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Case Report

Patient Specific Titanium Implant Post Maxillectomy: The Evolution of Surgical Reconstruction

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ABSTRACT

Background: Malignancies arising from paranasal sinus account for 0.2-0.8% of all malignant neoplasms and 3% of the malignant neoplasms occurring in the head and neck. Surgical treatment of maxillary sinus carcinoma often consists of an open sub-total or total maxillectomy with a subsequent significant defect. Besides, the proximity of the maxillary sinus with complex anatomical structures make reconstruction a major challenge for head and neck surgeons. Reconstruction with temporalis myofascial flap along with titanium implant have proven to be a reliable reconstruction technique. **Objective:** The objective of this case report is to highlight our surgical management and reconstruction method for maxillary sinus cancer. **Methods:** We present a case of maxillary sinus squamous cell carcinoma in a 69 years old patient, who underwent total maxillectomy and reconstruction of surgical defect with 3D printed patient specific titanium implant and temporalis myofascial flap. **Results:** The patient had adequate postoperative functional and aesthetic outcome. The objective of this case report is to highlight our surgical management and reconstruction method for maxillary sinus cancer. **Conclusion:** The reconstruction method brings reliable and satisfactory functional result and quality of life with minimal complications.

Keywords: maxillary sinus carcinoma, temporalis myofascial flap, titanium implant, total maxillectomy

1. Introduction

The incidence of paranasal sinus malignancies is rare, with 80% of these tumors arising from the maxillary sinus [1,2]. Squamous cell carcinoma (SCC) of maxillary sinus is the most common malignancy requiring maxillectomy [3]. The surgical treatment of maxillary tumours often consists of open subtotal or total maxillectomy resulting in significant defect [4]. The objectives of reconstruction are to preserve masticatory and visual functions, seal the oral cavity, ensure nasal breathing and preserve facial aesthetics [5-7]. The volume defect is filled using free flap reconstruction [5-8]. The orbital floor and rim need to be reconstructed with stiff material such as the three-dimensional (3D) printed titanium implant where it creates a precise anatomical reproduction of the defect based on a pre-operative computerized tomography (CT) scan [4,7]. They are also more resistant than mesh, allowing for a more stable reconstruction [4,6,7]. Our purpose was to describe the management of maxillary tumours and the subsequent reconstruction of maxillary defects. Here, we report a case of maxillary sinus malignancy where the patient underwent total maxillectomy and reconstruction of surgical defect with 3D printed patient-specific titanium implant with temporalis muscle flap.

2. Case Presentation

A 65-year-old Chinese lady with known case of nasopharyngeal carcinoma stage 1 complicated with osteoradionecrosis came to our clinic for her regular surveillance follow up. Patient completed her radiotherapy

and has been under remission past 35 years. Patient also had history of tooth extraction 25 years ago which leads to non-healing wound subsequently forming bilateral oroantral fistula. Patient complained of two-month history of intermittent bleeding from oral cavity and right facial swelling. Oral cavity examination showed irregular mass arising from right oroantral fistula. Physical examination did not reveal any cervical lymphadenopathy.

Histopathological (HPE) findings of the mass revealed moderately differentiated, non-keratinizing SCC. CT scan of the brain to the abdomen revealed destruction of maxillary sinus bone with soft tissue mass which is close to the midline of the alveolar process anteriorly. Superiorly, the tumour did not invade the orbit. The masticator space, pterygoid muscles and pterygoid plates are spared. There are no lymph node or distant metastasis. Patient underwent right total maxillectomy, reconstruction with 3D printed titanium infraorbital implant, temporalis myofascial flap as well and temporary obturator. A Weber-Ferguson approach with subciliary and upper lip extensions was performed. A premaxillary cheek flap was then raised until it reached the zygomatic arch. The infraorbital nerve was cauterised and sacrificed. A maxillary bone en bloc resection was performed using the cutting guide. We ensured radical excision and minimised the possibility of margins involvement by frozen section before proceeding with the reconstruction technique. The temporalis myofascial flap was raised, rotated and tunnelled through the subcutaneous flap in order to cover the maxillectomy defect as depicted in Figure 1. The titanium implant was then fixed with screws on to the ipsilateral nasal bone, zygomatic arch and to the opposite maxilla as depicted in Figure 2. The infrastructure defect was closed with temporary obturator. HPE of total maxillectomy specimen showed moderately differentiated SCC. Patient was then started on adjuvant radiotherapy 60 Gy in 30 fractions. There was no evidence of tumor recurrence 6 months post treatment.



Figure 1. Post total maxillectomy with reconstruction with temporalis muscle flap

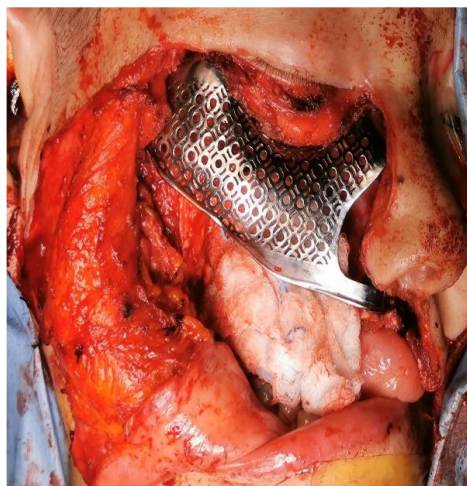


Figure 2. Reconstruction with 3D printed titanium implant

3. Discussion

SCC involving maxilla is the most common malignancy requiring maxillectomy.³ According to the National Comprehensive Cancer Network (NCCN) guidelines, surgical resection is recommended for patients with resectable tumors with no positive margins or extra-lymph node extension.^{2,3} Literature shows that surgery followed by adjuvant radiotherapy is the more common modality of treatment in the maxillary sinus SCC.² In our study, the patient underwent adjuvant radiotherapy with no evidence of tumour recurrence.

Primary reconstruction following surgical resection of tumour has been debatable.^{5,8} It is said that primary closure of the surgical defect can hamper an early detection of recurrence.^{5,8} However, reliable reconstruction ensures radical excision, minimising the possibility of margins involvement and/or recurrence.⁸ There are several methods that can be used to reconstruct the maxilla defect after excision of the tumour such as temporalis myofascial flap where it has a constant vascular supply from the deep temporal and the middle temporal vessels.^{5,8} Use of the temporalis myofascial rotational flap can minimize the functional and cosmetic deficits.^{5,8} However, due to its short arc of rotation, the flap can cover only moderate sized defects.⁸

A titanium implant should be preferred in the case of large size and complex defects that need precise contouring and stability, or when the orbital rim has to be reconstructed.^{4,7} Bone and cartilage tend to resorb and seem less resistant to infection.^{4,7} A titanium mesh with a soft tissue flap is also used to provide support to the eyeball.⁶ This material provides greater precision and can be easily shaped as needed but the fragile material can be unstable.⁶ 3D visualization is available for surgical planning and the design of surgical guides and implants.^{4,7} This process is performed in a medical computer-aided design software program.^{4,7} A 3D printed titanium implant has the advantage where it precisely fills the blank space and provides high stability.^{4,7} Using this implant is a time-saver during surgery because of the absence of a second site, the use of the bone-cutting guides and better adaptation to the defect.^{4,7} For moderate maxillary defects, reconstruction may only consist of screwing the implant in and covering it with a pedicle fascia temporalis flap.^{4,7} The rich vascularisation of the face and flap as well as the porous design of the implant, which provides host-cell integration, reduces bacterial contamination.^{4,7} No infection occurred in our case.

Additionally, the surgical obturator placed during surgery provides a matrix for surgical packing, reduces oral contamination, enables the patient to speak more effectively and lessens the psychological impact of the surgery.^{3,5,8} Three to four months after surgery, the definitive prosthesis may be constructed depending on the size of the defect, prognosis of healing and tumor control.^{3,5,8}

This reconstruction technique mentioned above allows a large resection with acceptable functional and aesthetic outcomes with satisfactory oncological resection.⁴ However, it cannot be substituted for the use of free flap reconstruction to fill the volume defect after maxillectomy in all cases.⁴ Furthermore, its additional cost must be considered and balanced with its benefits.⁴

4. Conclusion

Patient specific 3D printed titanium implant and temporalis muscle flap is a reliable technique for reconstruction post total maxillectomy with satisfactory functional result. It should be considered an alternative among other orbital floor and rim reconstruction techniques. However, further studies including more patients and a longer follow-up are needed to reach definite conclusions.

5. Data Availability Statement

All data supporting the findings of this study are available within the paper. The data are provided as images (Figure 1, Figure 2 and Figure 3).

6. Ethical Statement

The patient provided written informed consent for the publication of this case report and the accompanying images.

7. Author Contributions

All authors contributed to the design and implementation of the research, data analysis, and finalizing the manuscript.

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10. Conflict of Interest

Authors declares no conflict of interest.

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