

CLINICAL REPORT

An alternative impression technique for capturing anatomic undercuts to rehabilitate a patient with a total maxillectomy: A clinical report



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Rehabilitating a patient after a maxillectomy with a conventional obturator prosthesis can be an effective way of restoring speech, deglutition, and mastication. Obturator rehabilitation remains a viable option for most maxillary defects because of low cost, limited morbidity, decreased hospital stay, and the ease of prosthesis modification.^{1,2} The extent of these defects can vary greatly among patients and depends on tumor characteristics and resection size; as a result, as the size of the defect increases, the amount of retention, stability, and support for the prosthesis decreases. The degree of movement of such prostheses depends on the number of teeth present, size and shape of the defect, and the amount of residual alveolar ridge.³⁻⁶ Prosthodontic principles such as axis of rotation, vertical forces during mastication, shape of remaining alveolar ridge, and resistance to vertical forces all play an important role in maintaining the stability of the obturator.⁵⁻⁷

The rehabilitations of a total maxillectomy can be challenging because of the lack of anatomic structures to support and retain large prostheses. Concomitant or adjuvant therapies to the tumor bed and associated oral morbidities, including microstomia, delicate soft tissues, xerostomia, and trismus, also hamper the prosthetic

ABSTRACT

Patients who have undergone a bilateral maxillectomy are particularly difficult to rehabilitate prosthetically by using a conventional obturator prosthesis, mainly because of the extensive loss of tissues for retention and support. In these situations, adapting to existing undercuts within the defect is essential. Traditional impression techniques capture certain anatomic landmarks but may fall short of the needed sinus undercuts. This article describes an alternative impression technique for capturing 3 opposing undercuts to help retain, support, and stabilize a hollow 1-piece obturator prosthesis for a patient who underwent a total maxillectomy. (*J Prosthet Dent* 2019;122:412-6)

outcome. In-depth evaluation of what remains and what can be used to support and retain the planned prosthesis is essential. Occasionally, the limited options for retention can be frustrating and require creative problem solving. Such hindrances are related to the available anatomic undercuts, access to these areas, and the divergent paths among them. Large surface areas that these types of prostheses replace can result in increased weight. To help minimize this burden, the hollowing technique has been described.⁸

Complex options have been presented for the rehabilitation of total maxillectomy defects⁹⁻¹³ as well as vascularized surgical reconstruction.¹⁴⁻¹⁸ Each of these options have specific applications, and some present complications related to the materials used¹⁹; nonetheless, these have been addressed.²⁰

The decision between surgical reconstruction with a flap or prosthetic rehabilitation with an obturator is complex and multifactorial and is often based on the

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surgeon's preference and experience.²¹⁻²⁴ However, patient preference, medical comorbidities, financial constraints, pain, and other conditions must be taken into consideration with each patient. This clinical report shows an alternative impression technique for capturing opposing undercuts to retain a hollow 1-piece maxillary definitive obturator prosthesis for a patient with a total maxillectomy.

CLINICAL REPORT

A 70-year-old white woman presented to the Section of Oral Oncology and Maxillofacial Prosthodontics at MD Anderson Cancer Center (MDACC) for consideration of prosthetic rehabilitation for a maxillary defect. She was initially treated in 2012 for a T4N0M0 squamous cell carcinoma of the premaxilla. After a thorough diagnostic evaluation, she underwent induction chemotherapy with moderate response. This was followed by central midline infrastructure maxillectomy, subtotal palatotomy, resection of the floor of the nose, split thickness skin graft, and insertion of a surgical obturator. The defect extended from left to right maxillary first molar. These procedures were followed by postoperative external beam radiation specifically intensity-modulated radiation therapy (IMRT). The preoperative bed received 60 Gy in 30 total fractions. She was treated with 3 distinct phases of rehabilitation. After postradiation healing, she was rehabilitated with a definitive obturator by using second molars bilaterally; these teeth had a guarded prognosis after surgery, although they were useful in her early care. She successfully used the first definitive obturator until 2015. As anticipated, 1 of the abutment teeth became periodontally compromised and infected and was extracted without complications (Fig. 1). The second tooth became mobile several months later and was also extracted. After both abutment teeth had been removed, the existing maxillary obturator was nonretentive; however, the patient was accustomed to the esthetics and phonetics of the prosthesis and did not want to lose these important features. The immediate need to obturate the defect led the clinicians to modify the existing prosthesis with a novel technique.

The evaluation of the edentulous maxillary defect led to the identification of functional undercuts in the sinus remnants and floor of the nose. For ease of insertion and removal of the obturator, a conventional approach to obtaining the definitive impression was determined to be inadequate. The existing prosthesis provided a good scaffold to guide the effort rather than starting over, and so an alternative approach was used to obtain the impression.

The existing prosthesis was used as a tray. Areas to be modified were marked on the prosthesis by using an indelible marker intraorally. Large access holes were

drilled on the marked areas by using a cutter tungsten carbide laboratory bur (Brasseler USA) from the cameo surface to the intaglio surface in the selected areas: 1 anterior and 2 posterior (Fig. 2). These access areas were sufficiently large for the operator's finger to fit and allowed direct manipulation of the tissue conditioner material (Trusoft; Bosworth Co) superiorly and laterally into the undercuts.

Tissue conditioner was mixed to a slightly thicker consistency than recommended by the manufacturer. This was loaded by using a spatula onto the intaglio surface and manipulated into the undercuts. Once retention was achieved, the newly impressed areas were evaluated for voids extraorally. All the irregularities were filled in with the same material until a uniform impression was obtained. After the procedure was completed and retention was adequate, the patient was allowed to function with the prosthesis for 24 hours. Thereafter, the patient was satisfied with the enhancements, and pressure spots were not encountered. After the 24-hour trial, the functional impression was taken to the laboratory, and the tissue conditioner was replaced with heat-polymerized materials, acrylic resin, and a definitive silicone soft liner (Molloplast B; DETAX) (Figs. 3, 4). The materials were processed conventionally with trial packing. The silicone soft liner was placed into the undercuts, whereas the remainder consisted of acrylic resin.

After processing, excess materials were trimmed, and the obturator was hollowed through the cameo surface to reduce weight. A lid was created and bonded to the obturator with light-polymerized material (Triad Gel; Dentsply Sirona). After complete polymerization, the prosthesis was polished and delivered. Adjustments were made as needed.

DISCUSSION

The supporting structures of the maxillary abutment teeth were compromised by the surgical intervention, radiation morbidities, and prosthesis load. This resulted in significant bone loss and tooth mobility. Although hyperbaric oxygen therapy (HBO) was considered preoperatively, it was contraindicated for this patient because the teeth were minimally supported by bone at the time of extraction. Healing was unremarkable in both sockets.

The patient inquired about further prosthetic rehabilitation options as her teeth failed. She was presented with different treatment options including osteocutaneous free flap reconstruction (fibula) with an implant-retained and supported obturator prosthesis or a conventional obturator prosthetic rehabilitation. The treating specialists felt that a surgical reconstruction would be the best treatment option, and the patient declined flap surgery because of the extended surgery and recovery

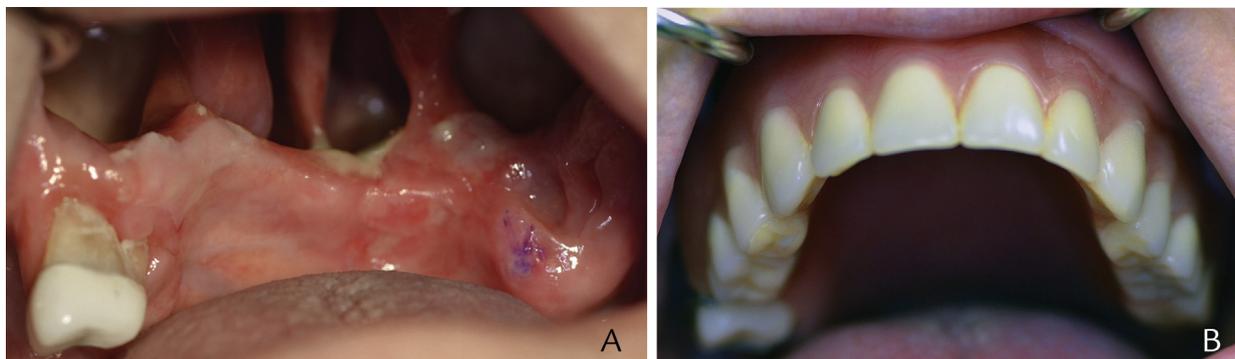


Figure 1. A, Maxillary defect without prosthesis (notice second molar with extensive bone loss and anterior maxillary defect). B, Definitive obturator prosthesis.



Figure 2. A, Cameo surface of maxillary obturator. B, Intaglio surface of maxillary obturator. Access holes (arrows) used to allow direct manipulation of impression material to engage opposing undercuts in posterior lateral sinus and anterior nasal space.

time. Prosthetic options used for the rehabilitation of total maxillary defects have been described as engaging undercuts in anatomic structures,⁹ fabrication of a maxillary obturator retained by an extraoral device,¹⁰ and fabrication of a prosthesis in various segments joined by retentive magnets¹¹; some have used a combination of materials such as titanium frameworks and removable copolymers¹² and zygomatic implants to retain the prosthesis.¹³

A thorough evaluation of the maxillary defect after the loss of the abutment teeth revealed accessible and useful anatomic surfaces for retention and support of the proposed modified 1-piece maxillary hollow obturator prosthesis. Positive findings in this patient were the lack of trismus, lack of contracture of the maxillary lip, and salivary competency in spite of curative IMRT therapy. The patient also exhibited good coordination and dexterity.

After the dental extractions, the patient required immediate obturation. The prosthesis did not engage significant retentive undercuts due partially to the path of insertion among the existing teeth and tumor-ablate areas. The existing obturator was markedly modified allowing direct placement and manipulation of

impression material in the undercut areas, particularly the lateral and posterior areas of the sinus cavities and the anterior nasal floor. The selection of tissue conditioner material was for ease and flow of the material into and out of the desired areas. For maximum retention benefit, all 3 retentive areas were used, in contrast with the prosthesis described by Pigno and Funk⁹ who used only 1 site. Extension into 3 retentive areas helped simplify the design.

Once the impression of the defect was obtained, the intaglio surface of the obturator was processed by using a combination of materials, heat-polymerizing acrylic resin, and a definitive soft-liner silicone material for strategic undercut areas. This approach duplicated the effect accomplished by the impression technique without fear of locking the prosthesis in place. After processing the prosthesis, it was heavy and required hollowing. The cameo surface was selected similar to previously published techniques.⁸ The patient's dexterity also played an important role in the success of this prosthesis. The insertion process was carefully explained and demonstrated by the clinician and replicated by the patient. Care was taken to prevent tissue damage.



Figure 3. Lateral and intaglio surface of definitive maxillary obturator after processing with acrylic resin and Molloplast B materials.

The disadvantage of the combination of materials is the degradation and bacterial contamination of the silicone material, requiring periodic replacement to prevent stomatitis as stated by Budtz-Jorgensen.¹⁹ In addition, frequent follow-up appointments, in which the maxillary defect is examined and the silicone material exchanged, can be challenging and time consuming. Detailed and personalized home care instructions for the hygiene of the defects and cleansing of the obturator prosthesis are



Figure 4. Cameo surface of obturator. Prosthesis hollowed from cameo surface not affecting retentive elements of intaglio surface and reducing weight.

important at each return visit as emphasized by past clinicians.²⁰

SUMMARY

An alternative impression technique was presented for a patient with a history of bilateral maxillectomy and complete loss of maxillary dentition. The patient's existing obturator was used as a scaffold, which facilitated the orientation and simplification of the overall impression process. The result demonstrates the rehabilitation of an extensive maxillary defect with a 1-piece hollow prosthesis retained simply by engaging bilateral and opposing undercuts within the maxillary defect.

REFERENCES

1. Breeze J, Morrison A, Dawson D, Tipper J, Rehman K, Grew N, et al. Health-related quality of life after maxillectomy: Obturator rehabilitation compared with flap reconstruction. *Br J Oral Maxillofac Surg* 2016;54:857-62.
2. Chigurupati R, Aloor N, Salas R, Schmidt BL. Quality of life after maxillectomy and prosthetic obturator rehabilitation. *J Oral Maxillofac Surg* 2013;71:1471-8.
3. Chambers MS, Lemon JC, Martin JW. *Head and neck surgery-otolaryngology*. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2006. p. 1853-65.
4. Brown KE. Peripheral consideration in improving obturator retention. *J Prosthet Dent* 1968;20:176-81.
5. Desjardins RP. Obturator prosthesis design for acquired maxillary defects. *J Prosthet Dent* 1978;39:424-35.
6. Keyf F. Obturator prostheses for hemimaxillectomy patients. *J Oral Rehabil* 2001;28:821-9.
7. Beumer J III, Marunick MT, Esposito SJ. *Maxillofacial rehabilitation: prosthodontic and surgical management of cancer-related, acquired, and congenital defects of the head and neck*. 3rd ed. Chicago, IL: Quintessence Publishing Co; 2011. p. 33.
8. Chalian VA, Barnett MO. A new technique for constructing a one-piece hollow obturator after partial maxillectomy. *J Prosthet Dent* 1972;28:448-53.
9. Pigno MA, Funk JJ. Augmentation of obturator retention by extension into the nasal aperture: a clinical report. *J Prosthet Dent* 2001;85:349-51.
10. Aponte-Wesson R, Carroll W, Waite P, Seidenfaden JC. Interim obturator retained by an extraoral device: a clinical report. *J Prosthodont* 2008;17:582-5.
11. Sasaki H, Kinouchi Y, Tsutsui H, Yoshida Y, Karv M, Ushita T. Sectional prostheses connected by samarium-cobalt magnets. *J Prosthet Dent* 1984;52:556-8.
12. Reitemeier B, Schaal W, Wolf A, Walter M. Sealing maxillary titanium obturators with removable flexible caps. *J Prosthet Dent* 2016;115:381-3.

13. Shirota T, Shimodaira O, Matsui Y, Hatori M, Shintani S. Zygoma implant-supported prosthetic rehabilitation of a patient with maxillary defect. *Int J Oral Maxillofac Surg* 2011;40:113-7.
14. Gbara A, Darwich K, Li L, Schmelzle R, Blake F. Long-term results of jaw reconstruction with microsurgical fibula grafts and dental implants. *J Oral Maxillofac Surg* 2007;65:1005-9.
15. Jacobsen C, Kruse A, Lubbers HT, Zwahlen R, Studer S, Zemann W, et al. Is mandibular reconstruction using vascularized fibula flaps and dental implants a reasonable treatment? *Clin Implant Dent Relat Res* 2014;16:419-28.
16. Chapeha DB, Teknos TN. *Head and neck surgery-otolaryngology*. 4th ed. Philadelphia, PA: Lippincott William & Wilkins; 2006. p. 2369-91.
17. Handschel J, Burghardt S, Naujoks C, Kubler NR, Giers G. Parameters predicting complications in flap surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2013;115:589-94.
18. Brown JS, Shaw RJ. Reconstruction of the maxilla and midface: introducing a new classification. *Lancet Oncol* 2010;11:1001-8.
19. Budtz-Jorgensen E. The significance of *Candida albicans* in denture stomatitis. *Scand J Dent Res* 1974;82:151-90.
20. Skupien JA, Valentini F, Boscato N, Pereira-Cenci T. Prevention and treatment of *Candida* colonization on denture liners: a systematic review. *J Prosthet Dent* 2013;110:356-62.
21. Moreno MA, Skoracki RJ, Hanna EY, Hanasono MM. Microvascular free flap reconstruction versus palatal obturation for maxillectomy defects. *Head Neck* 2010;32:860-8.
22. Borlase G. Use of obturators in rehabilitation of maxillectomy defects. *Ann R Australas Coll Dent Surg* 2000;15:75-9.
23. Brown L, Rieger JM, Harris J, Seikaly H. A longitudinal study of functional outcomes after surgical resection and microvascular reconstruction for oral cancer: tongue mobility and swallowing function. *J Oral Maxillofac Surg* 2010;68:2690-700.
24. Cordeiro PG, Chen CM. A 15-year review of midface reconstruction after total and subtotal maxillectomy: part I. Algorithm and outcomes. *Plast Reconstr Surg* 2012;129:124-36.

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Noteworthy Abstracts of the Current Literature

Comparison of various implant provisional resin materials for cytotoxicity and attachment to human gingival fibroblasts

Shim JS, Kim HC, Park SI, Yun HJ, Ryu JJ

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Purpose. The aim of this study was to evaluate the responses of human gingival fibroblast (HGF-1) in contact with provisional materials with various chemical compositions and fabricated using different methods.

Material and methods. A total of 210 specimens in eight experimental groups were used. Groups were divided by chemical compositions (poly[ethyl methacrylate], poly[methyl methacrylate], bis-acryl, and hybrid ceramic) and fabricating methods (direct, indirect, and computer-aided design/computer-aided manufacturing [CAD/CAM]). To evaluate the surface characteristics of each group, roughness, water contact angle, and degree of conversion were measured. The responses of HGF-1 to provisional materials were evaluated with cytotoxicity and cell attachment assay. The roughness, surface energy, degree of conversion, level of cytotoxicity, and cell attachment were compared between groups using one-way analysis of variance (ANOVA) and Tukey's multiple comparison ($\alpha=.05$).

Results. The poly(ethyl methacrylate)-direct/indirect and poly(methyl methacrylate)-direct/indirect groups showed higher roughness than the bis-acryl-direct/indirect, poly(methyl methacrylate)-CAD/CAM, and hybrid ceramic-CAD/CAM groups with statistical significance ($P<.05$). The poly(ethyl methacrylate)-direct group showed the significantly highest water contact angle, and the hybrid ceramic-CAD/CAM group showed the lowest water contact angle ($P<.05$). The groups that used indirect fabrication methods showed a higher degree of conversion than those that used direct fabrication methods, regardless of chemical composition ($P<.05$). The poly(ethyl methacrylate) groups showed significantly lower cell viability than the other groups regardless of fabricating methods ($P<.05$). The poly(ethyl methacrylate)-direct method group showed the lowest cell attachment, and the hybrid ceramic-CAD/CAM method group showed the highest cell attachment ($P<.05$).

Conclusions. Poly(methyl methacrylate) and bis-acryl have lower cytotoxicity to HGF-1 than poly(ethyl methacrylate). Indirect fabrication and CAD/CAM are recommended to prevent residual monomer and achieve high cell attachment. To use direct fabrication methods, the auto-mix system is beneficial for the favorable cell response, as it derives a smooth surface.

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