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Ameloblastoma Resection and Tissue-Engineered Reconstruction: A Case Report and Review of Contemporary Techniques

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ABSTRACT

Ameloblastoma is a benign, but highly aggressive odontogenic tumor prone to local recurrence, making definitive surgical resection the preferred curative treatment. While radical resection yields superior long-term control, it necessitates complex reconstruction to restore both form and function. A 16-year-old male was referred to our academic institution for treatment of a left mandibular ameloblastoma. A surgical resection was planned with the aid of virtual surgical planning (VSP). The patient underwent segmental resection of the left mandibular lesion followed by immediate reconstruction with tissue engineering utilizing custom cutting guides and hardware. The procedure was completed without complication, demonstrating the feasibility and reliability of VSP-guided segmental resection with immediate tissue engineered reconstruction. This case reinforces current literature, which overwhelmingly favors radical resection for long-term disease control and validates the use of advanced surgical techniques, such as VSP and tissue engineering. These techniques can shorten operating room times as well as avoid the morbidity associated with a traditional iliac crest bone graft harvest or fibula free flap reconstruction.

CASE REPORT

A 16-year-old male was referred to our academic institution for definitive treatment of a recently diagnosed conventional ameloblastoma of the left mandible. An incisional biopsy and extraction of teeth #'s 17 and 32 were performed by an outside provider, and a definitive histopathological diagnosis was rendered prior to the referral. The patient was asymptomatic, and the lesion was an incidental finding on a panoramic radiograph noted to have been present for approximately one year before the diagnosis.

RADIOGRAPHIC IMAGING

A panoramic image was obtained during our initial consultation, which revealed a multilocular radiolucent lesion in the left posterior mandible associated with teeth #19-21 (Figure 1). Of note, there was root resorption of the associated teeth. Following two-dimensional radiography, a cone beam computed tomography (CBCT) scan was obtained, which further detailed the lesion's extent (Figure 2).

Figure 1: Panoramic image of left posterior mandibular lesion pre-operatively.

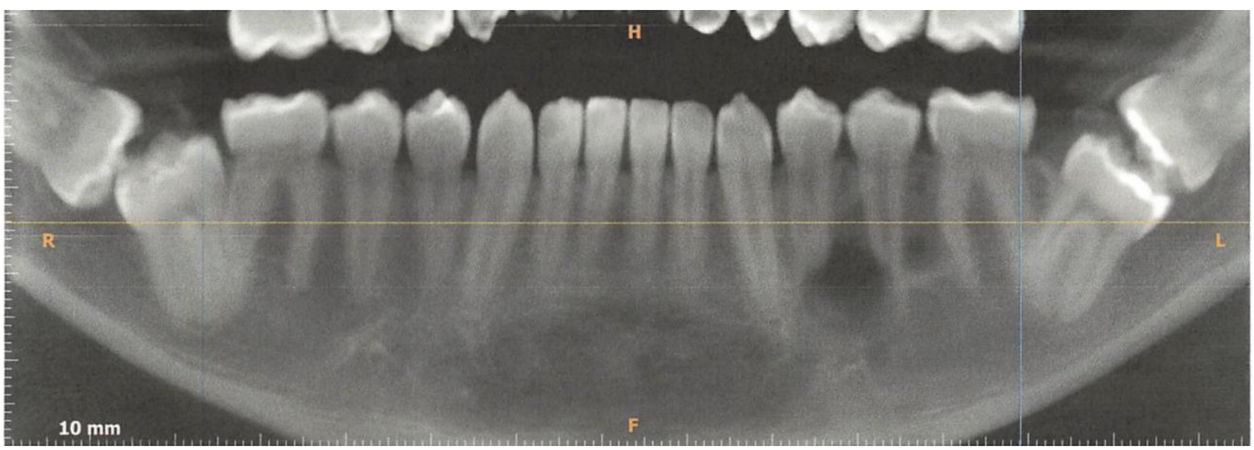

Figure 2: CBCT with reconstructed panoramic image of left posterior mandibular lesion pre-operatively

DIFFERENTIAL DIAGNOSIS

In the case reported, a definitive histopathological diagnosis was already rendered prior to the referral. However, it is important to discuss the differential diagnosis of a multilocular radiolucent lesion of the posterior mandible. Based on the clinical and radiographic findings associated with this specific case, the differential diagnosis for this lesion would have included ameloblastoma, odontogenic keratocyst (OKC), and odontogenic myxoma.

TREATMENT

The patient was taken to the operating room under general anesthesia for resection of the left mandibular ameloblastoma and reconstruction with tissue engineering.

Bone marrow aspirate was first obtained from the right anterior superior iliac crest (Figure 3). A small stab incision was made over the harvest site, and a Synthes trocar system was used to aspirate a total of 120 cc of bone marrow aspirate in four syringes containing Anticoagulant Citrate Dextrose Solution, Solution A (ACD-A), to prevent clotting of the aspirate. The bone marrow aspirate was centrifuged to yield 10 cc of bone marrow aspirate concentrate (BMAC). The donor site incision was closed with two 5-0 plain gut sutures and dressed with sterile gauze and a Tegaderm dressing.

Figure 3: Bone marrow aspiration of the right anterior iliac crest.

Attention was then turned intraorally. The occlusion was verified followed by application of a hybrid arch bar to the maxilla and an Erich arch bar to the mandible. The patient was then prepped and draped in sterile fashion with the mouth and nose isolated with Tegaderm dressings to maintain a sterile extraoral field. A submandibular approach was utilized for surgical access. Once the lesion and mandible were adequately visualized, the patient-specific cutting guides were secured to the mandible, which also included predictive holes for the reconstruction plate (Figure 4). Both proximal and distal osteotomies were completed using a reciprocating saw. The lesion was removed in its entirety and submitted for permanent histopathological evaluation (Figure 5). New drapes were then applied directly around the mouth, and a single provider placed the patient into maxillomandibular fixation (MMF) with care taken not to contaminate the submandibular incision site. Following MMF, a new Tegaderm dressing was applied over the mouth, and the previously mentioned drapes were removed. Reconstruction was performed utilizing tissue engineering. A total of 40 cc of crushed cancellous freeze-dried allograft was mixed with 10 cc of BMAC and three rhBMP-2 absorbable collagen sponges (6.3 mg total) cut into small fragments. The custom reconstruction plate was then secured across the defect with bicortical screws guided by the previously mentioned predictive drill holes provided by the cutting guides. A pre-bent stock 0.3 mm Stryker titanium mesh crib was adapted to the defect and secured with monocortical screws at the inferior border both proximally and distally. The mixture of allograft, rhBMP-2, and BMAC was condensed into the mesh across the defect to restore proper form to the mandible (Figure 6). A layered closure was performed followed by removal of the oral Tegaderm dressing. The occlusion was verified and confirmed to be stable and reproducible.

The patient was admitted for 23-hour observation. He had an uncomplicated hospital stay and was discharged home on post-operative day one.

Figure 4: Patient-specific cutting guides secured to the mandible.

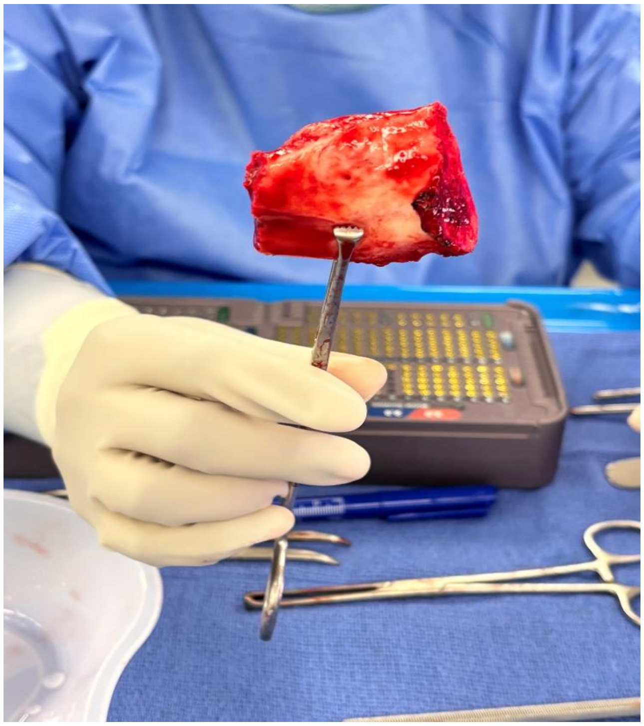

Figure 5: The ameloblastoma specimen post-resection.

Figure 6: Reconstruction of mandible with tissue engineering.

OUTCOME AND FOLLOW-UP

A panoramic radiograph was obtained on post-operative day seven (Figure 7). The patient has had an uncomplicated post-operative course. He has been followed at appropriate intervals with subsequent panoramic radiographs demonstrating graft consolidation (Figure 8). The patient will be treatment planned for conventional endosteal implants at six months post-operatively for dental rehabilitation.

Figure 7: Panoramic image of left posterior mandibular reconstruction one week post-operatively.

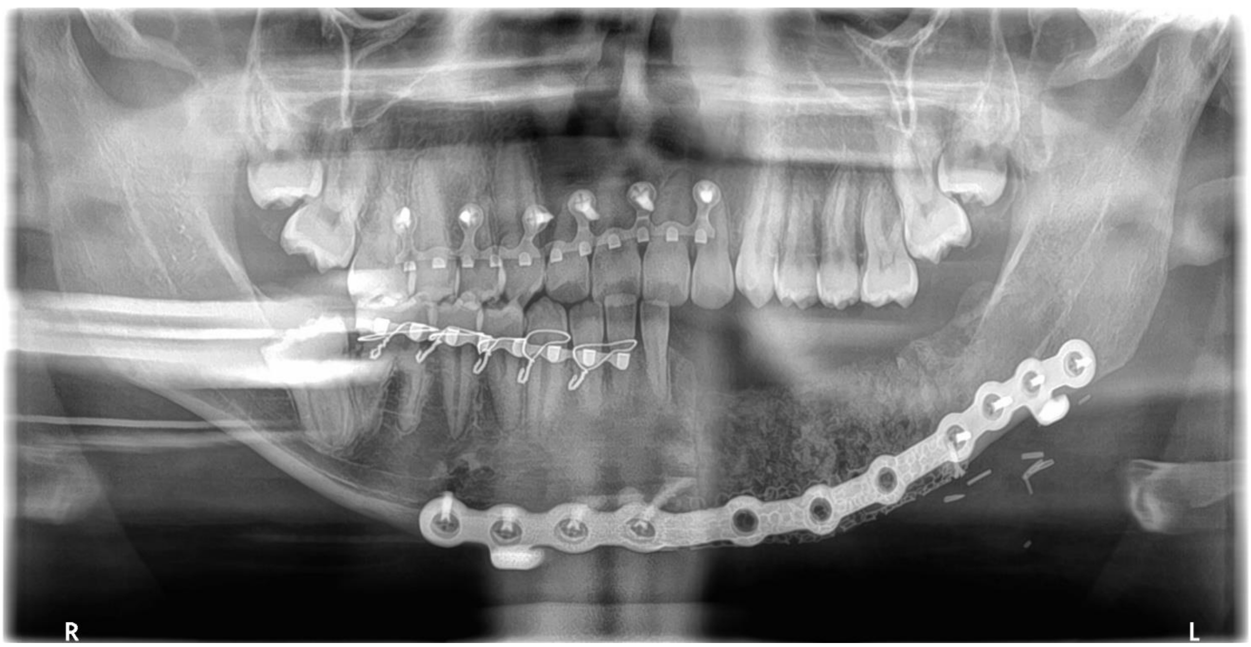

Figure 8: Panoramic image of left posterior mandibular reconstruction 1.5 months post-operatively.

DISCUSSION

Ameloblastoma is a rare, epithelial-derived odontogenic tumor, accounting for approximately 10 percent of all tumors found in the mandible and maxilla [1]. While histologically benign, it exhibits a characteristic locally aggressive growth pattern, infiltrating surrounding osseous structures and soft tissues. This invasiveness results in significant local destruction and a high propensity for local recurrence.

The World Health Organization (WHO) has continually refined the classification of ameloblastoma to better align histological features with clinical behavior. The most recent edition categorizes ameloblastomas into four main types: conventional ameloblastoma (formerly solid/multicystic), unicystic ameloblastoma, extraosseous/peripheral ameloblastoma, and metastasizing ameloblastoma [1]. The conventional type, which is the most common, exhibits islands and strands of odontogenic epithelium with classic features like palisaded basal cells and reverse polarity.

The majority of ameloblastomas are found in the posterior mandible, with the conventional (solid/multicystic) subtype being the most common presentation. However, the radiographic appearance of these lesions can be misleading. Traditional two-dimensional imaging, such as panoramic radiography, frequently classifies lesions as multilocular, suggesting wide internal septations. Advanced imaging, specifically multiplanar Computed Tomography (CT), has demonstrated that a large proportion of these cases are pseudo-multilocular, meaning the 3D extent and true bony involvement are less aggressive than initially suggested by 2D views. According to Kim et al. (2025), multiplanar CT imaging provides superior delineation of tumor margins and cortical perforation, enhancing the ability to classify and predict the biological behavior of ameloblastoma. Such imaging-based evaluation assists clinicians in differentiating between solid/multicystic and unicystic variants, which have distinct prognostic implications [2]. This distinction underscores the importance of 3D imaging modalities in accurately classifying the lesion, assessing cortical plate perforation, and determining surgical margins.

Due to its high recurrence rate, management of ameloblastoma remains a central clinical challenge. Treatment approaches are broadly categorized as conservative or radical, each presenting a distinct tradeoff. Conservative treatment, usually involving enucleation and curettage (sometimes with chemical adjunctive therapy), offers excellent functional and aesthetic outcomes with minimal initial morbidity, but it is usually reserved only for specific subtypes of the unicystic variant that have lower recurrence potential. Specifically, extensive systematic reviews have established that recurrence rates are approximately three times higher following conservative treatment compared to radical approaches for the remaining variants. Conversely, radical surgical resection, specifically segmental or marginal resection with 1 cm bony margins, is widely regarded as the most reliable and curative solution. In addition to 1 cm bony margins, it is suggested to take at least one uninvolved anatomic barrier. For instance, if the lesion is eroding through the cortex of the mandible, the periosteum should be included in the resection as the one uninvolved anatomical barrier. Clinical data supports this approach, with retrospective reviews demonstrating recurrence rates of 0% for resected lesions, confirming its role in achieving long term disease control [3]. Gasparro et al. (2024) conducted an umbrella review comparing conservative versus radical approaches, concluding that while conservative treatment may preserve more normal anatomy and reduce initial morbidity, it carries a significantly higher recurrence risk. In contrast, radical resection provides superior long-term control and improved quality of life due to the lower likelihood of repeat interventions [4]. These findings align with the management approach selected in the case presented, where a resection was performed to minimize recurrence risk. Furthermore, Lalchandani et al. (2024) underscore the importance of early detection and multidisciplinary management, noting that ameloblastomas can recur many years after treatment if surveillance is inadequate. Lifelong follow-up with periodic imaging is essential to detect recurrence at an early, manageable stage [1].

While radical resection provides superior disease control, it inevitably creates significant bony defects, which can result in severe functional impairment of speech, mastication, and swallowing as well as aesthetic disfigurement. The subsequent need for complex reconstruction has traditionally made this approach daunting for larger defects, but modern surgical techniques and technological advances have dramatically improved efficiency while simultaneously decreasing morbidity. Current surgical protocols employ Virtual Surgical Planning (VSP) for fabrication of patient-specific custom cutting guides for precise osteotomies and custom titanium hardware, both of which improve accuracy and efficiency in the operating room. Chen et al. (2024) emphasized that modern reconstructive techniques, including microvascular free flap reconstruction and the use of patient-specific implants, enable restoration of mandibular continuity and facial symmetry with favorable long-term outcomes. Their 13-year retrospective review supports that comprehensive surgical resection combined with immediate reconstruction yields optimal functional recovery and patient satisfaction [3].

Reconstruction of bony defects involves the use of either vascularized or non-vascularized bone grafts. The workhorse of the vascularized bone graft has proven to be the free fibula flap, whereas the workhorse for non-vascularized grafting has traditionally been the anterior iliac crest bone graft. However, even in the setting of a good soft tissue bed, non-vascularized grafts are limited by the amount of autogenous bone you can harvest. This limits the size of the defect you can restore. Traditionally, the quantity of autogenous bone that can be harvested from a unilateral anterior iliac crest is able to restore defects up to 5 cm in length. Larger defects would require a posterior iliac crest bone graft, multiple autogenous bone harvest sites, or a fibula free flap reconstruction.

Newer tissue engineering techniques utilize allogeneic bone graft as opposed to autogenous bone harvesting. This allograft is combined with rhBMP-2 and bone marrow aspirate concentrate, or BMAC. BMAC can easily be harvested from multiple sites, including the anterior or posterior iliac crests. The allograft acts as a matrix or scaffold, rhBMP-2 provides an osteoinductive cell signal, and BMAC provides mesenchymal and osteoprogenitor cells for osteogenesis. This tissue engineering triad is essentially a recipe for bone growth and provides many advantages to the traditional autogenous harvest. The BMAC harvest is minimally invasive compared to the autogenous bone harvest and thus reduces overall morbidity. Most importantly, the use of allograft allows you to overcome the limitation of the quantity of bone you can harvest when performing autogenous grafting. In essence, you are no longer limited by the amount of bone you can harvest, because you virtually have an unlimited supply of allograft that you can utilize. This allows for the reconstruction of much larger defects than were previously permitted with traditional autogenous methods. Of note, this potentially allows you to avoid the significant morbidity associated with a fibula free flap. The goal of immediate reconstruction is to restore the native bone contour, preserve facial symmetry, and establish a platform for future dental rehabilitation with osseointegrated implants [3]. Melville et al. (2023) demonstrated tissue engineering's high rate of successful reconstruction for large mandibular continuity defects, achieving comparable or even superior results to vascularized free flaps. Importantly, it should be noted that you can achieve a significantly superior amount of overall bone volume with tissue-engineered reconstruction compared to a fibula, which is typically much smaller than the native mandible. The combination between BMAC and rhBMP-2 enhances early bone formation and allows for reduced BMP dosage without compromising outcomes [5]. Their tissue engineering workflow aligns with the reconstructive technique used in the case presented, which further demonstrates its success.

In summary, the management of ameloblastoma should be guided by careful radiographic assessment, histopathological classification, and a multidisciplinary treatment approach. Radical resection remains the most predictable method for preventing recurrence, while advancements in reconstruction planning and techniques now mitigate many of the traditional morbidities associated with extensive surgery. Continued long-term monitoring remains essential to ensure durable outcomes and optimal quality of life for affected patients.

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