

## **Mandibular reconstruction with microvascularized graft after ameloblastoma resection: case series**

**Reconstrução mandibular com enxerto microvascularizado após ressecção de ameloblastoma: série de casos**

**Reconstrucción mandibular con injerto microvascularizado tras resección de ameloblastoma: serie de casos**

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### **Abstract**

Ameloblastoma is a locally aggressive and highly infiltrative tumor with a high recurrence rate. Its multicystic form the recommended treatment is resection with a safety margin, which results in significant facial defects with esthetic and functional repercussions. Microvascular surgery revolutionized the reconstruction of significant defects because these grafting techniques allow a more satisfactory aesthetic and functional restoration. This study aimed to report a series of cases of reconstructions of mandibular defects using microvascularized fibular graft after ameloblastoma resection. Six patients were included in this study, and we collected data related to the surgical procedure, diagnosis, complications and follow-up. The patients were characterized as four women and two men, with a mean age of 23.8 years, with a diagnosis of mandibular ameloblastoma located mainly in the body, angle and mandibular ramus. These patients underwent lesion resection, resulting in defects larger than 5 cm, which justified using a microvascularized fibular graft for its reconstruction. The patients evolved well, with good results and without recurrences or complications in a postoperative follow-up of 2 to 5 years. Ameloblastoma is a lesion that reaches large dimensions and causes excellent cosmetic and functional damage. The microvascularized graft is an alternative in reconstructing significant defects and allows satisfactory morphofunctional reestablishment with minimal complications.

**Keywords:** Ameloblastoma; Bone transplantation; Mandible; Microcirculation.

### **Resumo**

O ameloblastoma é um tumor localmente agressivo e altamente infiltrativo, com alta taxa de recidiva. Na sua forma multicística, o tratamento preconizado é a ressecção da lesão com margem de segurança, o que resulta em grandes defeitos orofaciais, com repercussões estéticas e funcionais. A cirurgia microvascular revolucionou a reconstrução de grandes defeitos, pois essas técnicas de enxertia permitem um reestabelecimento estético e funcional mais satisfatório. Este estudo objetivou relatar uma série de casos de reconstruções de defeitos mandibulares utilizando enxerto microvascularizado de fíbula após a ressecção de ameloblastomas. Para isso, seis pacientes foram incluídos neste estudo e os dados relacionados ao procedimento cirúrgico, diagnóstico, complicações e preservação foram coletados. Os

pacientes foram caracterizados como quatro do sexo feminino e dois do sexo masculino, com idade média de 23,8 anos diagnosticados com ameloblastoma em mandíbula localizados em sua maioria no corpo, ângulo e ramo mandibular. Esses pacientes foram submetidos a ressecção da lesão, resultando em defeitos maiores que 5 cm, o que justificou a utilização de enxerto microvascularizado de fíbula para sua reconstrução. Os pacientes evoluíram bem, com bons resultados e sem recidivas ou complicações num acompanhamento pós-operatório de 2 a 5 anos. O ameloblastoma é uma lesão que atinge grandes dimensões e acarreta grande prejuízo cosmético e funcional. O enxerto microvascularizado é uma alternativa na reconstrução de grandes defeitos e permite um reestabelecimento morfofuncional satisfatórios com mínimas complicações.

**Palavras-chave:** Ameloblastoma; Transplante ósseo; Mandíbula; Microcirculação.

### Resumen

El ameloblastoma es un tumor localmente agresivo y altamente infiltrante con una alta tasa de recurrencia. Su forma multiquistica el tratamiento recomendado es la resección de la lesión con margen de seguridad, lo que resulta en defectos faciales importantes con repercusión estética y funcional. La cirugía microvascular revolucionó la reconstrucción de defectos importantes porque estas técnicas de injerto permiten una restauración estética y funcional más satisfactoria. Este estudio tuvo como objetivo reportar una serie de casos de reconstrucciones de defectos mandibulares mediante injerto de peroné microvascularizado tras resección de ameloblastoma. En este estudio se incluyeron seis pacientes y se recogieron datos relacionados con el procedimiento quirúrgico, diagnóstico, complicaciones y seguimiento. Los pacientes se caracterizaron por cuatro mujeres y dos hombres, con una edad media de 23,8 años, con diagnóstico de ameloblastoma mandibular localizado principalmente en cuerpo, ángulo y rama mandibular. Estos pacientes fueron sometidos a resección de la lesión, dando como resultado defectos mayores de 5 cm, lo que justificó el uso de un injerto de peroné microvascularizado para su reconstrucción. Los pacientes evolucionaron bien, con buenos resultados y sin recidivas ni complicaciones en un seguimiento postoperatorio de 2 a 5 años. El ameloblastoma es una lesión que alcanza grandes dimensiones y causa un excelente daño cosmético y funcional. El injerto microvascularizado es una alternativa en la reconstrucción de defectos importantes y permite un reestablecimiento morfofuncional satisfactorio con mínimas complicaciones.

**Palabras clave:** Ameloblastoma; Transplante óseo; Mandíbula; Microcirculación.

## 1. Introduction

Ameloblastoma is a benign neoplasm originating from odontogenic epithelial tissues found in the maxillary bones. Resections of extensive lesions result in significant defects, which affect facial esthetics, compromising patients' quality of life. The ideal treatment plan must aim for satisfactory results in both aesthetic and functional aspects (SIQUEIRA et al., 2019).

In clinical examination, ameloblastoma presents as a slow-growing tumor, locally invasive, benign in most cases, which can cause displacement, mobility and tooth resorption. It is often asymptomatic, with smaller lesions discovered only after radiographic examinations. The literature considers three variants of this neoplasm: conventional or multicystic, unicystic and peripheral (Neville, 2009; Melo et al., 2016).

Treatment remains controversial. Curettage is recommended for unicystic ameloblastoma cases and complete resection with surgical margins for multicystic ameloblastoma cases. The pathology is known for its aggressive behavior and high possibility of bone penetration adjacent to the radiographic limits. The degree of recurrence reported in the literature is high (Condezo et al., 2018).

Resection with surgical margins of multicystic ameloblastoma can be mutilating by causing significant bone defects. Among the available grafts, the autogenous one is the gold standard in these reconstructions. It provides enough bone and is the most biocompatible among the options, and is technically more practical to use. When reconstructions are more extensive than 5 mm, microsurgical techniques allow the use of osteomyocutaneous grafts, with the fibula being one of the most suitable options for the donor area (Alfaro; Magaz; Martínez, 2012; Amaral et al., 2018). Vascularized bone grafts provide reconstruction of large and composite defects, work well in irradiated fields, and allow immediate reconstruction. Despite the advantages mentioned, it is important to note necessitate lengthy admission, require specialized training and equipment (Marechek et al, 2018).

Prototyping with three-dimensional models is an excellent ally for the surgical planning of maxillofacial reconstruction. The rapid prototyping technology allows 3-D anatomical study, simulation of surgical procedures, guided

reconstruction, and reduced surgical time, resulting in shorter hospital stays and faster patient recovery. The literature also mentions the reduction of potential postoperative complications and better guidance and discussion of the surgical procedure with the patient (Siqueira, 2019).

This paper aims to present a case series of patients diagnosed with mandibular ameloblastomas rehabilitated with microvascularized fibular grafts after marginal resections. All subjects were treated at the Hospital Regional do Agreste, in Caruaru, Pernambuco, Brazil, under the care of both Maxillofacial Surgery and Plastic Surgery teams.

## 2. Methodology

A retrospective descriptive observational study involved patients of both sexes, different ages, and socioeconomic and cultural aspects, diagnosed with mandibular ameloblastoma and submitted to reconstruction with microvascularized grafts after marginal resection in a northeastern Brazilian hospital in 2015 and 2021. The collection of these cases aims to study and analyze data published in the literature through direct comparison in a qualitative method (Pereira et al., 2018).

This research had its design and methodology in line with the bioethical and moral principles provided for CONEP Resolution 466/2012 on works involving human beings, with a Certificate of Presentation of Ethical Appreciation 50694921.6.0000.5203 and a substantiated opinion of the Ethics and Research Committee, number 4.920.842. All patients involved in this research agreed to participate by signing the Informed Consent Form.

Data referring to qualitative criteria of each case were collected, characterizing the lesion and evaluating its recurrence after surgical treatment, in addition to analyzing the functional reestablishment of the mandible after reconstruction. These data were compared with those in the literature through a review.

## 3. Results

The group consisted of four women and two men treated at the ambulatory clinic of the Hospital Regional do Agreste (HRA), Caruaru, Pernambuco, Brazil, diagnosed with mandibular ameloblastomas.

The mean age was 23.8 years (range 13 to 33). In all patients, the tumor's location was the mandible: 04 cases involved body, angle and mandibular ramus, 01 case involved body and angle and 01 case involved symphysis, parasymphysis, body and mandibular angle. The most common symptom presented were swelling in the affected region (Figure 2-A, B). The evolution time until the initial hospital visit ranged from 07 months to 01 year and 06 months. Some patients reported previous treatment, such as attempted lesion decompression and mandibular resection with the installation of a 2.4 mm reconstruction plate without graft. Radiographically, 05 patients had a multilocular aspect of the lesion (Figure 1). Meanwhile, 01 of the patients had a mandibular area previously resected with the installation of a plate. It was possible to observe that the tumor had presented large dimensions in all cases, the smallest being 22x13in (inches) and the largest approximately 25x15in (inches). Given the extent of the lesion and the need for surgical margins, the reconstruction of the bone defect using a microvascularized graft was properly indicated (Figures 3-A, B; 4; 5).

All patients were followed up in an ambulatorial clinical setting for 02 to 05 years after surgery in the same hospital unit (Figure 6-A, B). All continue without signs of recurrence after the treatment performed (Table 1).

**Table 1** - Patients diagnosed with mandibular ameloblastoma treated with surgical resection and reconstruction with microvascularized graft.

	<b>Patient 1</b>	<b>Patient 2</b>	<b>Patient 3</b>	<b>Patient 4</b>	<b>Patient 5</b>	<b>Patient 6</b>
<b>Gender</b>	F	F	F	F	M	M
<b>Age</b>	13	17	27	33	28	25
<b>Site</b>	Posterior mandibular region	Posterior mandibular region	Posterior mandibular region	Anterior mandibular region	Posterior mandibular region	Posterior mandibular region
<b>Clinical aspects</b>	Painless swelling in mandible	Painless swelling in mandible	Painless swelling in mandible	Mandibular bone defect	Painless swelling in mandible	Painless swelling in mandible
<b>Radiographic aspects</b>	Multilocular radiolucent lesion	Multilocular radiolucent lesion	Multilocular radiolucent lesion	Previous mandibular resection with reconstruction plate installed	Multilocular radiolucent lesion	Multilocular radiolucent lesion
<b>Evolution time</b>	08 months	01 year and 06 months	10 months	Previous resection	07 months	01 year
<b>Approximate size</b>	22x13in	22x13in	23x14in	Previous resection	25x15in	24x14in
<b>Treatment</b>	Partial resection + microvascularized fibular graft	Partial resection + microvascularized fibular graft	Partial resection + microvascularized fibular graft	Fibula microvascular graft	Partial resection + microvascularized fibular graft	Partial resection + microvascularized fibular graft
<b>Follow-up period</b>	05 years	02 years	05 years	02 years	02 years	04 years
<b>Recurrence</b>	0	0	0	0	0	0
<b>Mandibular function</b>	Preserved	Preserved	Preserved	Preserved	Preserved	Preserved

Source: Personal archive (2021).

**Figure 1** - Computed tomography with three-dimensional reconstruction showing a multilocular lesion in the right posterior mandibular region.



Source: Personal archive (2019).

**Figure 2** - **A**) Front view of the patient in the preoperative period. **B**) Lesion visualized on intra-oral examination near the right retromolar region.



Source: Personal archive (2019).



**Figure 3** - Markings for surgical access. **A)** Extended submandibular access in association with a pre-auricular approach. **B)** Surgical margin traced for removal of viable bone graft and vascularized tissue flap.



Source: Personal archive (2019).

**Figure 4** - A three-dimensional prototype of the patient's mandible was used for surgery planning. Mandibular segment resected with the lesion is shown next to the prototype.



Source: Personal archive (2019).

**Figure 5** - Fibula graft attached to the resected mandible with a 2.4 mm reconstruction plate.



Source: Personal archive (2019).

**Figure 6** - 1 month of postoperative follow-up. **A)** Patient with satisfactory mandibular bone contour and mild swelling in the operated region. **B)** Intra-oral examination showing good healing and coaptation of the operative edges.



Source: Personal archive (2019).

#### 4. Discussion

Odontogenic tumors are a group of lesions that originate from elements of dental embryogenesis. According to tissue origin, they are divided into epithelial, mesodermal and mixed. Ameloblastoma is the most common tumor originating from the odontogenic epithelium. It is locally aggressive and highly infiltrative, with high recurrence, around 50% (MORAES, 2014). It is still not possible to detect the stimulus or trigger for the development of this neoplasm. However, concerning its molecular pathogenesis, there is a mutation in the MAPK signalling pathway genes. Its growth and tissue invasion are linked to the overexpression of TNF alpha, anti-apoptotic proteins, growth factors and matrix metalloproteinases (FREIRE et al., 2021).

Ameloblastoma predominantly occurs between the fourth and fifth decades of life. No gender and race differences are reported, and there is a predilection for the mandible in 80% of the cases. In our study, 100% of the analyzed cases were in the mandible. However, the involvement of the second to the fourth decade of life could be observed, differing from the literature. According to the current classification of the World Health Organization (WHO), three variants of ameloblastoma are recognized: unicystic, multicystic and peripheral. Clinically, ameloblastoma appears as an asymptomatic increase in volume that can evolve with large dimensions, causing functional and esthetic changes, also presented in our case series. Radiographically, the appearance of the lesion is compared to honeycombs or soap bubbles. Expansion of the bone cortical in the affected site and resorption of the roots of the involved teeth can be observed; with loculations that can be uni or multicystic. (Neville, 2009; Freire et al., 2021; Galvez, 2021).

Radiographic studies play a fundamental role in the pre and postoperative management of patients with ameloblastoma. Computed tomography is the gold standard exam for three-dimensional assessment of the lesion. Magnetic resonance imaging may also be indicated, especially in the maxilla, to analyse propagation in the orbital cavity. About treatment, for unicystic ameloblastomas, marsupialization and subsequent resection of the lesion may be acceptable. However, for multicystic ameloblastomas, the surgical approach with marginal resection is indicated, with surgical margins of 3,9x7,8in at least, which usually results in a segmental resection (maxillectomy or mandibulectomy) (Milman, 2016).

Segmental resections cause considerable morbidity (aesthetic, nervous, muscle, tooth loss and impairment of the stomatognathic system), so immediate reconstruction is ideally proposed, ensuring faster recovery of the affected region and with fewer functional, psychological and aesthetic complications for the patient, returning an acceptable facial harmony, in addition to reducing the number of surgical procedures and avoiding soft tissue changes such as retraction, fibrosis and low flaccidity. The autologous bone graft guarantees excellent aesthetic and functional results and has been the most indicated (PASTORE, 2019). The ideal graft for mandibular reconstruction must be biocompatible, have cells with osteogenic potential, be easily obtainable, resistant to masticatory forces and fractures, and the autologous graft best meets these needs (França, 2016). Furthermore, aligning the graft with the occlusal plane to provide an adequate platform for future dental rehabilitation and facilitate implant placement (Liu et al, 2020).

There are three main bone donor sites used for mandibular reconstruction: fibula, iliac and scapula. The fibular osteocutaneous free flap is the leading donor site for mandibular reconstruction, which was the indication for the reconstructions proposed in this study. The free osteocutaneous flap of the iliac crest provides bone with a height comparable to that of the native dentate mandible, which improves oral competence by supporting the lower lip and is rich in cancellous bone, facilitating oral rehabilitation. However, it has a limitation in the amount of soft tissue that can be transferred and can lead to a limited movement of the hallux and vascular impairment of the limb, which is why a preoperative magnetic resonance angiography is recommended. The scapular osteocutaneous free flap is versatile in the restoration of significant soft tissue defects. However, it is associated with limited shoulder movement and the impossibility of approaching two teams at the same surgical time. The morbidity of the donor area is the primary concern as the procedure can lead to limitations in walking (Bak, 2010).

Concerning the mandible, Galvez et al. (2021) argue that the graft donor area should consider the size of the defect after resection, so the reconstruction with fibula should be indicated in patients where the defect involves the body, angle and mandibular ramus, considering the tubular anatomy and the bone length, which provides a graft between 15in and 78in, with thicker cortical. In patients with the tumor occupying the mandibular angle and ramus, the iliac crest can be indicated as a free graft considering defects between 15in and 47in, the presence of more prominent cancellous bone and a low rate of resorption.

Microvascular surgery is the gold standard for the reconstruction and rehabilitation of mandibular defects. Vascularized bone grafts and bridging mandibular reconstruction plates for restoration of mandibular continuity in patients who undergo free flap reconstruction after segmental mandibulectomy are effective methods of restoring mandibular continuity following



segmental mandibulectomy, with the former being the preferred technique for patients undergoing microvascular reconstruction. (Head et al, 2003).

To be considered a microvascularized graft, a substantial amount of bone and soft tissue must be transferred with its vascular system to the head and neck region. The iliac crest and fibula grafts are the most used for extensive reconstructions, as in the case of partial tumor resections. Vascularized grafts have earlier consolidation in the recipient bed and are more resistant to infections when compared to non-vascularized grafts. The most common complication of this rehabilitation is venous thrombosis. It usually results from technical errors such as excessive tension in the suture line, traumatic surgical technique, extrinsic flap torsion or compression, inadequate pressure of vascular clamps or transfixation of the posterior wall of the vessel by a point of the anterior wall. Patients from our case series followed without complications (França et al, 2016). The vascularized bone flaps are rigidly fixed and join the native mandible, allowing the reconstructed mandible to resist masticatory forces. A variety of hardware systems have been developed to protect bone grafts and maintain occlusal and biomechanical relationships. The preference is to use a 2.0–2.4 mm locking reconstruction plate system. The plate is bent to adjust to the contour of the native mandible before resection, ensuring that a minimum of three screws is placed on each side of the resection for maximum stabilization, a principle followed in all our cases (Bak, 2010).

Reconstruction of vascularized tissue in the head and neck offers adequate and satisfactory esthetic results in maxillofacial deformity. Advanced technologies that incorporate patient-specific anatomical details have expanded the limits of head and neck reconstruction with increasing precision and shorter operative time (Kain et al, 2021; Goetze et al, 2017).

Mandibular reconstruction remains a challenge, despite the remarkable evolution provided by microvascular surgery, prototyping technology and the improvement of surgical technique and osteosynthesis materials. It is still impossible to fully restore continuity, recovery of sensitivity in the region, dental elements and soft tissue. Even so, an adequate treatment plan can achieve satisfactory results through an excellent restoration of esthetics and mandibular function, as in the cases reported in this study (França et al, 2016).

Vascularized fibula grafts provide conditions for a full dental rehabilitation of patients. The methods of reconstructive surgery and dental implants enable the medical and social rehabilitation of patients with mandibular defects resulting from large-scale resections (Khachatryan et al, 2018).

Galvez (2021) presented a case series with a 5-year follow-up showing no tumor recurrence, which can also be observed in our 2 to 5-year follow-up study. The follow-up of these patients must be in a long-term period due to the aggressive characteristics of the lesion, which usually present silent clinical signs, even in more advanced stages. Therefore, patients diagnosed with ameloblastomas have to be under close surveillance for at least 5 years.

## 5. Conclusion

Ameloblastoma can reach enormous dimensions and causes significant aesthetic and functional damage. The microvascularized graft is the gold standard reconstruction option for large maxillofacial defects, allowing morphofunctional reestablishment with minimal complications. However, the surgical technique must be precise and the equipment needed for microvascular surgery is expensive, which makes this type of rehabilitation unfeasible in some hospital units. In the reported cases, patients had excellent aesthetic and functional results, without complications. The case series presented here brought together a satisfactory sample and long postoperative follow-up times to better assess the benefits of the rehabilitation used, justifying its use in relation to other lower cost techniques.

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