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A modified technique of using digital technology to fabricate surgical obturator in patients with limited mouth opening

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ABSTRACT

This article presents a digital technique for the fabrication of an immediate surgical obturator for a patient with decreased mouth opening planned for maxillectomy. The amalgamation of pre-operative Cone Beam Computed Tomography (CBCT) data and 3D printing allowed for the fabrication of the immediate surgical obturator without conventional pre-surgical diagnostic impression. The surgical obturator was placed in position intra-orally post tumor resection to complete the obturation. The procedure followed led to an accurate fit of the prosthesis without any need for relining during surgery.

1. Introduction

Decreased mouth opening and added trismus is generally associated with oral squamous cell carcinoma patients. Such cases are referred to a maxillofacial prosthodontist for the fabrication of a surgical obturator. In such cases that are planned for resection of bone, fabrication of a surgical obturator is important to restore palatal integrity, speech and deglutition and to hold surgical packs. Prosthodontists in such a case face challenge in registering an accurate impression, which is a pre-requisite for fabrication of a surgical obturator. This article describes a technique of performing CBCT (Cone Beam Computed Tomography) scan, designing a 3-D model and fabrication of a surgical obturator which can serve as an alternative in cases with decreased mouth opening or trismus.

2. Material and methods

The patient planned for posterior inferior maxillectomy was explained regarding the treatment plan and an informed consent was taken. Following which she underwent CBCT with cotton rolls in the buccal vestibule and between tongue and palate (Fig. 1). The CBCT was required to evaluate tumor growth and fabricate a 3D model with soft tissue lining. The DICOM (Digital Imaging and Communications in Medicine) files were imported to slicer 4.1 software (3D slicer). The patient's DICOM data were used to form a multiplanar 3D model of patient in STL (Standard Tessellation Language) format. The threshold was set between −600 and 2500 Hounsfield Units (HU) to create a model with densities to involve hard and soft tissue. In segment editor the designing was done by removing the unwanted area with scissors. The palatal soft tissue morphology along with tumor growth and vestibular depth could be easily differentiated in all 3 CBCT planes due to presence of air adjacent to soft tissue (Fig. 2). The model required was masked and exported as a binary STL file. The binary STL file is imported into Autodesk meshmixer software (Autodesk) for editing the 3D model (Fig. 3). The 3-D model with normal morphology on the left side was mirrored towards the right side (with tumor growth). The model was sculpted and smoothened using digital brushes in software and the 3D model was exported as STL file. The final 3-D model was 3D printed using additive stereolithography using PLA material (WOL-3D). The 3D model was duplicated into dental stone model and surgical obturator was fabricated over the stone model through conventional method.

3. Results

The fit of the surgical obturator was confirmed during surgery after maxillectomy with minimal adjustment, 26-gauge steel wires were used to stabilize the surgical obturator intraorally due to decreased number of abutment teeth and nasal surgical packs (Fig. 4). The border extension of the obturator was adequate. There was no need to reline the surgical operator postoperatively for one month following which mouth opening was improved (Fig. 5) and a delayed surgical obturator was fabricated.

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Fig. 1. Patient with cotton rolls in mouth during CBCT scan.

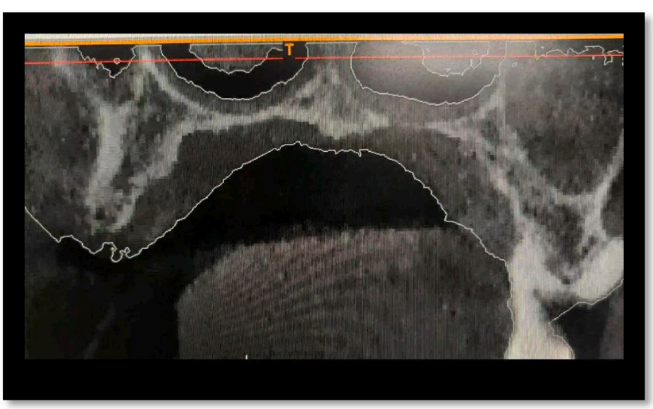

Fig. 2. Designing of STL file and marking the margins for maxilla.

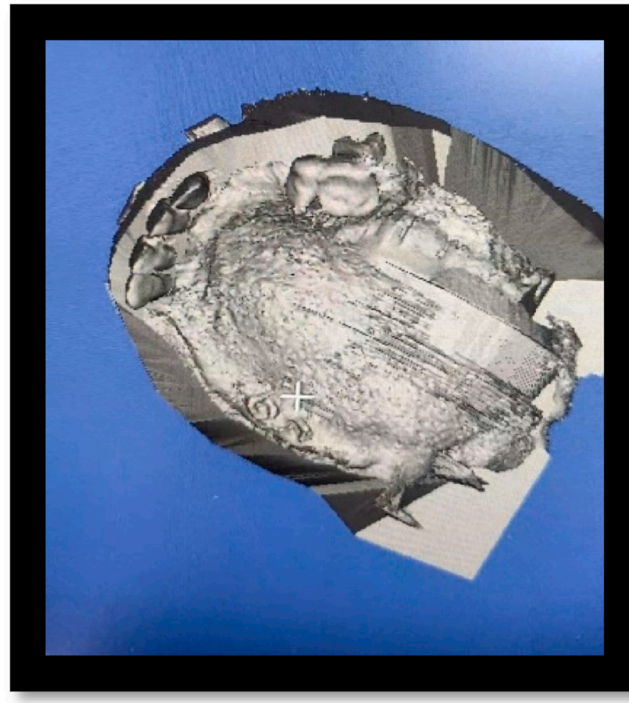

Fig. 3. D virtual model in CAD software.

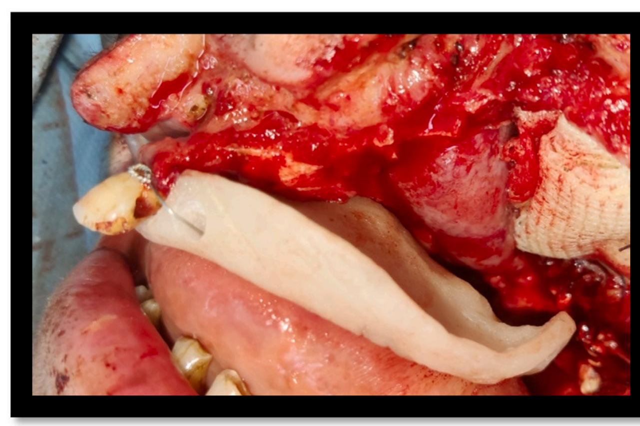

Fig. 4. Fit of Surgical Obturator after maxillectomy.

4. Discussion

The emerging use of 3D technology can aid in the management of such complex situations. Previous studies have shown the fabrication of surgical obturator using (CAD and RP) Computer Aided Design and Rapid Prototyping using DICOM data. Jeff et al.[1] had fabricated one surgical obturator using such means but at a bony level and required relining on a post maxillectomy impression. Theodorous et al.[2] used a combination of digital and analog techniques for the fabrication of interim obturator. Jiang et al.[3] used digital and analog approach for fabrication of obturator in their study. The technique in this article describes how a modification can be done during CBCT which can aid in the 3D designing of a model at soft tissue margin. It also decreases the chances of relining either intraorally or over post-surgical cast. Also, the duration of obturator fabrication is comparable to conventional technique. Thus it can aid in the fabrication of a surgical obturator that can be used immediately after surgery to aid in speech and healing. It will also decrease the dependency on Naso-Gastric tube post surgically and allow them to take food via the oral cavity. Although this method has several advantages over the conventional impression making, a few limitations are; requires CBCT data of the patient, increased cost and technical expertise.

5. Conclusion

This novel method for fabrication of surgical obturator by modification in performing CBCT and 3D designing technique can serve as an alternative for clinicians for cases where conventional impression making is challenging.

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Fig. 5. Evaluation of obturator during follow up.

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