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Prosthetic rehabilitation of orbital and maxillary defects with magnet-retained combined prosthesis

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Abstract
Surgical resection of the maxilla and orbital contents in patients with COVID-19-associated mucormycosis often results in significant facial disfigurement, functional loss, and psychological distress. Prosthetic rehabilitation plays a crucial role in restoring form and function, with retention methods such as adhesives, spectacle frames, implants, and magnets selected based on the characteristics of the defect and the patient's needs.
This case report presents a rehabilitation strategy for a patient with concurrent orbital and intraoral defects resulting from COVID-19-associated mucormycosis. The innovative approach involved the use of an intraoral obturator in combination with an extraoral orbital prosthesis. Secondary retention was achieved with magnets, while primary retention was secured through close adaptation of the prosthesis to surrounding tissues. This integrated rehabilitation not only restored facial form and function but also had a positive impact on the patient's psychological well-being.

Keywords: Orbital defect, maxillary defect, magnet-retained prosthesis, facial prosthetic rehabilitation, maxillofacial rehabilitation

Introduction
Mucormycosis is a rapidly progressing opportunistic fungal infection that can lead to severe, life-threatening complications. Acquired midfacial defects resulting from mucormycosis often cause considerable facial disfigurement and functional impairment [1]. Rehabilitation of this defect is essential for patients who have undergone surgical resection, particularly in the post-COVID context [2].
A key objective of maxillofacial rehabilitation is to provide comfort and protect the remaining soft and hard tissues. Effective retention of the prosthesis is crucial for achieving functional success and facilitating the patient's social reintegration. Various retention techniques have been documented, including the use of eye patches, spectacle frames, denture extensions, magnets, adhesives, and Osseo-integrated implants [3-6].
The use of spectacle frames offers a simple and cost-effective retention option; however, this method can be uncomfortable for patients, as the frame tends to become heavy and must be worn constantly. Modern prosthetic rehabilitation often relies on adhesives, which are easily accessible, simple to apply, and provide satisfactory retention for a limited duration. Prolonged use, however, may lead to allergic reactions or local irritation [7]. In addition, inadequate undercuts, facial movements, or sneezing can compromise adhesive stability. To enhance retention and comfort, orbital prostheses can be effectively attached to obturators using magnets or buttons [8]. Although magnets offer good retention, they can be expensive and may corrode or lose strength over time. Osseo integrated implants provide excellent stability [9], but their use is limited by additional surgeries, high costs, inadequate bone, or prior radiation [10]. Therefore, they are not suitable for all patients.
Anatomic retention can aid in securing an orbital prosthesis by employing a flexible conformer within the defect. The prosthesis is fabricated conventionally, with an extension into the conformer that engages the circumferential groove undercut, providing mechanical retention [7]. This article describes the rehabilitation of a patient with combined orbital and oro-nasal defects using rare-earth magnets to achieve prosthesis retention.

Case Report

A 55-year-old male presented to the Department of Prosthodontics at MGV's KBH Dental College, Nashik, with a chief complaint of facial disfigurement due to the absence of his left eye and regurgitation of food from the defect site for three years. The patient gave a history of diabetes, and the histopathological diagnosis revealed mucormycosis. Clinical examination revealed significant disfigurement of the left midface (Figure 1). Intraoral assessment showed a postsurgical defect on the left side, extending from the midline to the left cheek, with the palatal defect continuous with the orbital defect. The margins and surrounding tissues of the defects were healthy and unremarkable (Figure 2). The patient was wearing an interim prosthesis.

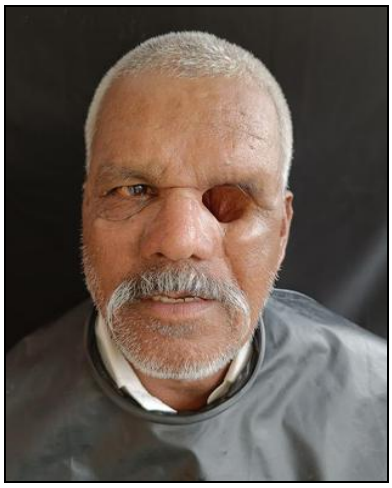


Fig 1: Extraoral pre-treatment (Frontal view)

Fig 2: Intraoral view of defect

Radiological examination revealed the loss of the left orbital floor and the left half of the maxilla, including the associated teeth. Mandibular movements were within normal limits. Speech intelligibility and swallowing were severely compromised, as the patient's tongue could not establish effective functional contacts due to the absence of anatomic boundaries. Prosthetic rehabilitation was planned using a magnet-retained intraoral-extraoral combination prosthesis. The prosthesis was designed in two sections to close the intraoral defect and create a partition between the oral and nasal cavities, thereby improving speech and swallowing. The intraoral obturator was fabricated first, followed by the orbital prosthesis, which was retained on the maxillary obturator using rare-earth magnets. Primary retention was achieved through tissue adaptation, while secondary retention was provided by the magnets functioning as a patrix-matrix system.

Procedure

Fabrication of an intraoral obturator prosthesis

On a stock metal perforated tray, low-fusing impression compound was placed at the position of the palatal defect to capture its full depth and extent, followed by a preliminary impression of the remaining maxillary arch and palatal defect using irreversible hydrocolloid (Algitex, DPI, Mumbai, India), in the same tray. Later, a diagnostic cast was obtained (Figure. 3). After placing a layer of modelling wax as a spacer, an auto-polymerizing resin tray was fabricated. Border molding was performed, and a definitive impression was made using medium-viscosity polyvinyl siloxane, which was poured with Type III gypsum to obtain the master cast (Figure 4, 5).

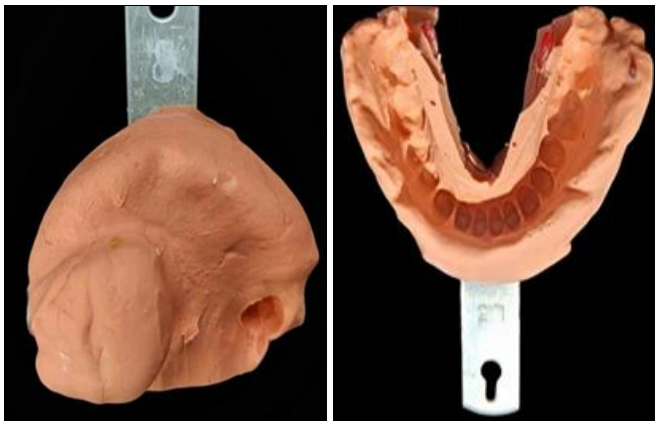


Fig 3: Preliminary maxillary and mandibular impression

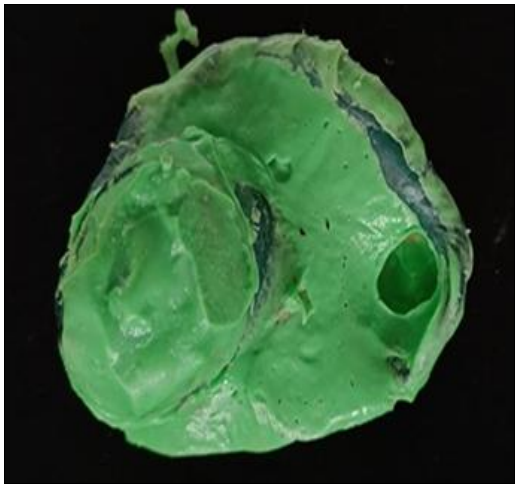


Fig 4: Final Impression

Fig 5: Final casts retrieved from secondary impression

Jaw relation was recorded, a facebow transfer was obtained, and the teeth were arranged with corresponding wax contouring (Figure 6, 7). After the try-in (Figure 8, 9), processing was done in heat-polymerizing acrylic resin. To reduce the weight of the prosthesis, the obturator was made hollow by using the lost-salt technique. After processing, an aperture was created on the mesial aspect of the bulb to remove the salt, thereby completing the hollow obturator. Two neodymium-iron magnets, each measuring 2 × 2 mm, were embedded on the superolateral aspect of the obturator bulb using auto polymerizing resin, allowing them to engage with corresponding magnets on the inferior surface of the conformer part of the extra-oral prosthesis for mutual retention [11] (Figure 10).

The prosthesis was delivered, and final occlusal adjustments were performed. Denture movement was minimized by distributing occlusal forces evenly in centric and eccentric positions. Premature contacts were corrected, and the stabilizing components were designed to reduce horizontal stresses.

Fig 6: Facebow Record

Fig 7: Teeth arrangement on Hanua Articulator

Fig 8: Try-in: intraoral frontal view

Fig 9: Try-in intraoral occlusal view

Fig 10: Embedding of 2 × 2 mm neodymium-iron magnets on obturator bulb

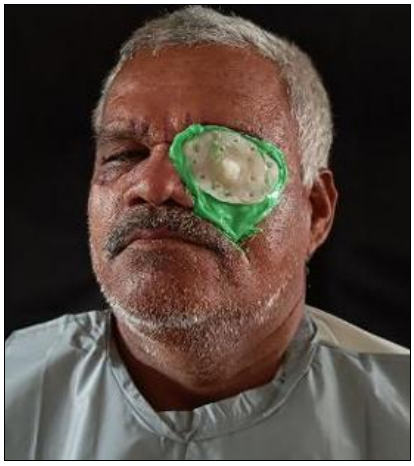
Fabrication of conformer-fabrication of extraoral prosthesis

First, a facial moulage was obtained by making an impression of the orbital defect and the normal eye, along with the surrounding structures, with irreversible alginate. A thin layer of Vaseline was applied to the patient's eyelashes and eyebrows, and a wax frame was created to outline the impression area and control alginate flow. Before alginate could set, gauze squares were placed over the alginate to enhance retention for a 0.25-inch plaster backing, providing adequate support for distortion-free removal. The alginate impression was poured in Type III gypsum (Kalstone; Kalabhai Karson, Mumbai, India). After the stone had set, the impression was carefully separated, and a definitive model was obtained.

Fabrication of Conformer and Attachment of Obturator with Orbital Prosthesis.

A conformer is the intermediate part of the prosthesis connecting the obturator to the orbital defect. It was first made in wax, then processed into heat-cured resin (DPI Heat Cured acrylic resin). It was then finished and polished and tried over the obturator to support and retain the silicone orbital prosthesis while bridging the gap between the orbital and maxillary defects. After this customized perforated tray was fabricated on the facial moulage in the orbital defect area. (Figure.11). A definitive impression of the orbital defect was made using light-body elastomeric impression material with the conformer positioned in place with the obturator [12, 13] (Figure 12).

Fig 11: Facial moulage



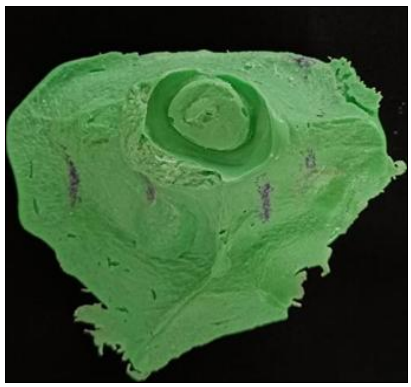


Fig 12: Final orbital defect impression, along with an acrylic conformer on the patient

The impression was poured, and a master cast was obtained for the orbital defect. Trial wax orbital prosthesis was fabricated on this cast, and the positioning of the iris, and the carving of eyelids were done by placing the wax prosthesis on the facial model obtained from the facial moulage to match the right eye. (Figure 13). At the try-in stage, the fit, pupil orientation, scleral color, size, and volume were evaluated and compared with the contralateral eye. After trying the wax orbital prosthesis was flasked, and dewaxing of the wax pattern was dewaxed. A thin coat of adhesive silicone was applied to the acrylic base to strengthen the bond with the silicone. The shade was matched under natural daylight, and the mold was packed with room-temperature vulcanizing silicone blended with intrinsic coloring to achieve lifelike characterization. The silicone was processed according to the manufacturer's instructions. After retrieval of the final prosthesis, excess material was carefully trimmed with a sharp blade, and the surface was finished using fine sandpaper. Final external characterization was performed with the patient present to ensure optimal esthetic outcome. The final prosthesis was delivered to the patient, with a wonderful color match [11-13] (Figure 15).

On the superior surface of the conformer, one single magnet was placed with autopolymerising resin, and the opposite pole magnet was placed in the orbital prosthesis [12] (Figure 14).

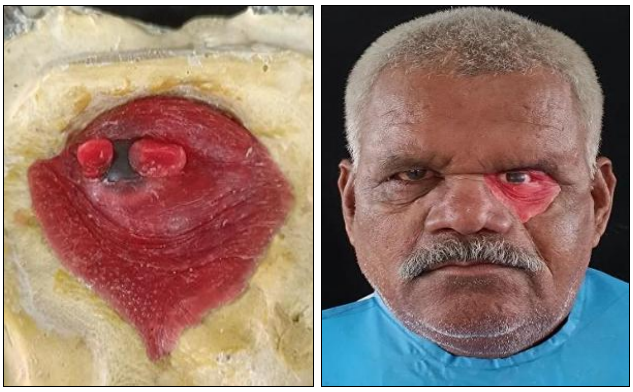


Fig 13: Wax pattern and positioning of the iris

Fig 14: Final attachment of obturator, conformer, and silicone orbital prosthesis

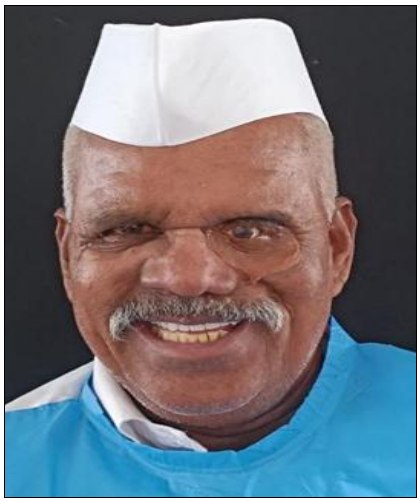


Fig 15: Patient with definitive prosthesis (frontal view)

Discussion

Orofacial defects create a connection between the oral and nasal cavities, which can result in difficulty in swallowing,

nasal regurgitation, reduced clarity of speech, and an unattractive appearance, often causing considerable psychological impact. Rehabilitation of patients with maxillofacial defects has long been a challenge for prosthodontists. Prosthetic rehabilitation offers several advantages over surgical reconstruction, including lower cost, ease of periodic examination and cleaning, and suitability for patients who are not candidates for surgery. The goal in rehabilitating such patients should be to select a suitable maxillofacial prosthetic material along with an economically viable retention method. Since the prosthesis is positioned in the maxilla, the constant downward pull of gravity can negatively affect its retention. Different approaches and materials, including sugar [14] and ice [15], have been employed to create lightweight, closed hollow obturators. In this case, the lost salt technique was used to fabricate prosthesis, reducing gravitational stress and enhancing speech resonance.

Numerous methods for fabricating and retaining maxillofacial prostheses have been reported, amongst which magnets have been used widely. The development of rare-earth permanent magnets, including Sm-Co (Samarium-Cobalt) and Nd-Fe-B (Neodymium-Iron-Boron) alloys, has enabled the production of very small magnets. Coatings of nickel, gold, or titanium have further addressed issues of tarnishing and corrosion [16]. The primary challenge in this case was achieving retention, as the continuous defect prevented either appliance from remaining stable on its own. This was addressed by using rare-earth magnets. A three-part prosthesis was fabricated with magnets placed on the obturator and inferior surface of the conformer and between the orbital prosthesis and the superior surface of the conformer. In order to attach a magnet to the orbital prosthesis, the base of the prosthesis was made with acrylic. Retention with magnets allows for easier placement and removal by simplifying the complex paths of insertion and removal [12]. Once the obturator was in place, the magnet within it provided a fixed reference, allowing the magnet in the eye prosthesis to automatically align and attach, thereby improving the retention of both prostheses.

Retention of orbital prostheses has been enhanced using tissue undercuts or by mechanically attaching the prosthesis to the patient's eyeglasses or dentures over the years. Silicone, with its superior marginal adaptation and lifelike appearance, is commonly used for orbital prostheses [17]. However, a limitation of silicone prostheses is their inability to chemically or mechanically bond with an eyeglass frame, which can make retention challenging [18]. The retentive force of magnets may gradually decrease with use, and some uncoated open-field magnets can exhibit cytotoxic effects due to the release of corrosion byproducts. Therefore, magnets should be replaced as soon as any signs of corrosion appear.

Despite the challenges, limitations, and complexity of the rehabilitation process, prosthodontists must make a dedicated effort to restore these patients to the highest possible level of function and esthetics.

Conclusion

Maxillofacial rehabilitation of combined intraoral and extraoral defects presents significant challenges in retention, function, and esthetics. A two-piece prosthesis using an intraoral obturator and an extraoral orbital prosthesis retained with rare-earth magnets offers a practical and effective solution. This approach not only restores facial appearance and oral function but also significantly improves the patient's psychological well-being and quality of life.

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Conflict of Interest

Not available.

Financial Support

Not available.

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