

Case Report

Maxillary hollow-bulb obturator: A paradigm shift

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Abstract

Maxillary defects, whether congenital or acquired, make a patient encounter an array of physical and psychological difficulties, leading to an extremely poor quality of life. Rehabilitation of such a patient is often challenging due to the extent of the defect area coupled with the absence of adequate retention caused by the size and weight of the prosthesis. Further, providing a proper seal of the oronasal communication is of utmost importance to restore function. Taking the above factors into consideration, a combination of hollow-bulb obturator consisting of a titanium framework and a flexible, snap-on silicone cap is an effective prosthesis providing a long-term treatment, increased retention, and a happy patient. The fabrication protocol included the use of computer-aided design, titanium along with laser welding, and an intraoral trial before final fabrication, hence, reconfirming the success of the prosthetic design. The maxillary obturator presented in this article eliminates several disadvantages associated with a conventional hollow-bulb obturator, thereby providing a novel, viable option for a maxillofacial prosthodontist.

Keywords: Computed-aided design-computed-aided manufacturing, laser welding, obturator prosthesis, silicone cap, titanium

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INTRODUCTION

An obturator is a maxillofacial prosthesis used to close, cover, or maintain the integrity of the oral and nasal compartments resulting from a congenital, acquired, or developmental disease process. The prosthesis facilitates speech and deglutition by replacing those tissues lost and can, as a result, reduce nasal regurgitation and hypernasal speech and improve articulation, deglutition, and mastication.^[1]

The extent and location of the maxillary defect directly impact the degree of impairment and difficulty of

prosthetic rehabilitation, in the process crippling the patient both functionally and psychologically. The defect area is generally button shaped requiring a large bulk of material, inevitably making the prosthesis heavy and unretentive.

Patients requiring an obturator prosthesis are generally completely or partially edentulous due to the nature of the resection. A conventional obturator is typically fabricated using acrylic resin and a cobalt-chromium palatal framework, along with an acrylic hollow bulb, to decrease the weight of the prosthesis.^[2] While a hollow bulb is lighter than the solid shape, it is heavier than a conventional removable prosthesis.^[3,4] Further, acrylic being a rigid

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material may impinge on the delicate mucosa in the defect undercuts, leading to sore spots and abrasions.

A synergy of partial or complete edentulism and increased weight of the prosthesis lead to an end result of compromised retention. This is further amplified by the inability to utilize the defect undercuts for retention.

Due to the limitations of a conventional, rigid obturator, a prosthetic design which involved a combination^[5] of a rigid titanium framework with a bulb and a flexible removable silicone cap was considered.

CASE REPORT

A 50-year-old male presented to the Department of Prosthodontics and Implantology with partial maxillary edentulism, a history of uncontrolled diabetes, and a mucormycosis infection which resulted in resection of the hard palate, leading to an Aramany Class VI maxillary defect [Figure 1]. On intraoral examination, he presented with an abrasion on the inferior turbinate within the

defect due to the existing prosthesis, which was a rigid, two-piece, magnetic acrylic obturator [Figure 2]. In due course of time, along with causing laceration of the delicate mucosa in the defect area, the prosthesis did not provide an adequate seal, resulting in the passage of nasal contents into the oral cavity and vice versa. This leads to the presence of malodor, unclear speech, handicapped masticatory function accompanied by poor nutritional status, discomfort, and an overall poor quality of life. Dissatisfied with his current prosthesis, the patient requested for a replacement.

Primary impressions were made using a medium-fusing compound (Y-dents, MDM Corporation) in the defect area and an irreversible hydrocolloid material (tropicalgin, zhermack) [Figure 3], followed by the fabrication of a special tray and final impressions with low-fusing compound (DPI Pinnacle Tracing Sticks) and a monophasic polyether wash impression (Aquasil, Dentsply) [Figure 4].



Figure 1: Aramany Class VI maxillary defect



Figure 2: Two-piece magnetic acrylic obturator

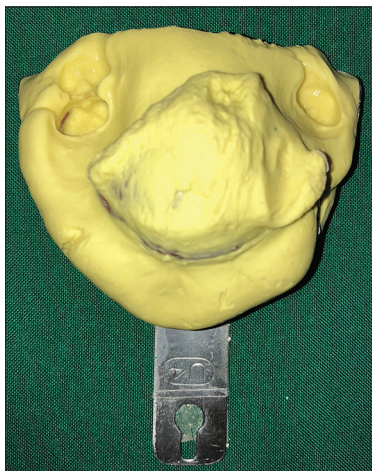


Figure 3: Primary impression

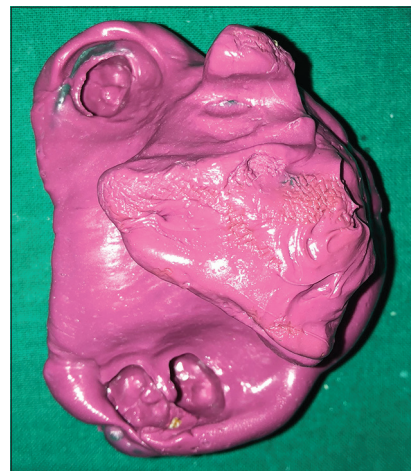


Figure 4: Final impression

A definitive cast was made and digitally scanned, and the framework as well as hollow obturator bulb was planned using a computer-aided design (CAD) (Exocad software). A contemporary three-dimensional (3D) design technique [Figure 5] was considered rather than the conventional wax-up to facilitate a holistic analysis of the final prosthesis. Further, the designed obturator bulb was milled in a poly (methyl methacrylate) (PMMA) material [Figure 6] before final fabrication to facilitate a definitive trial in the patient's mouth.

The design of the obturator bulb included a peripheral undercut 2.5 mm in width, encompassing the entire outer diameter of the bulb as it joined the underlying palatal framework. This aided in retention of the silicone cap. Five grooves, 1.5-mm deep, were provided on the surface of the bulb to allow correct orientation and additional retention of the removable cap.

Once the trial was approved, the designed prosthetic components were printed in a castable material (Juell 3D UV resin) [Figure 7] using a 3D printing machine (O3D Orchestrator), invested and casted in Class 1 pure titanium using a vacuum pressure casting system (Titec F205M, OROTIG). The titanium components were polished and laser welded (LASER Welder, EVO 125) [Figure 8]

together, hence providing a complete hollow-bulb titanium framework [Figure 9].

The maxilla–mandibular relationship was recorded, and the teeth arrangement is done in accordance with the mandibular natural teeth, followed by trial placement [Figure 10] to assess the patient's phonetics and esthetics.

The prosthesis was acrylized in heat-cured denture base resin.

A flexible cap was fabricated extraorally in the definitive cast using medical-grade silicone (Reviver, Medicept) [Figures 11a and b].

The final obturator prosthesis [Figures 12a and b] composed of the acrylized titanium framework and the removable cap was inserted intraorally, followed by a chair-side occlusal adjustment to ensure bilaterally stable occlusion.

DISCUSSION

Titanium is the most biocompatible (or least corrosive) metal available to the dental profession today.^[6] Moreover, as used in dentistry, 99.6% commercially pure titanium is nontoxic, hypoallergenic, and one-half of the weight



Figure 5: Computer-aided design of the obturator bulb



Figures 7: Three-dimensional printed castable framework



Figure 6: Definitive cast, trial obturator bulb in poly(methyl methacrylate), titanium framework

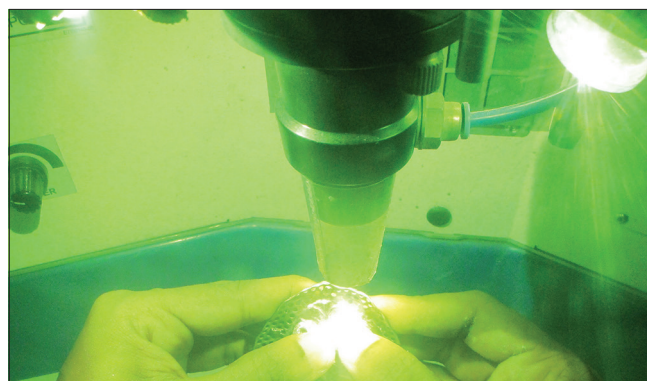


Figure 8: Laser welding of the titanium bulb and framework



Figure 9: Titanium bulb laser welded to the titanium framework. Note 5 orientation grooves and circumferential undercut for retention



Figure 10: Trial placement of the obturator



Figure 11a: Inner surface of the flexible, removable silicone cap showing orientation and retention locks



Figure 11b: Outer surface of the flexible, removable silicone cap which engages the defect undercuts



Figure 12a: Components of completed hollow-bulb titanium obturator and removable silicone cap



Figure 12b: Hollow-bulb titanium obturator with removable silicone cap

of cobalt-chromium. Due to its relatively noncorrosive nature and other favorable characteristics, titanium is the biological metal of choice for dental restorations.^[6] Moreover, an obturator being larger than most removable appliances with compromised supporting tissue architecture greatly benefits from the innate lightness of the pure titanium framework and hollow bulb. In addition, the oral cavity and defect area along with the secretions harbor numerous bacteria. In such an environment, a smooth, polished titanium surface is

extremely advantageous compared with an inherently porous acrylic bulb used in a conventional hollow-bulb prosthesis. A further advantage is the option of quality control by inspecting the titanium cast for voids using an X-ray device.^[7]

As stated earlier, the CAD technique allowed the practitioner to analyze the anticipated end result before the actual fabrication. The major advantage of this approach was the possibility of the trial PMMA framework. This gave an understanding of the success of this innovative technique in addition to throwing light on modifications required to suit the comfort of the patient (e.g., the designed obturator bulb was impinging on the bony inferior turbinate. This warranted an increased relief area between the obturator bulb and the underlying bony structure in the final prosthesis). Since the hollow bulb is made of rigid titanium, of minimal thickness, modifications of the final framework may lead to a perforation and a repeat casting. Hence, an intraoral trial negates the complications of a blind fabrication, confirming the fit and accuracy of the obturator.

The introduction of laser welding for titanium has revolutionized the field of implant prosthetics. As an extension, it has several advantages in the construction of a removable prosthesis as well. Laser welding is an attractive alternative method to join dental casting alloys.^[8] During the past decade, laser welding has been increasingly used because there is no need for investment and soldering alloy, working time is decreased, lasers are easy to operate, little damage is caused due to the denture resin from the pinpoint heat, and there are few effects of heating and oxidation.^[8] Titanium has a good penetration depth of the weld, lower thermal conductivity, and a greater rate of laser beam absorption.^[8] These properties make it easier to laser weld titanium.

Whereas the titanium framework is a rigid structure, the combination of a removable, silicone cap anchors the obturator in the smallest defect undercuts,^[9] such as the maxillary sinus openings, drastically improving the retention of the obturator. This provides a cushioning effect, comfort, and an impenetrable seal of the communication, inevitably increasing patient satisfaction, function, and an enhanced quality of life. It must be further emphasized that the resected area progressively undergoes dimensional variations due to cicatrices, fibrotic changes, and tissue contracture. This necessitates the fabrication of a new acrylic obturator at every phase. However, with

the current design, the removable, flexible cap is the only component which needs to be replaced to compensate for the defect alteration. Furthermore, the silicone cap can be disinfected regularly by immersing the cap in water at a rolling boil for 10 min.^[7] In addition, a replacement cap can be provided to ensure that the patient is not without a functioning prosthesis at any point.

Declaration of patient consent

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

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Conflicts of interest

There are no conflicts of interest.

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