths that originate from the various components of the odontogenic apparatus. They can be found equally distributed in both genders and in a wide age range, although some do demonstrate prevalence for more particular age groups. Most commonly, these tumors are found incidentally on routine radiographs, because they rarely cause any symptomatology, especially early in their course of development. Occasionally, however, the radiographic investigation is initiated by subjective patient complaints such as tooth loosening or pain, or objective findings such as facial swelling or malocclusion. Despite their benign nature, these tumors tend to behave aggressively in the sense that they can achieve significant sizes even before they become symptomatic, can cause bone and/or root resorption, and some are notorious for their unacceptably high recurrence rates, especially if appropriate treatment is not rendered initially. In addition, these tumors, if neglected or if not treated appropriately, can cause pathologic fractures owing to bone resorption for those found the mandible or extend to adjacent vital structures as the orbit or invade into the skull base, paranasal sinuses, nasal cavity, or infratemporal fossa for those that involve the maxilla.

Treatment of benign odontogenic tumors varies significantly based on the exact histopathologic diagnosis; not all tumors demonstrate the same behavior. Although there is no variation found in the literature regarding the proposed standard treatment of some odontogenic tumors such as the adenomatoid odontogenic tumor, there is significant controversy surrounding the treatment of others, more specifically the odontogenic keratocyst (OKC)/keratocystic odontogenic tumor (KCOT) and the ameloblastoma. Treatment can range from enucleation and curettage to

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peripheral ostectomy to resection with margins. The traditional teaching is that the tumor that is ameloblastoma or myxoma is treated with resection to the next anatomic layer (periosteum or muscle or fascia) and with a range of linear bony margin. This linear bony margin proposed for resection represents the shortest distance between the pathologic margin and the surgical resection and can range significantly in the literature from 0.5 to 1.5 cm. Interestingly, strict linear margins are often only applied to mandibular resections and not when the tumors involve the maxilla, because vital structures are not commonly sacrificed during maxillary resections for benign pathology. In part, this practice can be attributed to the various histologic subtypes, especially for the ameloblastoma that are believed to behave differently and demonstrate various tumor bone interface characteristics. Equally controversial is the treatment of the OKC/KCOT, specifically regarding the extent of "bony margins" that should be obtained, despite the tremendous body of literature that addresses extensively the histopathologic characteristics and the molecular landscape of the tumor. Finally, unlike in the treatment of malignant pathology, where clear definitions of "free" and "close" margin are established for the various tumors, there is no agreement as to what constitutes a "free" or "close" bony resection margin in benign odontogenic pathology. This article aims to discuss how bony margins are clinically and radiographically evaluated and what is currently known about tumor–bone interface of the most commonly encountered benign odontogenic tumors that guide treatment recommendations specifically regarding the "bony margin" that should be obtained. Although the current literature is depleted of information, we attempt to discuss the various methods that are available to the surgeon for the evaluation of the tumor extent into bone and those that may assist with the preoperative and perioperative assessment of the status of bone margins to ensure adequate tumor resection. The tumors discussed in this article are ameloblastoma, KCOT, odontogenic myxoma, calcifying epithelial odontogenic tumor (CEOT), and adenomatoid odontogenic tumor.

Ameloblastoma

The preoperative assessment of ameloblastoma often begins when first discovered clinically, and fully visualized, most commonly on a panoramic radiograph. Computed tomography (CT) allows for 3-dimensional visualization of the tumor borders and also serves as an indispensable aid in surgical planning specifically for solid tumors. Traditionally, preoperative imaging has been used to guide the resection plan especially for mandibular tumors since when the tumors involve the maxilla one of the standard maxillectomies (types I–V) is undertaken. Gortzak and colleagues[1] evaluated the borders and spread of ameloblastoma in several patients who underwent resection for large tumors. They found that ameloblastoma invaded via the cancellous bone and had small tumor nests up to 5 mm from the borders of the tumor.

There has been controversy as to the most ideal surgical margin because review of ameloblastoma resections often shows that the tumor extends histologically beyond its radiographic demarcation. Although some have advocated for 3-cm resection margins, and others for enucleation and curettage, the review of most published cases has resulted in the general acceptance of 1.0- to 1.5-cm linear margins for curative treatment.[2–5] In their study of 46 ameloblastomas, Rastogi and colleagues[6] investigated the various histopathologic types of ameloblastomas in an attempt to develop the most effective surgical procedure with curative intent. Using the resection specimens the researchers investigated the bone–tumor interface with serial sections of 0.25 cm. Their study validated that the various histopathologic subtypes of ameloblastoma infiltrate and invade bone differently. They identified that in unicystic ameloblastoma, bony infiltration was seen in 0.25 cm of the bone margin, whereas no tumor was found beyond 0.5 cm. In cases of follicular and plexiform ameloblastoma, tumor was found in up to 0.5 cm of the bone margin, but not beyond 0.75 cm. Finally, in granular ameloblastoma, bone infiltration was found at 0.75 cm of the tumor–bone interface. Based on these findings, they recommended resection of the solid the ameloblastoma variants with 1.0 to 2.0-cm bony margins, but caution against accepting enucleation and curettage as a universal treatment of all cystic tumors. The authors suggest that access to the entirety of the tumor and operator skills best guides the treatment option for the later tumors. One of the limitations of this type of study is that conventional ameloblastoma rarely present in a "pure" form. Instead, it occurs with a mix of histologic appearances. Despite this issue, the concept of treatment based on histopathologic diagnosis is novel. Validation of this study with additional large case series would be very beneficial and perhaps assist in establishing a more defined bony resection margin for each subtype of ameloblastoma that will allow for tumor clearance and prevent unnecessary excision of tumor-free tissue.

Radiographic evaluation of the tumor extent with CT is of paramount importance in assessment