MANDIBULAR RECONSTRUCTION USING AUTOGENOUS CALVARIAL BONE GRAFT COMBINED WITH NANO-HYDROXYAPATITE/Β-TRICALCIUM PHOSPHATE COMPOSITE IN A PINDBORG TUMOR AFFECTED AREA

RECONSTRUÇÃO MANDIBULAR COM ENXERTO ÓSSEO AUTÓGENO DE CALOTA CRANIANA COMBINADO COM COMPÓSITO DE NANO-HIDROXIAPATITA/Β-FOSFATO TRICÁLCICO EM ÁREA AFETADA POR TUMOR DE PINDBORG

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ABSTRACT

Introduction: The use of bone grafts in dentistry following partial or total bone resections plays a crucial role in both functional and aesthetic rehabilitation. However, it is not always possible to use only xenografts or alloplastic materials; in many cases, the combination with autogenous bone is necessary due to the nature of the defect. Objective: To demonstrate that excellent outcomes can be achieved by combining alloplastic grafts with autogenous bone for large reconstructions. Case Report: In cases involving oral cysts and tumors, treatment is carefully determined based on biopsy results and complementary exams, with removal planned with safe margins to prevent recurrence. This paper presents the clinical case of a 30-year-old female patient, melanoderm, with no pre-existing conditions, who underwent a routine radiographic exam for orthodontic treatment, during which a radiolucent area was observed in the anterior mandibular region. The patient was referred to a specialized center in oral and maxillofacial

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surgery, where an incisional biopsy was performed. Histological analysis confirmed a Pindborg tumor. The proposed treatment was *en bloc* resection of the lesion, performed under general anesthesia in a hospital setting. After six months, an autogenous calvarial bone graft combined with synthetic biomaterials was performed. Conclusion: The combination of autogenous bone with alloplastic materials offers a viable and effective solution for extensive oral and maxillofacial reconstructions, ensuring structural and aesthetic rehabilitation while minimizing morbidity.

Keywords: Bone Graft. Autogenous Graft. Bone Healing. Biomaterial. Nano-Hydroxyapatite.

RESUMO

Introdução: O uso de enxertos ósseos em odontologia após ressecções ósseas parciais ou totais desempenha um papel crucial na reabilitação funcional e estética. No entanto, nem sempre é possível utilizar apenas xenoenxertos ou materiais aloplásticos; em muitos casos, a combinação com osso autógeno é necessária devido à natureza do defeito. Objetivo: Demonstrar que excelentes resultados podem ser alcançados pela combinação de enxertos aloplásticos com osso autógeno para reconstruções de grande porte. Relato de Caso: Em casos envolvendo cistos e tumores orais, o tratamento é criteriosamente determinado com base nos resultados de biópsia e exames complementares, com remoção planejada com margens seguras para prevenir recidivas. Este trabalho apresenta o caso clínico de uma paciente do sexo feminino, 30 anos, melanoderma, sem condições preexistentes, que foi submetida a exame radiográfico de rotina para tratamento ortodôntico, durante o qual foi observada uma área radiolúcida na região anterior da mandíbula. A paciente foi encaminhada a um centro especializado em cirurgia bucomaxilofacial, onde foi realizada biópsia incisional. A análise histológica confirmou tratar-se de tumor de Pindborg. O tratamento proposto foi a ressecção em bloco da lesão, realizada sob anestesia geral em ambiente hospitalar. Após seis meses, foi realizado enxerto ósseo autógeno de calota craniana combinado com biomateriais sintéticos. Conclusão: A combinação de osso autógeno com materiais aloplásticos oferece uma solução viável e eficaz para reconstruções orais e maxilofaciais extensas, garantindo reabilitação estrutural e estética, minimizando a morbidade.

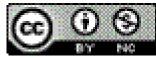
Palavras-chave: Enxerto Ósseo. Enxerto Autógeno. Cicatrização Óssea. Biomaterial. Nano-Hidroxiapatita.

RESUMEN

Introducción: El uso de injertos óseos en odontología tras resecciones óseas parciales o totales desempeña un papel crucial en la rehabilitación tanto funcional como estética. Sin embargo, no siempre es posible utilizar únicamente xenoinjertos o materiales aloplásticos; en muchos casos, la combinación con hueso autógeno es necesaria debido a la naturaleza del defecto. Objetivo: Demostrar que se pueden lograr excelentes resultados combinando injertos aloplásticos con hueso autógeno para reconstrucciones extensas. Caso clínico: En casos de quistes y tumores orales, el tratamiento se determina cuidadosamente con base en los resultados de la biopsia y los exámenes complementarios, planificando la extirpación con márgenes seguros para prevenir la recurrencia. Este artículo presenta el caso clínico de una paciente de 30 años, melanodermo, sin afecciones preexistentes, quien se sometió a un examen radiográfico de rutina para tratamiento de ortodoncia, durante el cual se observó un área radiolúcida en la región mandibular anterior. La paciente fue remitida a un centro especializado en cirugía oral y maxilofacial, donde se le realizó

una biopsia incisional. El análisis histológico confirmó un tumor de Pindborg. El tratamiento propuesto fue la resección en bloque de la lesión, realizada bajo anestesia general en un entorno hospitalario. Seis meses después, se realizó un injerto óseo autógeno de calota combinado con biomateriales sintéticos. Conclusión: La combinación de hueso autógeno con materiales aloplásticos ofrece una solución viable y eficaz para reconstrucciones orales y maxilofaciales extensas, garantizando la rehabilitación estructural y estética, a la vez que minimiza la morbilidad.

Palabras clave: Injerto Óseo. Injerto Autógeno. Cicatrización Ósea. Biomaterial. Nanohidroxiapatita.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INTRODUCTION

The demand for oral rehabilitation in dentistry has increased over the years due to the reduction in bone levels following infections, bone tumors, tooth loss, and age-related atrophy (Nunes *et al*., 2024). The need to correct small and/or large bone defects has become feasible through bone grafting, a technique that has been widely studied and applied alongside osseointegrated implants (Nunes *et al*., 2024).

The surgical-prosthetic outcome depends on factors such as the degree of bone loss, the patient's overall condition, and especially the grafting and jaw reconstruction techniques employed in the rehabilitation, which is only possible with adequate bone bases to support masticatory loads (Heckmann, 2025). A wide variety of materials can be used as bone substitutes, including autogenous, homograft, xenograft, and alloplastic bone (Tanaka *et al*., 2008).

The best results are often achieved with autogenous or homologous bone due to its osteogenic, osteoconductive, and osteoinductive properties, as well as its lack of specific immune response, making it the ideal grafting material (Pedrosa Júnior *et al*., 2009; Etemadi *et al*., 2023; Vieira & Pavane, 2024). In this type of graft, the donor and recipient are the same individual, and the potential donor sites are chosen based on the characterization of the volume and type of bone defect (Etemadi *et al*., 2023). However, disadvantages include the limited quantity of bone available at the donor site, the need for a second surgical site, risks of vascular and neurological injury, and postoperative morbidity (Moran & Collares, 2019).

The ideal characteristics of the bone used for reconstruction include ease of

revascularization, osteogenesis, osteoinduction, lack of antigenicity, availability in sufficient quantity without requiring a donor site, and the ability to provide mechanical support and stability (Javed *et al*., 2010; Zhang *et al*., 2023).

Several techniques have been described for the reconstruction of atrophic jaws, all aiming to provide bone volume for rehabilitation with osseointegrated implants (Faverani *et al*., 2014; Kablan, 2025).

In this context, when rehabilitation involves a pathological area, the challenge becomes even greater. The selection of the material to be used is a crucial factor in achieving optimal biological and functional outcomes (Tousidonis *et al*., 2024). Thus, the surgical treatment of odontogenic tumors aims to remove the lesion using approaches that range from conservative procedures, such as enucleation, to more aggressive interventions like block bone resections (Baral *et al*., 2020; Tousidonis *et al*., 2024).

The calcifying epithelial odontogenic tumor (CEOT), or Pindborg tumor, which will be addressed in this paper, is a typically benign neoplasm and is considered a rare tumor of the facial region (Pindborg *et al*., 1956; Maiorano *et al*., 2003; Shekarkhar *et al*., 2005; Neville *et al*., 2011). It has a predilection for the mandibular body region, presenting slow growth and generally no symptoms, although it is locally aggressive and can cause significant cortical expansion (Takata & Slootweg, 2017). Radiographically, it appears as a unilocular or multilocular cyst-like lesion, with the unilocular form being more common in the maxilla (Fazeli *et al*., 2019).

Reconstruction and oral rehabilitation after the loss of these bone segments, involving small or large blocks of dentoalveolar structures, provides essential functional and aesthetic stability (Nunes *et al*., 2024; Heckmann, 2025). The high predictability and successful prognosis of such treatments contribute to the scientific community by encouraging further studies and perspectives aimed at resolving cases of this nature (Xu *et al*., 2025).

Therefore, the aim of this study is to present a precise diagnosis using histological techniques and to demonstrate improved outcomes through surgical reconstruction of the mandible using a calvarial bone graft associated with nano-hydroxyapatite following the resection of a Pindborg tumor.

CASE REPORT

A 30-year-old female patient, non-smoker, clinically healthy (no systemic diseases), and

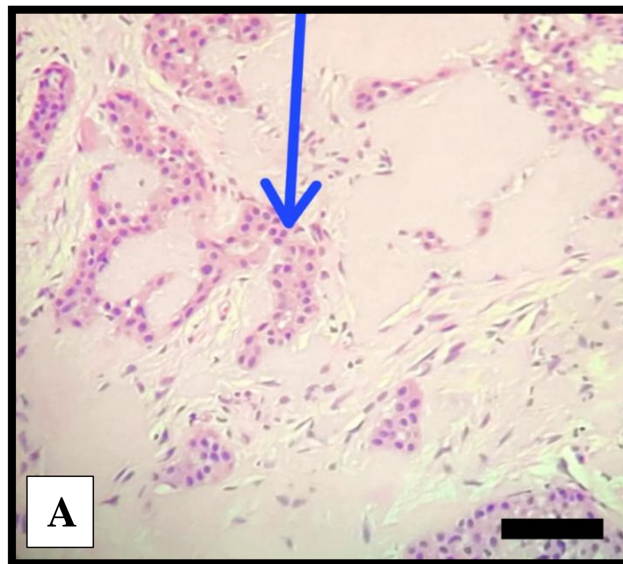
without bruxism, sought the Department of Implant Dentistry at the Brazilian Association of Dentistry (ABO, Campo Grande, MS) in July 2024. Her main complaint was the misalignment of the lower anterior teeth, which led her to seek orthodontic treatment combined with dental implants.

The patient provided the *Term of Free and Informed Consent* (approved by the Bioethics Department of ABOMS) for the publication of case report details and the associated images.

An initial panoramic radiograph revealed a radiolucent area in the anterior mandibular region with severe bone loss. The medical history search and blood test confirmed the patient was in normal general health. A cone-beam computed tomography (CBCT) further image examination confirmed a radiolucent image located beneath teeth 42 and 43 and a biopsy followed under local anesthesia (Bupivacaine - Neocaína 0,5% 1:200,00 Cristália,Brazil).

The biopsy result confirmed the initial diagnostic hypothesis of Pindborg tumor. (Figure 1)

Figure 1: The optical microscopy reveals polyhedral odontogenic neoplastic cells with acidophilic cytoplasm and rounded nuclei, organized in islands and cords within a fibrous stroma containing amyloid material (blue arrow). Areas of hemorrhage and a mild inflammatory cell infiltrate complete the histopathological features consistent with the diagnosis of a Pindborg tumor. (x 40 magnification, 300µm scale bar)



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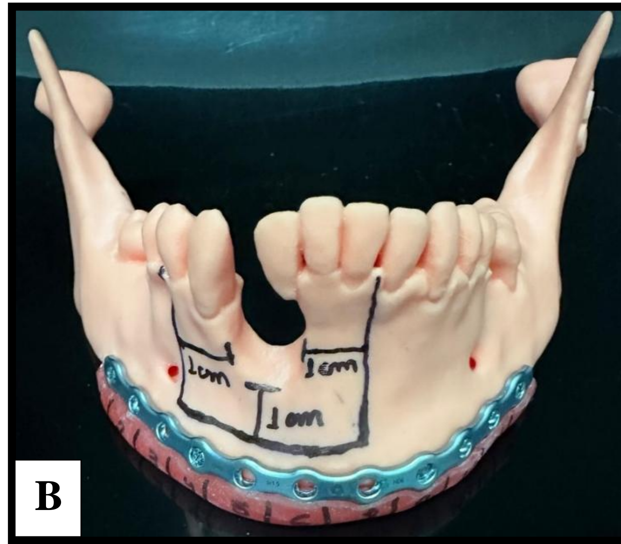
The CBCT image was used to print a 3D model (prototype) to achieve more precise surgical planning. (Figure 2)

Figure 2: Mandibular prototype with surgical markings for resection, including the surgical guide and reconstruction plate in position.



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Treatment Planning / Execution

The proposed treatment involved harvesting a homologous graft from the calvarial bone and combining it with a nano-graft to fill the gap between the bone defects using Bue Bone® nano-graft material. Following this, collagen membranes were placed. A minimum waiting period of 60 days was observed before the placement of a provisional prosthesis. For the placement of dental implants, a minimum healing period of 12 months was planned. After the patient's agreement and signing of the informed consent form, treatment was initiated.

Surgical Procedures

All surgical procedures, including follow-up assessments, were performed at the Department of Oral and Maxillofacial Surgery of ABO-MS, at the Hospital do Coração de Mato Grosso do Sul – Campo Grande – MS (Grupo Santa).

The patient underwent general anesthesia with nasotracheal intubation and received antibiotic prophylaxis with Cefazolin 2 g combined with Metronidazole 500 mg, with repeat doses every 6 and 8 hours, respectively.

The surgical plan included the installation of osteosynthesis material (Medartis® – Switzerland) using one titanium grade 4 reconstruction plate from the 2.0 Trilock system and

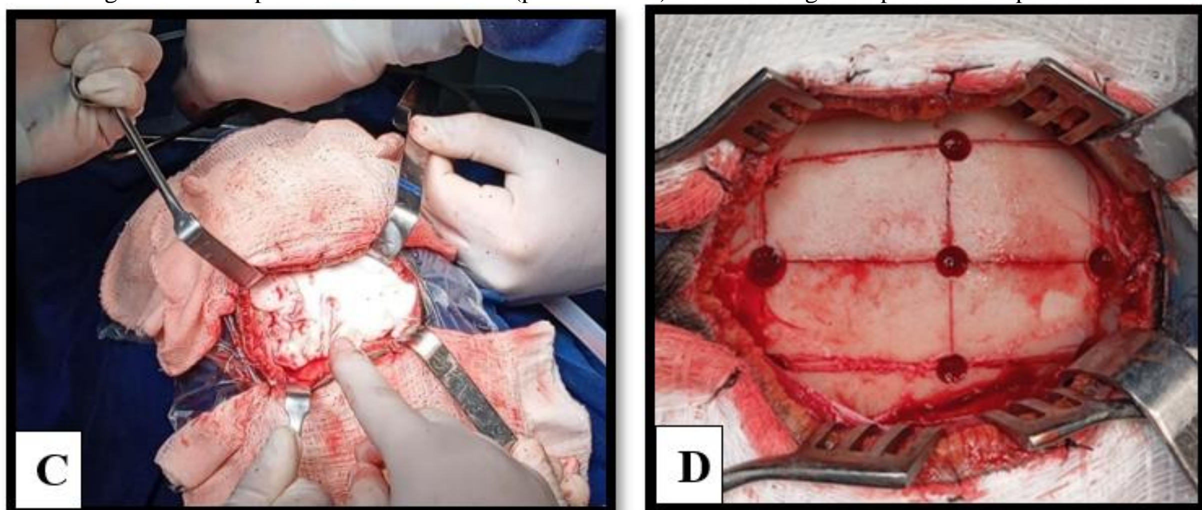
seven 2.0 Trilock screws. The case report follow-up and preservation period lasted 6 months, after which a new CT scan was performed to plan mandibular reconstruction surgery using an autogenous calvarial bone graft.

Mandibular Reconstruction Surgery

The mandibular reconstruction surgery was also performed at Hospital do Coração de MS – Campo Grande, MS (Grupo Santa). General anesthesia was administered with nasotracheal intubation, along with antibiotic prophylaxis using cefazolin 2 g and metronidazole 500 mg, repeated every 6 and 8 hours, respectively.

Access to the calvarial bone (donor site) was achieved through a coronal incision near the coronal suture (frontoparietal region), using a conservative approach with wide flap reflection (Figures 3, 4). After accessing the donor bed and harvesting a large quantity of autogenous bone using trephine burs, piezo tips, and chisels, the cranial bone defect was sealed with bone cement (methyl methacrylate) and layered sutures.

Figure 3 e 4: Exposure of the donor site (parietal bone) with markings and perforations performed.



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Following closure and isolation of the donor site, the recipient site (anterior mandibular region) was addressed.

A careful incision and periosteal dissection for tumor area removal (Figures 5, 6) was followed to the placement of autogenous bone blocks, which were stabilized with two 12-hole plates from the 2.0 system and 24 screws—4 bicortical and 20 monocortical (Medartis® –

Switzerland) (Figure 7).

Figure 5: Surgical view of the mandible after tumor resection. Figure 6: Resected mandibular region containing Pindborg tumor.

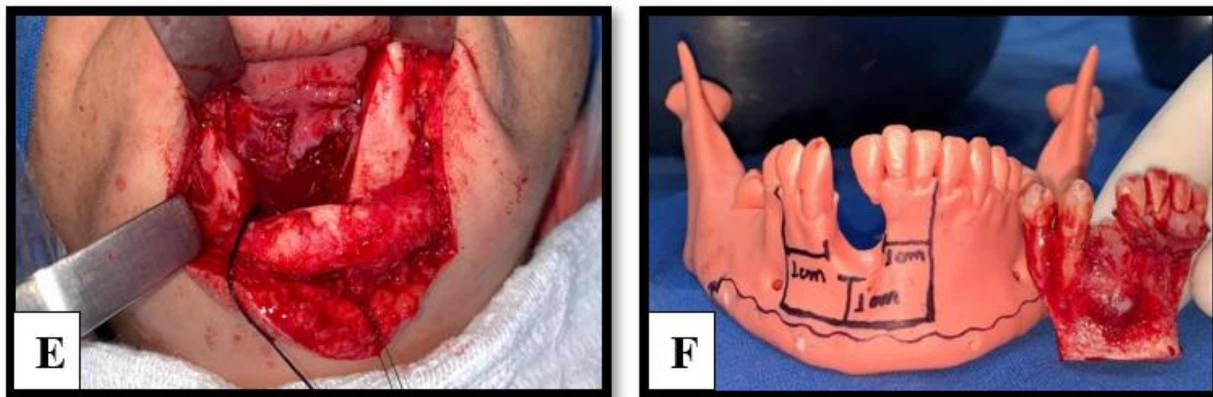

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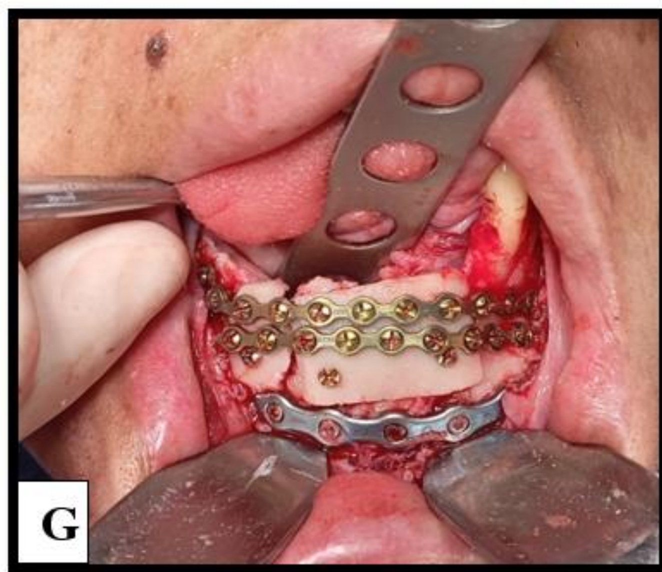
Figure 7: Bone graft installed and fixed with osteosynthesis material in the anterior mandibular region.



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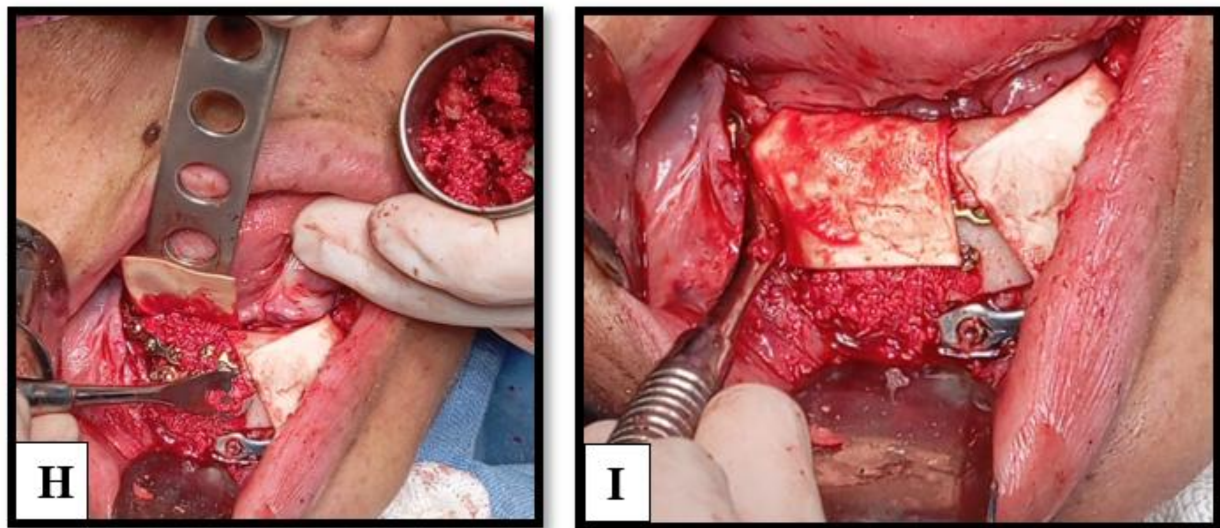
The remaining autogenous bone blocks were ground and mixed in two containers with 2.5 g of synthetic biomaterial Blue Bone (Regener®), which was used to fill the bone gaps between the grafted blocks. As a physical barrier to prevent cellular invasion of the graft, two type I collagen membranes measuring 2 mm in thickness — Green Membrane (Regener®), 25x65 mm — were used. (Figures 8, 9)

Figure 8: Insertion of particulate synthetic biomaterial into the spaces between the bone gaps and grafted bone blocks. Figure 9: Image of the bone graft and collagen membrane in position.



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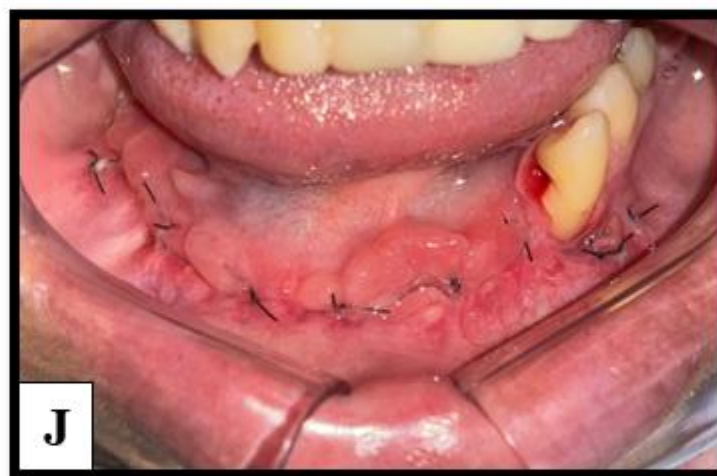
Wound closure was performed by stabilizing the flap with mattress sutures, complemented by continuous interlocking sutures and single interrupted sutures using 4-0 nylon (Figure 10).

Figure 10: Image of the sutures in place 15 days after surgery.



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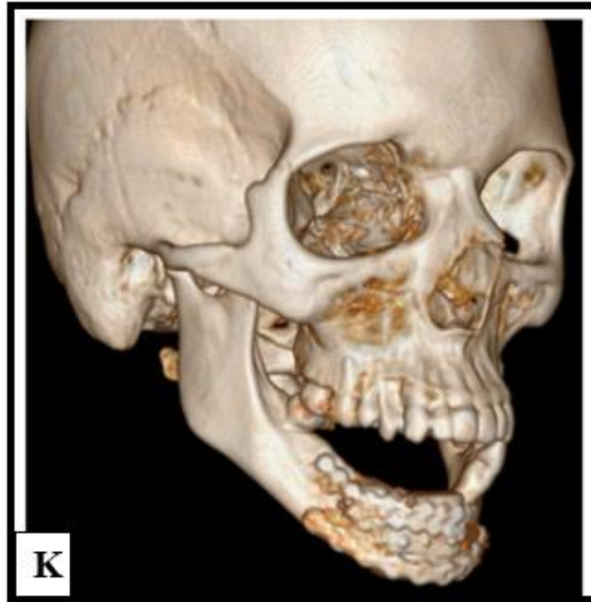
Postoperative Period / Postoperative Tomography

In the postoperative period, the patient was prescribed cephalexin 500 mg combined with clindamycin 300 mg for 7 days, along with symptomatic medications for pain and edema control. The patient continued under follow-up, showing good healing progress with no complaints. The

planned waiting time for the removal of the osteosynthesis material and implant placement is 12 months, which, according to the literature, is the necessary period for bone osseointegration of the graft with the recipient site (Figure 11).

Figure 11: 3D reconstruction showing the juxtaposition of plates and grafts.



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DISCUSSION

The Pindborg tumor is a benign lesion, accounting for less than 1% of all odontogenic tumors. It typically affects individuals aged 30 to 50 years and, according to Guimarães *et al*. (2015), shows a predilection for males. The most common site of occurrence is the posterior region of the mandible. However, the present case report involves a female patient with the tumor located in the anterior mandible. This type of tumor can be associated with unerupted teeth, which is relevant in the described clinical case, as the tumor was related to unerupted permanent lower incisors, despite radiographic findings, characterizing asymptomatic and slow growth features (Pindborg *et al*., 1956; Maiorano *et al*., 2003; Shekarkhar *et al*., 2005; Neville *et al*., 2011).

The recommended treatment is wide surgical resection with safety margins due to high recurrence rates after simple enucleation or curettage (de Souza *et al*., 2014). The clinical case is consistent with the literature, involving resection of the affected segment. According to Guimarães *et al*. (2019), reconstructive bone grafting and reconstruction plates may be indicated for rehabilitation of pathological areas. The tumor was the cause of the anterior mandibular defect

in the patient, compromising not only aesthetics but also mastication and phonetics, for example. Therefore, at the time of resection, the installation of a 2.4 system reconstruction plate was proposed to prevent fractures of the remaining bone base, which would later support the autogenous graft and implants.

The literature is rich in studies demonstrating the importance and predictability of using graft blocks combined with specific techniques (Mendonça *et al*., 2024). The calvarial bone is a source of autogenous bone (from the patient) frequently used in facial bone reconstructions, especially in cases of large defects caused by trauma, tumor resections, or congenital malformations (Hollensteiner *et al*., 2018). As described in this case report, this type of graft was included in the treatment plan due to its excellent biocompatibility, good bone quality (both cortical and spongy in some areas), and lower resorption rate compared to iliac crest grafts, avoiding a second surgical site in more functionally important areas such as the pelvis (Mendonça *et al*., 2024).

At the donor site, besides the possibility of closure without any graft material, synthetic polymers such as PMMA can be used (Peltroniemi *et al*., 2002; Chin *et al*., 2009; Andrabi *et al*., 2017; Maricevich & Campolina, 2017). The use of PMMA (polymethyl methacrylate) in calvarial reconstruction is well established in neurosurgery, especially in cranioplasty cases requiring repair of skull defects caused by trauma, surgery, infection, or tumor resections (Andrabi *et al*., 2017; Maricevich & Campolina, 2017). In the described case, the polymer was used to mold the donor area and prevent tissue dehiscence, preserving local aesthetics. The use of calvarial bone is justified when functional and aesthetic benefits outweigh the risks and can be combined with other materials, such as synthetic grafts (e.g., hydroxyapatite) (Peghin *et al*., 2024).

Synthetic grafts are biomaterials produced in the laboratory that simulate the mineral structure of human bone (Gross *et al*., 2023). In the described surgery, granulated graft from Regener was used, a hydroxyapatite (HA)-based material that is biocompatible and osteoconductive, although it has slow resorption. It also contains calcium phosphate such as β-tricalcium phosphate (β-TCP), which is more resorbable. This outcome results from extensive tissue engineering advances, aiming to make the grafted mandibular region a suitable base for rehabilitation with dental implants (da Silva Brum *et al*., 2019).

CONCLUSION

It can be concluded that the technique of combining autogenous grafts with alloplastic grafts is an excellent alternative for cases where the surgical site is very extensive. Pathologies such as the Pindborg tumor often require a larger volume of donor material; thus, this approach enables more predictable and long-lasting results for patients.

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