The Usefulness of a Facial Digital Biobank for Ameloblastoma Resection and Fracture Fixation - A Case Report

Isabella Romão Candido[1], Carolina Silvano Vilarinho da Silva[1,2], Eduardo dos Santos Garcia[1], André Luís Fernandes da Silva[2], Thais Maria Freire Fernandes Poleti[1], Ivan Onone Gialain[1], Alexandre Meireles Borba[1,2]

[1]Research Program in Integrated Dental Sciences, University of Cuiabá, Cuiabá, Brazil, [2]Department of Oral and Maxillofacial Surgery, General Hospital of Cuiabá, Cuiabá, Brazil

Abstract

Rationale: Ameloblastoma often requires complex facial treatments such as resection and reconstruction, which can be aided using three-dimensional resources towards improved surgical planning, reduction of surgical time, and customization. **Patient Concerns:** A 51-year-old patient, concerned about submandibular volumetric increase discovered performing imaging exams to install dental implants. **Diagnosis and Treatment:** Diagnosed with ameloblastoma, he underwent uneventful partial mandibular resection and placement of prebent mandibular reconstruction plate. Four months later, following a motorcycle accident, a deflection of the plate and mandibular fracture was observed. Using the initial prototyping, a new reconstruction plate was customized and surgically placed to reduce the mandibular fracture, with adequate titanium plate adaptation to the remaining bone and maintenance of aesthetic mandibular contour. **Outcomes and Take-away Lessons:** The current digital dentistry resources, such as computed tomography and intraoral scan, can be recovered and used as a backup of recorded anatomy anytime in future, providing a long-lasting facial digital biobank.

Keywords: Ameloblastoma, odontogenic tumours, personalized medicine, three-dimensional printing

Introduction

The use of three-dimensional (3D) resources applied to maxillofacial surgery has enabled a better understanding of facial changes, greater understanding of therapeutic possibilities, and even personalization of surgical guides and fixing plates. Ameloblastoma is a benign odontogenic tumour that can reach large proportions and cause aesthetic deformities in patients. Its treatment followed by local reconstruction is still seen as a challenge.[1] Therefore, the use of 3D technology has been growing as a means to facilitate treatment and reconstruction in addition to shortening the surgical time employed in these surgeries.[2]

In patients affected by major trauma, it is crucial to promote 3D reconfiguration of gnathic bones, restoration of the mandibular arch perimeter, and maintaining the intercondylar distance. This is crucial for both support of soft tissues and for the aesthetic appearance of patients. 3D modeling allows for prebending the internal fixation devices, thus resulting in increased accuracy and shorter surgical time.[2-4]

However, patients suffering from face tumours or facial trauma might benefit from 3D images obtained previously. The present study aims to report a case of three-dimensionally planned ameloblastoma resection, which after 4 months of resection suffered a complex fracture of the mandible, whose treatment was optimized by the availability of pretrauma 3D resources.

Access this article online

Quick Response Code:

Website: www.amsjournal.com

DOI: 10.4103/ams.ams_73_21

Case Report

A 51-year-old male, without previous comorbidities, was seen at the Department of Oral and Maxillofacial Surgery at General Hospital of Cuiabá, with a complaint of volumetric increase at his right submandibular region associated with intraoral bone enlargement, discovered after a 5-month period when performing imaging exams to install dental

Address for correspondence: Dr. Isabella Romão Candido, Department of Oral and Maxillofacial Surgery, General Hospital, R. 13 de Junho, 2101, Centro Sul, Cuiabá, MT, 78025-000, Brazil.
E-mail: isa_bellarc88@gmail.com

Received: 12-03-2021 **Last Revised:** 20-09-2021
Accepted: 28-09-2021 **Published:** 01-02-2022

How to cite this article: Candido IR, da Silva CS, Santos Garcia Ed, da Silva AL, Fernandes Poleti TM, Gialain IO, *et al*. The usefulness of a facial digital biobank for ameloblastoma resection and fracture fixation - A case report. Ann Maxillofac Surg 2021;11:325-8.

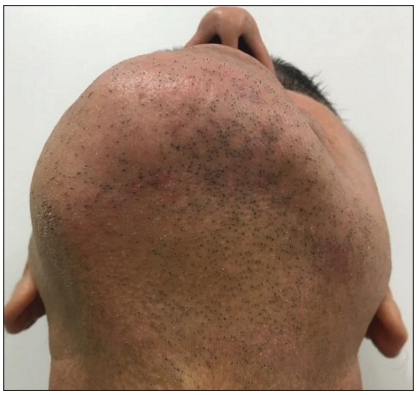

Figure 1: Axial view of the right submandibular augmentation and consequent facial asymmetry

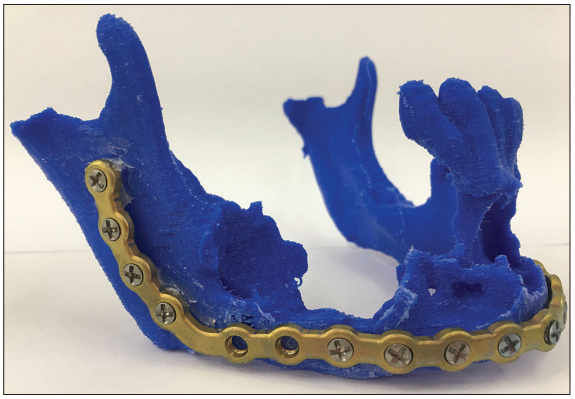

Figure 3: Anatomical impression of the mandible with prebent reconstruction plate

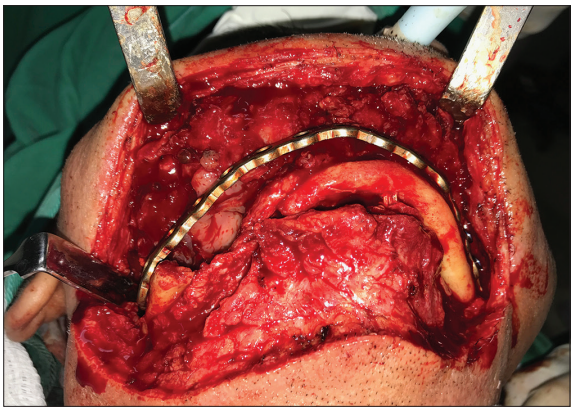

Figure 5: Second surgery, after facial trauma

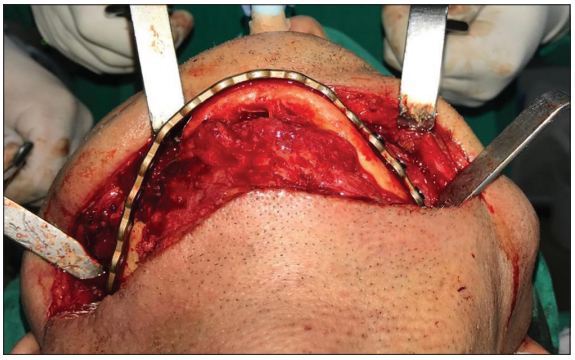

Figure 7: New reconstruction plate adapted to remnant mandibular structure

Figure 2: Axial projection in initial computed tomography scan. Multilocular lesion showing 3.55 cm in its largest diameter

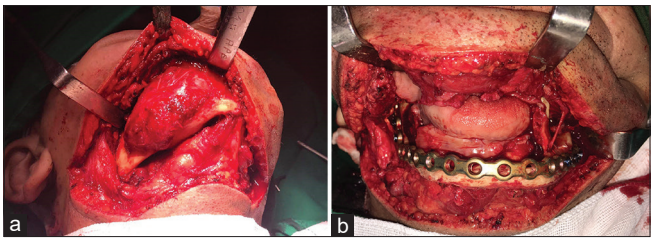

Figure 4: (a) Initial surgical view of the mandible before marginal surgical resection, (b) Reconstruction plate fixed after surgical resection

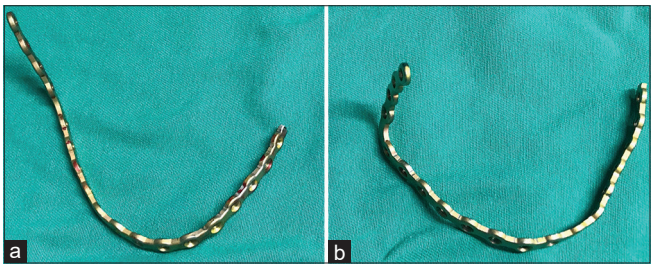

Figure 6: (a) Deflected reconstruction plate, (b) new prebent reconstruction plate

implants. Upon palpation, a firm swelling of approximately 3.5 cm at its greatest dimension was observed, corresponding to significant facial asymmetry [Figure 1]. Intraorally, the respective mandibular mucosa was erythematous, and local dental displacement was noticeable. Radiographic and tomographic examinations revealed the presence of a radiolucent multilocular lesion in the mandible extending from the right mandibular body to the left mandibular parasymphysis [Figure 2].

Incisional biopsy under local anaesthesia revealed an anatomopathological result of ameloblastoma, corroborating clinical suspicion. From digital imaging and communications in medicine, files of the initial tomographic examination were exported to Dolphin Imaging 11.9 software (Dolphin Imaging and Management, Chatsworth, CA-USA), separating only the interest area (i.e., mandible) and saved

Figure 8: (a) Three-dimensional view from first computed tomography scan (b) Postoperative three-dimensional view of mandibular marginal resection (c) Three-dimensional view from first computed tomography scan of facial trauma (d) Postoperative three-dimensional view of mandibular osteosynthesis

in stereolithography (STL) format. The STL file was inserted in the Simplify 3D software (Simplify 3D, Blue Ash, OH-USA) and converted to 3D printing on the GT Max Pro H5 printer (GT Mexamerica-SP, Brazil) using ABS filament. Once with an anatomical impression of the mandible, the reconstruction plate was modeled to the remnant mandibular structure predicted to exist after resection [Figure 3].

Then, the patient underwent total excision of the lesion by mandibular marginal resection providing a visual safety margin of 1 cm at the remnant bony structure, making it possible to preserve the base of the jaw. The previously shaped reconstruction plate was fixed to maintain the arch perimeter and prevent pathological fracture [Figure 4].

In the 4-month postoperative period, the patient was a victim of a motorcycle accident, with direct trauma to the face, causing a deflection of the plate that was fixed in the region of resection and fracture of the mandibular base that remained [Figure 5]. From the initial prototyping, a new reconstruction plate (2.4 system) was moulded. Successful reduction of the mandibular fracture along with replacement of the plate was performed. There was adequate titanium plate adaptation to the remaining bone and maintenance of aesthetic mandibular contour [Figures 6 and 7].

Currently, the patient is at an 8-month postoperative follow-up since the last intervention, with the expected limitations from resection of ameloblastoma and awaiting opportunity for rehabilitation with dental implants [Figure 8].

Discussion

Ameloblastoma is a benign odontogenic neoplasm, recently classified without the inclusion of the terms "solid/multicystic" which were removed due to the lack of biological significance and not to create confusion with the current possible unicystic, extraosseous/peripheral, or metastatic variants (malignant). Ameloblastoma treatment is commonly performed by resection with establishment of safety margins.[5]

The 3D loss of bone results in difficulty in accurate anatomical reduction of atrophic jaws, which have undergone subsequent trauma. The morbidity of these reconstructive surgeries can be reduced with the use of 3D technologies that serve as useful tools to restore function and aesthetics.[2,6]

The use of prebent plates created from 3D-printed models for individuals with mandibular fractures and undergoing reconstruction after major resections are associated with shorter intraoperative time and lower operating costs compared to those treated with adaptation and fixation.[6,7] This promotes better intraoperative management and less need for major adjustments to fixation devices during the intraoperative period. In addition, having a 3D printer in the same facility where the patient will be operated reduces the waiting time for the surgery and thus its overall cost.[6]

No case reports were founded in the literature where a previous 3D template was used as a reference for 3D biomodel printing for a patient who later suffered facial trauma or tumour. Thus, in the absence of this anatomical information, the most common alternative is mirroring of the contralateral healthy segment and its transposition to the area that will be submitted to surgical treatment. In this way, the impression of a new 3D model and presurgical planning with prebent internal fixation device can minimize the handling of the reconstruction plate during surgery and with good results in terms of symmetry and biomechanics.[8] Difficulty arises if the tumour or the trauma affects both sides of the face and prevents the mirroring option for reconstruction.

Biobanks provide biological resources that enable its use mainly for research purposes.[9] Hence, biobanks could collect anatomical data to be used in future by a particular individual. For such, a cone-beam computed tomography (CBCT) could be used to gather soft- and hard-tissue anatomy, whereas it presents minimal distortion, significantly reduced dose radiation and lower costs compared to fan-beam computed tomography. For the dental anatomy, poorly reproduced by any computed tomography,[10] intraoral scanning is an accessible reality in the current digital dentistry era, with no radiation effects. Hence, a backup of the craniofacial skeleton, composed by the union of the CBCT and the dental scans, could allow biobanks to evolve by offering data storage services referring to the craniofacial skeleton.

Conclusion

The associated use of innovative technological devices, such as 3D printing, and facial digital biobanks help not only to improve surgical planning as a guiding aid during the operation but also

acting as a tool that allows a possible treatment in at-risk patients of facial injury, such as sportspersons and defense personnel and for those who develop any type of facial anatomical defect.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understand that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

The Foundation for Research Support of the State of Mato Grosso (FAPEMAT) in association with the Brazilian National Council for Scientific and Technological Development (CNPq) partially supported the present research through the grant FAPEMAT-SES/MT-Decit/SCTIE/MS-CNPq- 003/2017.

Conflicts of interest

There are no conflicts of interest.

References

1. Kreppel M, Zöller J. Ameloblastoma – Clinical, radiological, and therapeutic findings. Oral Dis 2018;24:63-6.
2. Kumta S, Kumta M, Jain L, Purohit S, Ummul R. A novel 3D template for mandible and maxilla reconstruction: Rapid prototyping using stereolithography. Indian J Plast Surg 2015;48:263-73.
3. Martelli N, Serrano C, van den Brink H, Pineau J, Prognon P, Borget I, *et al.* Advantages and disadvantages of 3-dimensional printing in surgery: A systematic review. Surgery 2016;159:1485-500.
4. Naros A, Weise H, Tilsen F, Hoefert S, Naros G, Krimmel M, *et al.* Three-dimensional accuracy of mandibular reconstruction by patient-specific pre-bent reconstruction plates using an "in-house" 3D-printer. J Craniomaxillofac Surg 2018;46:1645-51.
5. Wright JM, Vered M. Update from the 4th edition of the world health organization classification of head and neck tumours: Odontogenic and maxillofacial bone tumors. Head Neck Pathol 2017;11:68-77.
6. King BJ, Park EP, Christensen BJ, Danrad R. On-site 3-dimensional printing and preoperative adaptation decrease operative time for mandibular fracture repair. J Oral Maxillofac Surg 2018;76:1950.e1-8.
7. Velasco I, Vahdani S, Ramos H. Low-cost method for obtaining medical rapid prototyping using desktop 3D printing: A novel technique for mandibular reconstruction planning. J Clin Exp Dent 2017;9:e1103-8.
8. Abbasi AJ, Parvin M, Bashiri S. Innovative use of a stereolithographic model together with the mirror image technique to reconstruct a defect in mandibular continuity. Br J Oral Maxillofac Surg 2018;56:887-9.
9. Coppola L, Cianflone A, Grimaldi AM, Incoronato M, Bevilacqua P, Messina F, *et al*. Biobanking in health care: Evolution and future directions. Transl Med 2019;17:172.
10. Venkatesh E, Elluru SV. Cone beam computed tomography: Basics and applications in dentistry. J Istanb Univ Fac Dent 2017;51 3 Suppl 1:S102-21.