Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

AMELOBLASTOMA - A REVIEW OF LITERATURE

HARIVIGHNESH S*

Postgraduate Trainee, Department of Oral and Maxillofacial Surgery, Tagore Dental College and Hospital, Chennai. ORCID ID: 0000-0002-8228-147X, Corresponding Author Email ID: drharivighnesh@gmail.com

RIAZ RAHIM

Professor and Head, Department of Oral and Maxillofacial Surgery, Tagore Dental College and Hospital, Chennai.

PANDIYARAJAN P

Postgraduate Trainee, Department of Oral and Maxillofacial Surgery, Tagore Dental College and Hospital, Chennai. ORCID ID: 0000-0002-7573-1727

MOHAMMED HASSAIN Z

Postgraduate Trainee, Department of Oral and Maxillofacial Surgery, Tagore Dental College and Hospital, Chennai.

ASHIK AHAMED

Postgraduate Trainee, Department of Oral and Maxillofacial Surgery, Tagore Dental College and Hospital, Chennai.

Abstract

Ameloblastoma is the most common benign odontogenic tumor of epithelial origin. It exhibits a locally aggressive behaviour and high recurrence rate with multitude of factors involving in its molecular pathogenesis. It is generally asymptomatic and has a gradual growth pattern with little indication of swelling, it is commonly missed in the early stages. However, despite its benign origin, ameloblastoma is a locally aggressive tumour with potential malignant change. Therefore, the tumour should be removed completely to avoid recurrence and potential malignant transformation, with or without border preservation.

1. INTRODUCTION

Ameloblastoma is a benign tumour that arises in the mandible and upper jaw from epithelial cellular elements and dental tissues. Because ameloblastoma is generally asymptomatic and has a gradual growth pattern with little indication of swelling, it is commonly missed in the early stages. However, despite its benign origin, ameloblastoma is a locally aggressive tumour with potential malignant change. Therefore, the tumour should be removed completely to avoid recurrence and potential malignant transformation, with or without border preservation. The mandible is an integral part of the human facial look and plays an essential role in orofacial function. As a result, mandibular bone abnormalities can cause oral function issues, aesthetic issues, and psychological issues.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

2. PATIENT PRESENTATION

Ameloblastomas are benign odontogenic tumours that can be locally aggressive and metastasize [1]. They are most common in the mandible, especially around the angle. They are most common between the third and fifth decades, with a roughly equal male-to-female ratio. The incidence is unknown, but the literature suggests that it varies geographically. According to most studies, they are the second most common odontogenic tumours after odontomas [2].

Up to 80% of ameloblastoma cases in Reichart PA et al. 3677 case series occur in the mandible, with a preference for the posterior mandibular region [3]. In addition, it has been linked to unerupted third molar teeth, particularly in unicystic cases [4].

According to R. Becelli et al., the most common presentation for ameloblastoma is a painless swelling of the mandible or maxilla; in a series of 60 patients, up to 35% had their lesion identified as an incidental finding on imaging [4]. Pain with rapid growth could be a sign of the rare malignant ameloblastoma. Tooth displacement and root resorption are uncommon but reported in up to 25% of desmoplastic ameloblastomas in a study of 24 cases by Schafer DR et al. Perineural invasion is rare, with only a few cases reported. Only a few cases have been reported as caused by sinonasal cavities [5].

Slootweg PJ et al. concluded that desmoplastic ameloblastomas frequently occur in the mandible or maxilla's anterior or premolar regions. Ameloblastic carcinomas prefer the mandible over the maxilla as well. Maxillary ameloblastomas are also more common in the posterior molar region [6].

Peripheral ameloblastoma manifests as an extraosseous soft tissue lesion on the gingiva with no bony involvement. It frequently appears as a painless sessile, firm, exophytic growth with a warty appearance. It affects people of all ages, ranging from 9 to 92; males outnumber females, and 70% of cases occur in the mandible.

3. DIAGNOSTIC EVALUATION

Imaging and possibly a biopsy are part of the preoperative diagnostic evaluation. Ameloblastomas, except for the peripheral subtype, arise in the bone and are thus commonly detected incidentally on dental X-rays (orthopantomography) or plain films. X-rays typically show a lytic lesion with scalloped margins, resorption of tooth roots, and impacted molars (unicystic). The most common type of ameloblastoma, the multilocular/solid type, has the classic "soap bubble" appearance [7,8].

Despite occasionally being sufficient for a thorough evaluation, plain X-rays lack sensitivity and specificity for the degree of invasion of the bone and soft tissues. Computed tomography (CT) is the most helpful diagnostic imaging modality, typically showing well-defined radiolucent uni/multilocular expansile lesions, according to R. Becelli et al. In their case report, Cohen MA et al. mentioned that CT is useful for evaluating cortical destruction (revealing a window for biopsy) and soft tissue extension, identifying the full extent of the tumour to support surgical planning [9]. According to Fujita

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

M et al. [10], MRI may provide more comprehensive information than CT regarding soft tissue extension and marrow extension beyond the lytic bone cavity.

MRI is beneficial for maxillary ameloblastomas because it helps characterise the orbit, paranasal sinuses, and skull base extension. Because desmoplastic ameloblastomas have poorly defined soft tissue borders and are frequently misdiagnosed as fibro-osseous lesions, MRI should be considered [11]. PET-CT is usually reserved for metastatic ameloblastoma, where it can help with distant metastasis staging.

According to Dunfee BL et al., imaging findings are characteristic, and histology is used to confirm the diagnosis. A biopsy before treatment may be helpful to avoid unnecessary operations on lesions of alternative aetiology that should be treated alternatively or observed, such as osteomyelitis, cystic fibrous dysplasia, giant cell tumour, ossifying fibroma, multiple myeloma, rare sarcomas. In malignant ameloblastomas, biopsies also allow for accurate preoperative staging. Furthermore, over-treatment of benign dentigerous cysts that cannot be distinguished from some unicystic ameloblastomas must be avoided. These cysts cannot be diagnosed using FNA and require open biopsy in the form of curettage. It is determined by a biopsy and should be performed at the beginning of the case.

Maxillary ameloblastomas frequently involve adjacent soft tissue, similar to adenocarcinomas and squamous cell carcinomas. Fine needle aspiration can be obtained through an imaging-identified window of cortical erosion or the dental socket. An incisional biopsy can provide a more accurate diagnosis, but it requires disruption of the mucosa, which must be removed during surgery. Peripheral ameloblastomas are not covered by bone and can be easily biopsied. [12]

4. HISTOPATHOLOGY

Ameloblastoma histopathologically resembles normal odontogenic enamel epithelium and ectomesenchyme. Odontogenesis is characterized by chronological and reciprocal interactions between ectomesenchymal cells derived from the neural crest and the oral cavity lining epithelium [13].

The ameloblastic epithelium is thought to be formed by (1) cells from the rests of the enamel organ, but also by (2) cells from Hertwig's sheet or epithelial cell rest of Malassez, (3) epithelial boundary of an odontogenic cyst, notably a dentigerous cyst, (4) basal cells of the oral mucosa, and (5) heterotopic epithelial from other parts of the body, possibly pituitary.

The WHO classification of ameloblastomas in 2005 includes four subtypes. The commonest one is the solid/multicystic type in Reichart PA et al., 3677 case series, accounting for 91% of the ameloblastomas. The unicystic type accounts for 6%, extraosseous ameloblastoma accounts for 2%, and the desmoplastic type accounts for 1% [3].

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

The most aggressive clinical/pathologic association, according to Gardner DG et al., is seen in the solid/multicystic type, which is associated with the highest recurrence rate of up to 90% with conservative operations such as enucleation and curettage. On the other hand, plexiform unicystic ameloblastoma is an ameloblastoma variant with a low recurrence rate following enucleation [14].

The most benign type is unicystic, subdivided into intraluminal and intramural subtypes. The intraluminal unicystic subtype does not invade the supporting connective tissue, has a lower recurrence rate, and may be the only histology amenable to conservative surgical treatment [14].

Based on 100 cases of desmoplastic ameloblastomas, Philipson HP found a higher prevalence of 4-13% of resected ameloblastomas, which contradicts WHO data [15].

According to Larsson's case series analysis, unicystic and desmoplastic ameloblastomas are central because they are centred within the marrow space and encapsulated by bone. In contrast, peripheral ameloblastomas are extra-osseous and do not involve the underlying bone. They have similar histology, but this is the only ameloblastoma that can be evaluated during an oral exam due to a pedunculated or exophytic lesion on the gingiva [16]. Cellular atypia and mitotic activity are uncommon in any histologic subtype of ameloblastoma. Any increase in either parameter should raise the possibility of a malignant process like ameloblastic carcinoma or odontogenic sarcoma. Ameloblastoma has microscopic patterns such as follicular, plexiform, acanthomatous, spindle, basal cell-like, desmoplastic, and granular cells. Patterns can be uniform or mixed.

The WHO classification excludes malignant subtypes of ameloblastomas. Despite this, it is believed that these tumours can arise from nothing or progress from a benign form.

Elzay, Slootweg, and Muller outlined two types of ameloblastoma: metastatic ameloblastoma and ameloblastic carcinoma, which account for 2% of all. Metastatic ameloblastoma typically has well-differentiated benign histology similar to the solid/multicystic type at the primary site. However, additional foci of the benign histology are identified in location(s) distant from the primary and are considered Metastasis.

In 2009, Kruse et al. [17] published a classification system for malignant ameloblastomas, dividing ameloblastic carcinomas into three subtypes, with the primary distinction based on the presence of a known primary neoplasm. The most aggressive sub-types is ameloblastic carcinoma, identified by malignant histologic characteristics like increased or abnormal mitoses and cytological atypia [18].

Ameloblastic carcinoma can be identified without regard to Metastasis based on the primary site's histology. However, it has been reported that distant metastases can develop four months to 12 years after surgery. The lung is the site of metastatic ameloblastomas and ameloblastic carcinomas most frequently (70–85% of all cases), followed by bone, liver, and brain. Regional neck metastasis is more common in the malignant transformation of primary tumours from the mandible and is reported to make up 35% of metastatic sites in one series. The lengthy course of the tumour, frequent

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

recurrences often managed conservatively, and late-appearing metastatic illness is common characteristics among individuals with malignant transformation of their benign ameloblastoma[19,1,21].

Despite previous supposition that the route of lung metastasis was topical by aspiration of tumour from numerous trans-oral conservative surgeries, the pattern of lung metastasis does not favour the right middle and lower lobes as seen with aspiration. Instead, Metastasis is thought to occur by lymphatic (rare) or hematogenous spread [22].

5. TREATMENT

Surgical treatment is typically used to treat ameloblastomas. However, the extent of resection has historically been contentious, with two surgical options: radical and conservative approaches. The first involves enucleation/curettage of the bony cavity, while the second is a radical procedure with sufficient margins. Enucleation has the advantage of being an outpatient procedure that does not require reconstruction and can be performed with less invasive techniques. In the past, simple enucleation had a 60-90% recurrence rate, and it is currently believed that this treatment method does not affect managing multicystic ameloblastomas [4, 23, 24]. However, because the intraluminal subtype, which requires an open biopsy for diagnosis, does not exhibit an invasive pattern, the use of this procedure for unicystic ameloblastomas, which are seen in the paediatric population, is still controversial [25]. In addition, benign dentigerous cysts can be treated with straightforward enucleation and mimic unicystic ameloblastomas.

5.1. Ameloblastomas in Children

In children, ameloblastomas are uncommon. However, according to published reports, unicystic ameloblastomas are more common in children. These reports advise relatively conservative treatment in the beginning and more aggressive therapy for recurrences [26,27]. Sampson DE and Pogrel MA suggested that enucleation and curettage be used as the initial treatment, followed by physiochemical therapy or peripheral ostectomy in the mandible and localised resection in the maxilla [28].

5.2. Unicystic Ameloblastoma

When Robinson and Martinez first described unicystic ameloblastoma in 1977, it was thought to be less aggressive, and the recommended treatment was straightforward enucleation [29]. According to whether the cystic lesion had an intraluminal plexiform proliferation of the epithelial lining (intra-luminal unicystic ameloblastoma), an intraluminal plexiform invasion of the supporting connective tissue (mural uni-cystic ameloblastoma), or a cystic lesion with the epithelial invasion of the supporting connective tissue in either a follicular or plexiform form. After this reclassification, Philipsen HP et al. suggested that the first two subgroups were nonaggressive and could be treated with enucleation. However, the third subgroup (the intramural group) required more aggressive treatment. This review of 193 cases was conducted in 1998. However, once the lesion has been removed, this differentiation can typically only be made retrospectively from histological

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

material [31]. Because many solid ameloblastomas contain a cystic component and because multicystic lesions behave more like solid ameloblastomas, it is frequently challenging to distinguish between a unicystic ameloblastoma and a multicystic ameloblastoma. It is probably for these reasons that more recent studies have shown that simple enucleation of the so-called unicystic ameloblastoma is associated with a recurrence rate that may be as high as 60% and is similar to historical recurrence rates noted from enucleation of solid and multicystic ameloblastomas [32,33,34,25]. There is still a feeling that unicystic ameloblastoma is inherently less aggressive than its solid counterpart and should respond to a less aggressive treatment modality. However, simple enucleation may not be appropriate.

For this reason, Curi MM et al. and Pogrel MA et al. advocated cryotherapy to limit recurrence rates of unicystic ameloblastomas[35,36]. In addition, Chapelle KA et al. and Rosenstein et al. proposed to extend the procedure intra-operative to include tissue fixatives such as Carnoy's solution [37,38], drilling [36] and cautery [39]. The outcomes of the procedures above demonstrate decreased recurrence rates.

Data from 82 ameloblastoma specimens showed microscopic tumour extension 2–8 mm (mean of 4.5 mm) beyond the radiographic boundaries of the tumour by Carlson ER [40]. Hence, the recommended bone margins are 1–1.5 cm for unicystic and 1.5–2 cm for solid/multicystic histological types and provide increased cure rates [4, 41, 42]. According to Ndukwe KC et al., Ameloblastic carcinoma requires 2–3 cm bone margins [43].

5.3. Solid and Multicystic Ameloblastoma

Jordan RC et al., in 2003, by a review of 307 cases, suggested that solid and multicystic ameloblastomas should be treated similarly for prognostic and treatment purposes. However, the histological subtypes, which include the follicular, plexiform and granular cell variants, are only of histological interest and do not determine the prognosis or treatment [15].

Previously in a meta-analysis in 1987, Cranin A N et al. suggested that the granular cell might be more aggressive, and Philipsen HP et al. in 2001, based on 100 cases from the literature, desmoplastic variants might be more aggressive, which is contrary to the current literature [44].

The evidence suggests that solid and multicystic ameloblastomas should be regarded as benign but aggressive neoplasms with a potentially high recurrence rate. It is impossible to find recent studies on solid or multicystic ameloblastomas treated by enucleation or curettage, but historical articles suggest a recurrence rate of 60–80% with local treatment only.

According to Gardener DG et al., recurrence can occur 20 years after initial treatment but usually occurs 2–5 years later [45]. Data from 82 ameloblastoma specimens showed microscopic tumour extension 2–8 mm (mean of 4.5 mm) beyond the radiographic boundaries of the tumour by Carlson ER [40]. Hence, the recommended bone margins

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

are 1.5–2 cm for solid/multicystic histological types and provide increased cure rates [4, 41, 42].

In the case of lesions with soft tissue extension, this means at least one tissue plane of clearance around such lesions. Dissections must be supra-periosteal in the case of lesions perforating the buccal or lingual plate. In the mandible, it may be possible to leave 1 cm margins with a marginal resection, but in most cases, segmental resection is required.

The inferior alveolar nerve is often sacrificed and can be reconstructed with a nerve graft if indicated. However, in most cases, patients tolerate the loss of the inferior alveolar nerve without difficulty. Techniques have been described for segmentally resecting the mandible with nerve preservation, but this runs the risk of recurrence of the ameloblastoma from cell remnants left adherent to the inferior alveolar nerve, according to Kuriakose MA et al. [46]

In the maxilla, 1-cm margins commonly result in perforation of the sinus and often the nasal cavity and possibly even the orbit and infratemporal fossa. In general, maxillary lesions can be more troublesome than mandibular lesions because although they are histologically identical, lesions in the posterior part of the maxilla have different pathways to infiltrate and can spread to the posterior wall of the maxilla and into the pterygomaxillary space.

According to Zwahlen RA et al. and Nastri AL et al., Infiltration of the greater palatine canal to the base of the skull has also been described, and partial or complete maxillectomy may be required with continuity resection of the pterygoid plates [47,48].

5.4. Peripheral Ameloblastoma

There are few studies of peripheral ameloblastoma. It appears as an extraosseous soft tissue lesion generally on the gingiva with no bony involvement. It is histologically identical to intraosseous ameloblastoma but may arise from the dental lamina's surface epithelium or extraosseous remnants. It responds well to local excision with no recurrence, which could be considered the extraosseous equivalent of enucleation [49]. Peripheral ameloblastoma can be removed with 1 cm soft tissue margins and a cuff of the uninvolved alveolar bone (marginal mandibulectomy) to ensure a proper deep margin.

5.5. Malignant Variants

Two malignant variants of ameloblastoma have been described. One histologically resembles a solid ameloblastoma but shows its malignant status by the presence of metastases (often to the lungs). The second type shows histological markers for malignancy (pleomorphism, mitosis), whether or not it has metastasized [50]. The latter variant often shows dedifferentiation if it recurs and has a worse prognosis [1,51]. Therefore, a full metastatic workup is recommended, and surgical treatment should be radical.

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

Data from 82 ameloblastoma specimens showed microscopic tumour extension 2–8 mm (mean of 4.5 mm) beyond the radiographic boundaries of the tumour by Carlson ER [40]. Hence, according to Ndukwe KC et al., Ameloblastic carcinoma requires 2–3 cm bone margins [43]. Radiation therapy may play a role in managing malignant ameloblastoma postoperatively [52,53,54].

5.6. Alternative Techniques

Alternative procedures like enucleation or curettage supported by a method to remove any remaining cells have been explored due to the morbidity of segmental and total resection of the mandible or the maxilla for a basically benign but locally aggressive lesion.

Practices described for this purpose include using liquid nitrogen cryotherapy, according to Curi MM and Pogrel MA et al. [35,36] and using tissue fixatives such as Carnoy's solution, according to Chapelle KA et al. [38]. The evidence base for these treatments is small, but they have promise in smaller, more localized, more accessible, completely intrabony lesions. However, these alternative treatments are more difficult to apply to the maxilla because they cannot usually be used in the maxillary sinus or nasal cavity, which is often involved.

Gardner DG et al. suggested frozen soft tissue sections, especially overlying cortical perforation and bone marrow margins [55, 56, 57]. Intra-operative frozen sections demonstrate 95–98 % accuracy with a false negative rate of 3.8 % attributed to inadequate sampling versus misinterpretation by the pathologist [55,58].

6. RECURRENCES

Most studies stress that inadequate treatment of ameloblastoma will result in recurrence, but few articles describe the management of recurrent ameloblastomas. According to Muller et al., in cases of inadequate surgery, the follicular type of ameloblastoma recurs more quickly than the plexiform type, and the multicystic or solid form recurs more often than the unicystic form. [59]

According to Olaitan AA et al., the recommended treatment for recurrences is radical surgery, particularly with maxillary ameloblastoma, where spread can occur to structures posterosuperior to the maxilla [60]. Any soft tissue extension evident in the recurrence needs special attention. The treatment of recurrent ameloblastoma excludes enucleation.

After treatment for recurrent ameloblastoma with histologically positive margins, radiation therapy may be useful in some cases. [3,29,54]. Carlson et al. suggested that surgeons rely on preoperative imaging to correlate the tumour's boundaries with palpable surgical landmarks. Some use calculations from the CT to determine the proper location for osteotomies, ensuring adequate margins. In addition, several groups have used intra-operative diagnostic assistance to evaluate bony margins, including plain specimen radiography [55,56,57].

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

7. RADIOTHERAPY AND CHEMOTHERAPY:

Traditionally, radiation therapy is controversial in the management of ameloblastoma. According to the studies and case reports by Anastassov GE et al., Miyamoto CT et al. and Ueda M et al., it may play a role in managing malignant ameloblastoma postoperatively. It may be of some value following surgery for recurrent ameloblastoma with histologically positive margins, but the outcomes do not have promising and prominent results.[52.53,54]

The possible efficacy of radiotherapy must be weighed against the risk of future radiation-induced malignancies and other long-term sequelae of radiation therapy. More work is needed to validate this treatment option [61].

Despite these experiences, some studies by Slootweg PJ et al. and Philip M et al. advocate for adjuvant radiation in ameloblastic carcinoma, though the data are mixed [6,62].

Systemic chemotherapy has been attempted several times, employing numerous agents and combinations. For example, Amzerin M et al. reported that ameloblastoma might be sensitive to platinum-based agents [63]. Much like radiotherapy, however, only with continuous reporting of empirical case-based data will the role of systemic chemotherapy be evaluable in this rare entity. Furthermore, with advances in understanding the molecular pathogenesis of ameloblastoma, targeted agents with fewer systemic side effects may prove more valuable than traditional chemotherapeutic regimens.

8. RECONSTRUCTION

Mandibular ameloblastomas are advocated, which indicate a segmental resection that includes at least one adjacent uninvolved anatomic barrier for proper margins. The healthy mucosa overlying the cortical perforation is often removed as a margin [59]. Segmental resection of the mandible results in discontinuity of the jaw, which is stabilised to its previous position by titanium reconstruction plates to ensure proper occlusion. A fibular-free flap is used to restore bone continuity and allow for dental restoration. In cases of cortical erosion, there needs to be a 1 cm soft tissue margin along the mucosa of the oral cavity, and the fibular free flap skin paddle is used to line the oral cavity. Reconstructive outcomes show a high success rate for both aesthetics and functional outcomes.

For segmental defects of the mandible, vascularised free bone grafts are standard. The fibular free flap has the added advantage of reconstructing long-segment mandibular defects. In an exceedingly small percentage of patients, a rare vascular pattern to the lower extremity (Bilateral perineal arteria magna) precludes this flap. The iliac crest free flap is also an outstanding reconstructive choice for mandibular defects, allowing for dental restoration with the added advantage of harvesting internal oblique muscle for the reconstruction of the floor of the mouth. In addition, the iliac crest can be favoured for

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

mandibular angle defects eliminating the need for multiple osteotomies as seen with the fibula. [64,65,66].

In the mandible, significant bone defects may lead to functional impairment affecting swallowing or speech and causing aesthetic deformities. With the development of microsurgical techniques to harvest vascularised bone grafts, many researchers consider the fibula flap the workhorse for reconstructing significant segmental mandible defects.

As summarised by Ghara et al., the potential advantages of the fibula flap are as follows:

- It's straight shape and high mechanical resistance to pressure and torsion
- Rapid incorporation and healing of the highly vital flap due to the excellent perfusion
- Its composition, with a high content of cortical bone
- Its great length, which allows the bridging of significant defects
- The possibility of osteotomised it at various points allowing adaptation
- The relatively simple harvesting of the flap with conveniently sized blood vessels for anastomoses
- The low morbidity of the donor region.

Moreover, it can be elevated with skin and muscle as an osteomyocutaneous flap. [67]

According to Jose M et al. 2010 in a review of 117 patients, the first reconstructive option for significant mandibular defects (ramus plus body, body plus symphysis, or subtotal defects) is the free fibula osteofasciocutaneous free flap, and the average bone transfer measured 11.7cm. [68]

Hidalgo DA et al., Beppu M et al., Graham RG et al. and Munoz Guerra MF et al. have stated that large bony defects can be reconstructed satisfactorily with a free fibula flap. [50,38,69]

One of the disadvantages of the free fibula is the amount of soft tissue that can be harvested. In addition, the first report of Hidalgo mentioned a high incidence of failure of the skin paddle [70].

Anatomic studies and reports of sizeable clinical series have demonstrated that Hidalgo DA et al. and Beppu M et al. show the reliability of the skin paddle when oriented around the junction of the distal third to two-thirds.[50]

Some investigators, such as Rohner et al., advocate the iliac crest free flap as the ideal osseous flap for mandible reconstruction in dentate patients with adequate soft tissues. In their study published in 2003, when comparing the morbidity of the iliac crest and fibula-free flap donor sites, they found no relevant data supporting the frequently quoted increased morbidity of iliac-free flaps. Nevertheless, their study focused on orthopaedic outcomes.[71]

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

According to Jose M et al. study, one of the most significant disadvantages of this flap, especially when harvesting the internal oblique muscle, is the weakening of the abdominal wall, which may lead to an abdominal hernia. In the 117 case series, more than 85% of patients had normal leg function. Calf paresthesias (21.4%) and claw-toe deformity (19.8%) were the most frequent complications recorded. [68]A few technical details influenced this positive outcome. By selectively dissecting the skin paddle perforators in the posterior crural septum, no muscular cuff is needed to ensure the vascularity of the skin, resulting in less morbidity at the donor site. According to Wei et al., Flexor hallucis longus and tibialis posterior are routinely sutured to the interosseous membrane to provide a new insertion to the muscle, thereby highly reducing the complication. Early rehabilitation is recommended in all patients to avoid scarring contracture and muscle atrophy.

These data are similar to those published by Jaquiery et al. [1] and Gurlek et al.[44] Approximately 80% of men and women reported negligible limitations, and more than 75% judged the aesthetic outcome of the donor site as good or excellent.

Zlotolow I et al. and several others have advocated harvesting a large cuff of soleus muscle to fill the depressed area underneath the bony contour. However, the long-term result could be more predictable regarding subsequent muscle atrophy. [45] Moreover, it increases donor site morbidity significantly.

The use of implant restorations based on free fibula flaps was first reported in the early 1990s by Zlotolow I et al. Since then, several studies have evaluated the different prosthetic options available and the long-term results. Sound long-term effects have been reported using dental implants in fibula flaps. [45,72]

Ghara et al. reported four failures of 121 implants placed in 30 patients with free fibula flap reconstruction. They highlighted the significant improvement in the quality of life of their patients. [67]

In the 117 case series by Jose M et al., 88 patients (75.2%) were restored with a removable denture, 20 patients (17%) remained edentulous, and just nine patients (7.7%) received an implant-based restoration. Unfortunately, most patients refused to undergo further operations or could not afford the cost.

According to Disa JJ et al., when the fibula-free flap is compared with the scapular or radial osteocutaneous free flap, one main advantage is the better bone quality. It is perfectly able to support prosthetic implant rehabilitation. Radial forearm flap also has many desirable characteristics, but it is associated with an unacceptably high fracture rate in the residual radius.

There are case series reported by Neligan PC et al. and Thoma A et al. l with good results for mandible reconstruction with the radial forearm osteofasciocutaneous flap or scapular osteocutaneous flap [16,32].

Xi'an Shiyou Daxue Xuebao (Ziran Kexue Ban)/
Journal of Xi'an Shiyou University, Natural Sciences Edition
ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

The most significant disadvantage of the scapular flap, according to Shpitzer T et al., is that it takes much longer than a fibula flap because a 2-team approach is impossible. In addition, significantly less bone is available than with a fibula flap. [46]

Therefore, although large series have reported good results for mandible reconstruction with the radial forearm osteofasciocutaneous flap or scapular osteocutaneous flap, neither is considered a first reconstruction option.

Maxillary lesions are removed through various approaches for partial maxillectomy, with the resultant defect allowing communication among the oral cavity, paranasal sinuses, and/or nasal cavity, causing alterations in speech and swallowing as air and food escape via the fistula during eating and talking. The extent of the soft tissue involvement is demonstrated by preoperative MRI, with the surgical margins limited by potential morbidity from proximity or involvement of vital structures, including the orbit, skull base, cranial nerves and/or carotid artery. Commonly, these defects are not reconstructed with a free flap to avoid covering a potential recurrence site. Instead, a skin graft is used to line the cavity, and the patient is fitted with an obturator, allowing for easy access to the resection bed during surveillance.

9. CONCLUSION

Unicystic ameloblastoma is generally not possible to make a diagnosis before surgical intervention (often, an odontogenic cyst is suspected preoperatively). The subtype cannot be identified preoperatively even when a unicystic ameloblastoma is diagnosed on an initial biopsy. Simple enucleation appears to result in an unexpectedly high recurrence rate of up to 60%. The recommended treatment for a known unicystic ameloblastoma may be enucleation, curettage and physicochemical therapy with liquid nitrogen or Carnoy's solution. If liquid nitrogen or Carnoy's solution is unavailable, an en-bloc resection is recommended.

Solid and multicystic types of ameloblastomas have a high recurrence rate following simple enucleation (60–80%). However, surgical resection of solid or multicystic ameloblastoma with 1 cm of bony margin and one tissue plane margin in soft tissue is reported to have up to zero recurrence rate. Treatment options with enucleation and peripheral ostectomy may, along with physicochemical treatments, including liquid nitrogen or Carnoy's solution, have suggested promising results in initial studies, but long-term effects are not available.

Although histologically identical, peripheral ameloblastoma represents a different lesion in the gingiva's soft tissue only and is essentially benign. In addition, it responds well to local excision.

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

References

1. Henderson JM, Sonnet JR, Schlesinger C, Ord RA. Pulmonary metastasis of ameloblastoma: case report and review of the literature. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999: 88: 170–176. “https://doi.org/10.1016/s1079-2104(99)70113-7”
2. Daley TD, Wysocki GP, Pringle GA. Relative incidence of odontogenic tumors and oral and jaw cysts in a Canadian population. Oral Surg Oral Med Oral Pathol 1994: 77: 276–280.
3. Reichart PA, Philipsen HP, Sonner S (1995) Ameloblastoma: biological profile of 3677 cases. Eur J Cancer B Oral Oncol 31B(2):86–99
4. Becelli R, Carboni A, Cerulli G, Perugini M, Iannetti G (2002) Mandibular ameloblastoma: analysis of surgical treatment carried out in 60 patients between 1977 and 1998. J Craniofac Surg 13(3):395–400
5. Schafer DR, Thompson LD, Smith BC, Wenig BM (1998) Primary ameloblastoma of the sinonasal tract: a clinicopathologic study of 24 cases. Cancer 82(4):667-674
6. Slootweg PJ, Muller H (1984) Malignant ameloblastoma or ameloblastic carcinoma. Oral Surg Oral Med Oral Pathol 57(2):168–176
7. Singer SR, Mupparapu M, Philipone E (2009) Cone beam computed tomography findings in a case of plexiform ameloblastoma. Quintessence Int 40(8):627–630
8. Underhill TE, Katz JO, Pope TL Jr, Dunlap CL (1992) Radiologic findings of diseases involving the maxilla and mandible. AJR Am J Roentgenol 159(2):345350. doi:10.2214/ajr. 159.2.1632353
9. Cohen MA, Hertzanu Y, Mendelsohn DB (1985) Computed tomography in the diagnosis and treatment of mandibular ameloblastoma: report of cases. J Oral Maxillofac Surg 43(10):796–800
10. Fujita M, Matsuzaki H, Yanagi Y, Hara M, Katase N, Hisatomi M, Unetsubo T, Konouchi H, Nagatsuka H, Asaumi JI (2013) Diagnostic value of MRI for odontogenic tumours. Dentomaxillofac Radiol 42(5):20120265. doi:10.1259/dmfr.20120265
11. Kawai T, Kishino M, Hiranuma H, Sasai T, Ishida T (1999) A unique case of desmoplastic ameloblastoma of the mandible: report of a case and brief review of the English language literature. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 87(2):258–263
12. Dunfee BL, Sakai O, Pistey R, Gohel A (2006) Radiologic and pathologic characteristics of benign and malignant lesions of the mandible. Radiographics 26(6):1751–1768. doi:10.1148/rg. 266055189
13. Chai Y, Jiang X, Ito Y, Bringas P Jr, Han J, Rowitch DH, Soriano P, McMahon AP, Sucov HM (2000) Fate of the mammalian cranial neural crest during tooth and mandibular morphogenesis. Development 127(8):1671–1679
14. Gardner DG, Corio RL (1984) Plexiform unicystic ameloblastoma. A variant of ameloblastoma with a low-recurrence rate after enucleation. Cancer 53(8):1730–1735
15. Philipsen HP, Reichart PA, Takata T (2001) Desmoplastic ameloblastoma (including ‘‘hybrid’’ lesion of ameloblastoma). Biological profile based on 100 cases from the literature and own files. Oral Oncol 37(5):455–460
16. Larsson A, Almeren H (1978) Ameloblastoma of the jaws. An analysis of a consecutive series of all cases reported to the Swedish Cancer Registry during 1958–1971. Acta Pathol Microbiol Scand A 86A(5):337–349
17. Kruse AL, Zwahlen RA, Gratz KW (2009) New classification of maxillary ameloblastic carcinoma based on an evidence-based literature review over the last 60 years. Head Neck Oncol 1:31. doi:10.1186/1758-3284-1-31

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

18. Fernandes AM, Duarte EC, Pimenta FJ, Souza LN, Santos VR, Mesquita RA, de Aguiar MC (2005) Odontogenic tumors: a study of 340 cases in a Brazilian population. J Oral Pathol Medicine 34(10):583–587. doi:10.1111/j.1600-0714.2005. 00357.x
19. Dhir K, Sciubba J, Tufano RP (2003) Ameloblastic carcinoma of the maxilla. Oral Oncol 39(7):736–741
20. Champy M, Loddé JP, Schmidt R, Jaeger JH, Muster D. Mandibular osteosynthesis by miniature screwed plates via buccal approach. J Maxillofac Surg 1978;6:14-21.
21. Bruce RA, Jackson IT (1991) Ameloblastic carcinoma. Report of an aggressive case and review of the literature. J Craniomaxillofac Surg 19(6):267–271
22. Kunze E, Donath K, Luhr HG, Engelhardt W, De Vivie R (1985) Biology of metastasizing ameloblastoma. Pathol Res Pract 180(5):526–535. doi:10.1016/S0344-0338(85)80017-0
23. Olaitan AA, Adeola DS, Adekeye EO (1993) Ameloblastoma: clinical features and management of 315 cases from Kaduna, Nigeria. J Craniomaxillofac Surg 21(8):351–355
24. Nakamura N, Higuchi Y, Mitsuyasu T, Sandra F, Ohishi M (2002) Comparison of long-term results between different approaches to ameloblastoma. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 93(1):13–20
25. Rosenstein T, Pogrel MA, Smith RA, Regezi JA (2001) Cystic ameloblastoma behaviour and treatment of 21 cases. J Oral Maxillofac Surg 59(11):1311–1316. doi:10.1053/joms.2001. 27522
26. Ord RA, Blanchaert Jr RH, Nikitakis NG, Sauk JJ. Ameloblastoma in children. J Oral Maxillofac Surg 2002: 60: 762– 770 discussion, 770-1.
27. Takahashi K, Miyauchi K, Sato K. Treatment of ameloblastoma in children. Br J Oral Maxillofac Surg 1998: 36: 453– 456.
28. Sampson DE, Pogrel MA. Management of mandibular ameloblastoma: the clinical basis for a treatment algorithm. J Oral Maxillofac Surg 1999: 57: 1074–1077 discussion 1078-9.
29. Robinson L, Martinez MG. Unicystic ameloblastoma: a prognostically distinct entity. Cancer 1977: 40: 2278–2285.
30. Ackermann GL, Altini M, Shear M. The unicystic ameloblastoma: a clinicopathological study of 57 cases. J Oral Pathol1988: 17: 541–546.
31. Philipsen HP, Reichart PA. Unicystic ameloblastoma. A review of 193 cases from the literature. Oral Oncol 1998: 34: 317–325.
32. Lau SL, Samman N. Recurrence related to treatment modalities of unicystic ameloblastoma: a systematic review. Int J Oral Maxillofac Surg 2006: 35: 681–690.
33. Li TJ, Wu YT, Yu SF, Yu GY. Unicystic ameloblastoma: a clinicopathologic study of 33 Chinese patients. Am J Surg Pathol 2000: 24: 1385–1392.
34. Olaitan AA, Adekeye EO. Unicystic ameloblastoma of the mandible: a long- term follow-up. J Oral Maxillofac Surg 1997: 55: 345–348 discussion 349-50.
35. Curi MM, Dib LL, Pinto DS (1997) Management of solid ameloblastoma of the jaws with liquid nitrogen spray cryosurgery. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 84(4):339–344
36. Pogrel MA (1993) The use of liquid nitrogen cryotherapy in the management of locally aggressive bone lesions. J Oral Maxillofac Surg 51(3):269–273
37. Muller H, Slootweg PJ (1985) The ameloblastoma, the controversial approach to therapy. J Maxillofac Surg 13(2):79–84

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

38. Chapelle KA, Stoelinga PJ, de Wilde PC, Brouns JJ, Voorsmit RA (2004) Rational approach to diagnosis and treatment of ameloblastomas and odontogenic keratocysts. Br J Oral Maxillofac Surg 42(5):381–390. doi:10.1016/j.bjoms.2004.04.005
39. Huffman GG, Thatcher JW (1974) Ameloblastoma the conservative surgical approach to treatment: report of four cases. J Oral Surg 32(11):850–854
40. Carlson ER (2000) Ameloblastoma. In: Symposium on odontogenic tumours, AAOMS 82nd annual meeting and scientific sessions, San Francisco, CA, September 23, 2000
41. Waldron CA (1987) A histopathologic study of 116 ameloblastomas with special reference to the desmoplastic variant. Oral Surg Oral Med Oral Pathol 63(4):441–451
42. Vayvada H, Mola F, Menderes A, Yilmaz M (2006) Surgical management of ameloblastoma in the mandible: segmental mandibulectomy and immediate reconstruction with free fibula or deep circumflex iliac artery flap (evaluation of the long-term aesthetic and functional results). J Oral Maxillofac Surg 64(10):1532–1539. doi:10.1016/j.joms.2005.11.065
43. Ndukwe KC, Adebiyi EK, Ugboko VI, Adeyemo WL, Ajayi FO, Ladeinde AL, Okojie VN, Ajike SO, Olasoji HO (2010) Ameloblastic carcinoma: a multi center Nigerian study. J Oral Maxillofac Surg 68(9):2111–2114. doi:10.1016/j.joms.2009.09.028
44. Jordan RC, Regezi JA. Oral spindle cell neoplasms: a review of 307 cases. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003: 95: 717–724.
45. Gardner DG, Pecak AM. The treatment of ameloblastoma based on pathologic and anatomic principles. Cancer 1980: 46: 2514–2519.
46. Kuriakose MA, Lee JJ, De Lacure MD. Inferior alveolar nerve-preserving mandibulectomy for non-malignant lesions. Laryngoscope 2003: 113: 1269–1273.
47. Nastri AL, Wiesenfeld D, Radden BG, Eveson J, Scully C. Maxillary ameloblastoma: a retrospective study of 13 cases. Br J Oral Maxillofac Surg 1995: 33: 28–32.
48. Zwahlen RA, Gratz KW. Maxillary ameloblastomas: a review of the literature and of a 15-year database. J Craniomaxillofac Surg 2002: 30: 273–279
49. Philipsen HP, Reichart PA, Nikai H, Takata T, Kudo Y. Peripheral ameloblastoma: biological profile based on 160 cases from the literature. Oral Oncol 2001: 37: 17–27.
50. Avon SL, Mc Comb J, Clokie C. Ameloblastic carcinoma: case report and literature review. J Can Dent Assoc 2003: 69: 573–576.
51. Zwahlen RA, Vogt P, Fischer FS, Gratz KW. Case report: myocardial metastasis of a maxillary malignant ameloblastoma. J Oral Maxillofac Surg 2003: 61: 731–734.
52. Anastassov GE, Rodriguez ED, Adamo AK, Friedman JM. Case report. Aggressive ameloblastoma treated with radiotherapy, surgical ablation and reconstruction. J Am Dent Assoc 1998: 129: 84–87.
53. Miyamoto CT, Brady LW, Markoe A, Salinger D. Ameloblastoma of the jaw. Treatment with radiation therapy and a case report. Am J Clin Oncol 1991: 14: 225–230.
54. Ueda M, Kaneda T. Combined chemotherapy and radiotherapy for advanced maxillary ameloblastoma. A case report. J Craniomaxillofac Surg 1991: 19: 272274.
55. Carlson ER, Marx RE (2006) The ameloblastoma: primary, curative surgical management. J Oral Maxillofac Surg 64(3):484–494. doi:10.1016/j.joms.2005.11.032
56. Williams TP (1993) Management of ameloblastoma: a changing perspective. J Oral Maxillofac Surg 51(10):1064–1070

ISSN: 1673-064X
E-Publication: Online Open Access
Vol: 66 Issue 07 | 2023
DOI 10.17605/OSF.IO/JE3NB

57. Black CC, Addante RR, Mohila CA (2010) Intraosseous ameloblastoma. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 110(5):585–592.doi:10.1016/j.tripleo.2010.02.040
58. Gephardt GN, Zarbo RJ (1996) Interinstitutional comparison of frozen section consultations. A college of American Pathologists Q-Probes study of 90,538 cases in 461 institutions. Arch Pathol Lab Med 120(9):804–809
59. Muller H, Slootweg PJ. The ameloblastoma, a controversial approach to therapy. J Oral Maxillofac Surg 1985;13:79–84
60. Olaitan AA, Arole G, Adekeye EO. Recurrent ameloblastoma of the jaws. A follow-up study. Int J Oral Maxillofac Surg 1998: 27: 456–460.
61. Huvos AG, Woodard HQ, Cahan WG, Higinbotham NL, Stewart FW, Butler A, Bretsky SS (1985) Post radiation osteogenic sarcoma of bone and soft tissues. A clinicopathologic study of 66 patients. Cancer 55(6):1244–1255
62. Philip M, Morris C, Werning J, Mendenhall W (2005) Radiotherapy in the treatment of ameloblastoma and ameloblastic carcinoma. Hong Kong J Radiol 8(3):157
63. Amzerin M, Fadoukhair Z, Belbaraka R, Iraqui M, Boutayeb S, M Rabti H, Kebdani T, Hassouni K, Benjaafar N, El Gueddari BK, Errihani H (2011) Metastatic ameloblastoma responding to combination chemotherapy: case report and review of the literature. J Med Case Rep 5:491. doi:10.1186/1752-1947-5-491
64. Zemann W, Feichtinger M, Kowatsch E, Karcher H (2007) Extensive ameloblastoma of the jaws: surgical management and immediate reconstruction using microvascular flaps. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 103(2):190–196. doi:10.1016/j.tripleo.2006.05.004
65. Pogrel MA, Podlesh S, Anthony JP, Alexander J (1997) A comparison of vascularized and non-vascularized bone grafts for reconstruction of mandibular continuity defects. J Oral Maxillofac Surg 55(11):1200–1206
66. Chana JS, Chang YM, Wei FC, Shen YF, Chan CP, Lin HN, Tsai CY, Jeng SF (2004) Segmental mandibulectomy and immediate free fibula osteoseptocutaneous flap reconstruction with endosteal implants: an ideal treatment method for mandibular ameloblastoma. Plast Reconstr Surg 113(1):80–87. doi:10.1097/ 01.PRS.0000097719.69616.29
67. Gumgum S, Hosgoren B. Clinical and radiologic behaviour of ameloblastoma in 4 cases. J Can Dent Assoc 2005: 71: 481– 484.
68. Porgal MA et al. Is there a role for enucleation in the management of ameloblastoma? Int. J. Oral Maxillofac. Surg. 2009; 38: 807–812 doi:10.1016/j.ijom.2009.02.018,
69. Cranin AN, Bennett J, Solomon M, Quarcoo S. Massive granular cell ameloblastoma with metastasis: report of a case. J Oral Maxillofac Surg 1987: 45: 800–804.
70. Arotiba GT, Ladeinde AL, Arotiba JT, Ajike SO, Ugboko VI, Ajayi OF. Ameloblastoma in Nigerian children and adolescents: a review of 79 cases. J Oral Maxillofac Surg 2005: 63: 747–751.
71. Hazelbag HM, Laforga JB, Roels HJ, Hogendoorn PC. Dedifferentiated adamantinoma with a revertant mesenchymal phenotype. Am J Surg Pathol 2003: 27: 1530–1537.
72. Ghandhi D, Ayoub AF, Pogrel MA, MacDonald G, Brocklebank LM, Moos KF. Ameloblastoma: a surgeon's dilemma. J Oral Maxillofac Surg 2006: 64:10101014.