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Prosthetically Driven Maxillofacial Rehabilitation with Implant Supported Overdenture: A Case Report

Mahdi Zahedi [1*], Azam Sadat Mostafavi [2]

1. Department of Prosthodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran.

2. Department of Prosthodontics, Dental Research Center, Dentistry Research Institute, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran.

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**Corresponding author:*
Mahdi Zahedi

Department of Prosthodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran.

Tel: +98-912-8698394
Fax: +98-21-84903747
Email: m-zahedi@razi.tums.ac.ir

ABSTRACT

This clinical report describes the prosthetic rehabilitation of a patient following a maxillary resection performed to treat Mucoepidermoid Carcinoma. Following hemi maxillectomy and total resolution of the tumor, implant placement was digitally planned to use the dual-scan technique, and implants were surgically inserted with the aid of a printed acrylic surgical guide. After successful osseointegration, a removable implant-supported overdenture retained by stud attachments was fabricated to improve prosthetic stability and minimize rotational and translational displacement under functional loading.

Keywords: Maxillary defect; Implant-supported overdenture; Prosthetically driven implant insertion; Maxillofacial prosthesis.

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Introduction

Mucoepidermoid Carcinoma (MEC) accounts for approximately 10% of all salivary gland tumors and represents nearly 35% of malignant neoplasms within this group. Among salivary gland tumors, Mucoepidermoid Carcinoma is considered one of the most clinically significant tumor types, with its prognosis varying according to the histopathological grading system [1,2]. About two-thirds of Mucoepidermoid Carcinoma cases occur in the parotid gland, while the remaining one-third develop in the minor salivary glands [3,4]. The most common therapeutic intervention for Mucoepidermoid Carcinoma involves wide surgical resection.

A successful treatment outcome is characterized by disease-free survival. However, due to the aggressive nature of the treatment protocol, patients often experience severe tissue morbidity, which can significantly compromise their quality of life. The most common strategy for the rehabilitation of these patients involves prosthetic reconstruction. Unlike small palatal defects, which can be surgically reconstructed using pedicled or microvascular free flaps, extensive defects often require rehabilitation with an obturator in combination with a maxillofacial prosthesis [5]. Maxillary defects can be classified according to various classification systems described in the literature. These classifications are valuable not only for descriptive purposes but also for guiding surgeons during the reconstruction and rehabilitation phases. Among these systems, the Aramany Classification is highly regarded for maxillectomy defects, offering valuable guidance for prosthodontists in obturator design, although it has certain limitations in accurately describing the surgical defect [6,7].

The introduction of implant-supported prostheses has significantly improved rehabilitation outcomes by enhancing retention, stability, and load distribution. However, implant placement in post-ablative maxilla is often challenging due to reduced bone volume, altered anatomy, and unfavorable force vectors. Consequently, careful prosthetically driven planning, often incorporating digital workflows, is essential to optimize implant positioning and biomechanical performance [8,9]. This clinical report describes the prosthetic rehabilitation of a post-ablative maxilla using a removable implant-supported overdenture, incorporating a prosthetic approach and digitally guided surgical planning.

Clinical Report

A 59-year-old male patient diagnosed with Mucoepidermoid Carcinoma was referred to Shariati Hospital, Tehran University of Medical Sciences, for surgical management. Histopathological examination confirmed a low-grade tumor. The patient underwent surgical excision of the lesion, followed by uneventful healing of the surgical site. After completion of healing, the patient was referred to an oncologist for evaluation of the need for adjuvant therapy, including radiotherapy and chemotherapy. Based on the oncological assessment, no additional adjuvant treatment was indicated. The patient was subsequently referred to the Department of Prosthodontics, Tehran University of Medical Sciences, for prosthetic rehabilitation. As shown in Figure 1, the maxilla presented with three remaining anterior teeth and was classified as an Aramany Classification Class II defect. The mandible exhibited a splinted fixed partial denture supported by five remaining teeth; however, these teeth demonstrated poor prognosis due to extensive endodontic lesions and grade III mobility.

Radiographic evaluation (Figure 1) and consultation with the periodontology department revealed a poor prognosis for the maxillary dentition and a hopeless prognosis for the mandibular dentition. The initial treatment plan included an implant-supported obturator for the maxilla and an implant-supported overdenture for the mandible. Informed consent was obtained, and prosthodontic diagnostic procedures were initiated to determine optimal implant positions and fabricate a surgical guide. The mandibular teeth were extracted, while the maxillary teeth were temporarily preserved to aid in record base stabilization. Primary impressions of both dental arches were taken using high-viscosity irreversible hydrocolloid impression material.

Diagnostic casts were poured, and self-cure acrylic (Pars Dental Company, Tehran, Iran) record bases with wax rims (Cavex Holland BV, Haarlem, Netherlands) were fabricated to establish the vertical dimension of occlusion and record centric relation (Figure 2). The wax rims were adjusted according to established prosthodontic landmarks, including lip commissural level, half of the retromolar pad height, interpupillary line (anterior plane), and Camper's line (posterior plane). Centric relation was recorded by Zinc Oxide Eugenol bite material (Kerr Corporation, Orange, CA, USA), and facebow transfer was performed. The casts were mounted on a semi-adjustable articulator (Mani Inc., Utsunomiya, Tochigi, Japan) as shown in Figure 3. Artificial teeth were chosen and arranged following complete denture principles. After the intraoral try-in and approval, the setup was marked with radiopaque fiducial markers (Figure 3) to superimpose the denture

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and radiographs accurately. The patient subsequently underwent a large-field CBCT scan while wearing the radiographic dentures in the established maxillomandibular relationship. Following CBCT acquisition, the dentures were scanned using a laboratory scanner (Medit Corp., Seoul, South Korea) in the correct maxillomandibular relationship. Based on radiographic assessment and surgical consultation, five implant sites were planned in the maxilla (central incisors, canine, first premolar, and first molar regions on the intact side), while four mandibular implants were planned in positions A, B, D, and E to optimize load distribution. Dentis S-Q implants were selected.

Surgical guide design was performed using Exoplan (Figure 4) software (exocad GmbH, Darmstadt, Germany). After virtual planning, surgical guides were fabricated using a DLP printer (Anycubic Technology Co., Ltd., Shenzhen, China) and transparent resin fluid (Anycubic Technology Co., Ltd., Shenzhen, China) and post-processed according to standard protocols. The surgical field was disinfected with povidone–iodine solution for 30 minutes before implant placement. Implant placement was performed using the guided surgical protocol with the Dentis SQ implant surgical kit (Figure 5). After six months, implant placement in the first premolar and molar regions was completed using a freehand approach due to sinus augmentation requirements and staged placement planning. Following an additional four-month healing period, the definitive prosthetic phase was initiated.

Open-tray impression copings were secured, and plastic trays were perforated in the impression coping location. Preliminary impressions were made using condensation silicone (Sildent, Tehran, Iran) with a one-step putty-wash technique. After pouring primary casts, an impression jig in conjunction with a special acrylic tray was constructed. The tray with a spacer and perforation was made for the maxilla, and a sectional tray without space in the posterior area and with space in the anterior part was constructed. Impression jig cutting and splinting were performed, a special tray was adjusted, and border molding was completed with greenstick compound (Kerr Corporation, Orange, CA, USA), and final impressions were taken using medium-body addition silicone materials (Betasil, Müller-Omicron GmbH & Co. KG, Lindlar, Germany) for the whole maxilla and incorporation with zinc oxide–eugenol impression paste (Cavex Holland BV, Haarlem, Netherlands) in the posterior mandible (Figure 6). Master casts were poured with dental stone, and verification jigs were constructed to confirm the accuracy of implant positions. Stabilized record bases were then fabricated over the healing abutments, and wax rims were prepared. Adjustment of the wax rims and recording of maxillomandibular relationships were performed using the same protocol as in the diagnostic phase. The casts were subsequently mounted on a semi-adjustable articulator, and composite denture teeth A2 shade (Yamahachi Dental Mfg., Co., Gamagori, Aichi, Japan) were arranged according to conventional complete denture principles (Figure 7). An intraoral try-in was performed to verify the accuracy of maxillomandibular records and tooth arrangement. To achieve improved control of functional forces transmitted to the prosthesis, stud attachments (Kerator, Dentium Co., Ltd., Seoul, South Korea) were selected and positioned with their long axes parallel to the occlusal plane. Relief and block-out procedures were performed on the master casts, followed by completion of the framework wax-up and subsequent casting of the metal framework (Figure 7).

The prosthetic teeth were then repositioned, and a second intraoral try-in was carried out to evaluate occlusion, phonetics, and lip support. Denture processing was completed using a conventional heat-polymerized compression molding technique. Laboratory remounting and occlusal equilibration were subsequently performed, and after final finishing and polishing, the prostheses were prepared for delivery. The Kerator attachments were secured intraorally according to the manufacturer's recommended torque values, and the definitive prostheses were delivered. Occlusion was refined to achieve balanced articulation, and the patient's phonetics were reassessed (Figure 8). At the 24-hour follow-up appointment, minor pressure areas were relieved, and the patient was subsequently enrolled in a regular follow-up protocol.

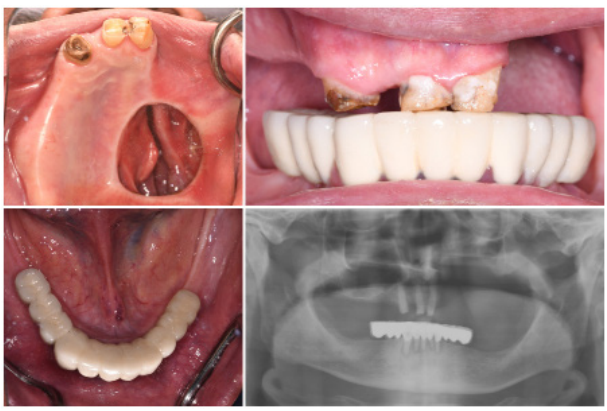


Figure 1. Pretreatment photos and radiographs.

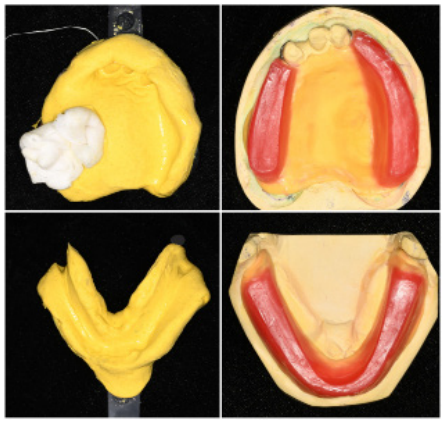


Figure 2. Primary impressions, casts and record base with wax rims.



Figure 3. Wax rims and occlusal plan determination, Centric relation record, mounting on SA articulator, initial teeth set-up, fiducial marker attachment.

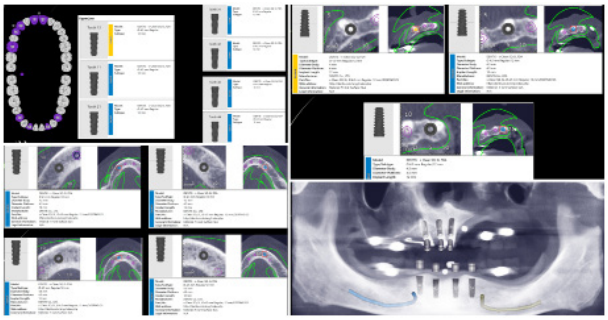


Figure 4. Surgical guide design.

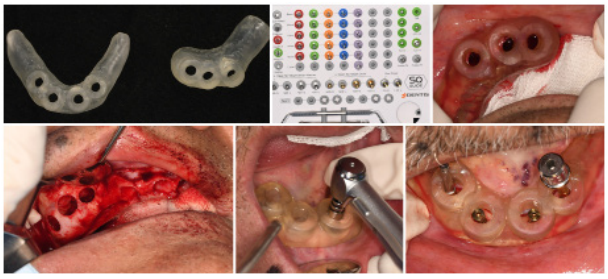


Figure 5. Guided surgery and implant placement.

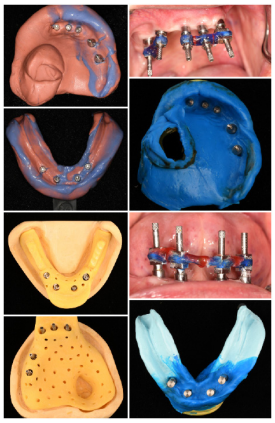


Figure 6. Primary impression, border molding, impression jig splinting and final impression.



Figure 7. Base and wax rim adjustment, CR recording, mounting in SA articulator and final teeth set-up. Attachment try in and framework wax-up.



Figure 8. Delivery; Frontal, occlusal, intaglio and smile view of processed denture.

Discussion

Rehabilitation of patients with post-maxillectomy defects continues to pose a difficult therapeutic problem for surgeons, dentists, and biophysicists. The present patient was diagnosed with low-grade mucoepidermoid carcinoma and underwent hemi maxillectomy, resulting in an Aramany Class II defect. Class II defects imply unilateral absence of posterior support with un-

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favorable rotational forces [10,11]. Another issue associated with treating patients with post-maxillectomy defects relates to the management of loading and rotation. It has been established that prosthetic maxillary implant supports are subject to multiple stresses caused by multidirectional forces due to an absence of posterior osseous support and long prosthetic lever arms that may lead to the development of micromovements in the implant-bone complex [12,13]. In the present case, a digital workflow, which included a prosthetic model, was used to optimize the number, angulation, and placement of the implants in accordance with the occlusal design, such that there is minimal prosthetic cantilever, optimal load transfer between the implants, and absence of focal stress concentration on the implants.

In post-ablative maxillary rehabilitation, implant placement is challenging because of altered anatomy, limited and irregular bone availability, and fewer suitable implant sites. Therefore, precise three-dimensional implant positioning and angulation are critical to optimize bone engagement, avoid anatomical structures, and achieve appropriate prosthetic emergence, implant distribution, and biomechanics. Implant placement should consequently be prosthetically driven according to the planned prosthetic design and occlusal scheme. Computer-guided surgery facilitates accurate transfer of the virtually planned implant positions to the surgical site and provides greater positional and angular accuracy than freehand placement [14,15]. While comparing stud-type retainers with the bar type, advantages such as better hygiene access and thinner frameworks can be considered with adequate retention. Nevertheless, they could potentially provide higher prosthetic mobility and therefore need careful balancing of occlusion and correct placement of implants [16]. In conclusion, it can be said that the rehabilitation of ablative maxilla defects not only assumes the survival of dental implants but also a certain prosthetic approach based on biomechanics. This particular case demonstrates the possible benefits of incorporating digital planning into treatment planning that is prosthetically based, particularly for post-ablative maxillary defects.

Conflict of Interest

There is no conflict of interest to declare.

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