Case Report

Prosthetic rehabilitation of resected orbit in a case of mucormycosis

Harsimran Kaur, Aditi Nanda, Mahesh Verma[1], Parul Mutneja[2], Dheeraj Koli[3], Smiti Bhardwaj

Senior Research Associate and [1]Director-Principal, Maulana Azad Institute of Dental Sciences, [2]Dental Surgeon, Safdarjung Hospital, [3]Assistant Professor, All India Institute of Medical Sciences, New Delhi, India

Abstract

The design of orbital prosthesis to rehabilitate patients with orbital exenteration depends on the underlying clinical condition, material chosen for prosthesis, method of retention of the prosthesis, and and preference of the patient. Rehabilitation of a patient with orbital exenteration due to mucormycosis has been described by fabricating a prosthesis that used polymethyl methacrylate (to fabricate a conformer) and silicone material (to fabricate prosthetic superstructure). The two-component prosthesis was designed to attain dual mechanical retention using an anatomic undercut (conformer) and manually created mechanical undercut (prosthetic superstructure). The objective was to maintain the biological health of the underlying postsurgical tissue, longevity of the prosthesis, optimal esthetics, and adequate retention.

Keywords: Conformer, dual, mucormycosis, orbital, retention

Address for correspondence: Dr. Aditi Nanda, Room No. 116, Senior Research Associate, Maulana Azad Institute of Dental Sciences, Bahadur Shah Zafar Road, New Delhi - 110 002, India.
E-mail: aditinanda@yahoo.com

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INTRODUCTION

Surgical exenteration of the orbital contents can result in morphological morbidity, functional limitations, and a negative psychological impact due to social ostracism. Postsurgical rehabilitation of orbital defects may be done by either surgical reconstruction methods or by using a prosthesis.[1] The advantage of prosthetic rehabilitation is creation of a "life-like appearance" of the prosthesis, minimum surgical intervention, and ease of clinical observation of the affected site (to rule out recurrence of the previous pathology). Manual or digital techniques can be used to fabricate an orbital prosthesis, using internally/extrinsically tinted polymethyl methacrylate, silicone elastomeres, or polyurethane.[2] To retain a prosthesis, several methods have been recommended including adhesives, conformers, use of mechanical undercuts (anatomically present or surgically created), and osseointegrated implants with attachments such as magnets, ball, and ring or bar and clip.[3,4]

The design of an orbital prosthesis to rehabilitate a patient with orbital exenteration depends on several factors including the underlying clinical status (extent of resection of orbital contents and risk of recurrence of pathology), preference of the patient (determined by affordability and dexterity to use the prosthesis), material

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chosen for fabrication, and the method of retention of the prosthesis.[3-9]

The current report discusses the rehabilitation of a patient with orbital exenteration due to mucormycosis by fabricating a prosthesis that combined (heat polymerized) polymethyl methacrylate and (room temperature vulcanizing) silicone prosthetic material. The objective was to maintain the biological health of the underlying postsurgical tissue bed, ensure longevity of the prosthesis, obtain esthetic outcome, and attain adequate retention of the prosthesis.

CASE REPORT

A 55-year-old male patient reported to Department of Prosthodontics with loss of orbital contents of the left side due to orbital exenteration as seen in Figure 1. Five months back, the patient had reported to the Department of Ophthalmology with pain on the left side near the root of the nose and inability to open the left eye for a week. Ophthalmologic examination confirmed endophthalmitis. Urine investigations revealed the presence of ketone bodies (history of diabetes) and histopathological examinations of the nasal swab confirmed the diagnosis of sino-orbital mucormycosis. Multidisciplinary interventions to treat the patient were made. Administration of amphotericin B (1 mg/kg/day for 4 weeks) with regular monitoring of renal functions was done. This was accompanied by orbital exenteration of the left eye 4 months before the patient reported to the Department of Prosthodontics. Prosthodontic intervention commenced after clearance from Department of Medicine, Ophthalmology, and Histopathology (subsequent to confirmation of the absence of any residual infection).

The resulting defect was rhomboid in shape (superior to inferior extent was 6.0 cm and medial to lateral extent was 4.0 cm). The defect extended into the ethmoid sinus medially and belonged to the Type I Classification of orbital exenteration.[5] Well-defined bony undercuts were present on the inferior aspect (depth of 10 mm) and superior aspect (depth of 5 mm) of the defect. The entire defect, including the region of undercuts was lined with well-healed tissue. The patient was not rehabilitated with any previous orbital prosthesis. Due to economic reasons, implant-supported orbital prosthesis was not chosen by the patient. The treatment plan was to rehabilitate the patient with an orbital prosthesis combining heat-polymerized polymethyl methacrylate (conformer shell substructure) and room temperature vulcanizing silicone (prosthetic superstructure). Existing anatomic undercut on the superior aspect was used to retain the conformer substructure. Manually created undercut in the conformer was used to retain the silicone superstructure.

The following steps were undertaken for fabrication of the prosthesis:

1. Creation of primary analog: Impression of the defect and adjacent tissues, including the unaffected eye was made in irreversible hydrocolloid (Tropicalgin, Zhermack) backed with modeling plastic impression compound (Pinnacle Impression Compound, Dental Products of India) [Figure 2]. Landmarks for sculpting the prosthetic eye were marked with indelible pencil, on the patient's face before making the impression [Figure 1]. A primary analog in Type III gypsum (Dental Stone, Kalabhai) was obtained from the impression
2. Fabrication of conformer: A secondary analog, was obtained by duplication of the defect portion of primary analog in silicone-duplicating material (Wirosil, BEGO). The secondary analog was used to fabricate the conformer shell substructure in heat-polymerized polymethyl methacrylate (Lucitone 199, Dentsply

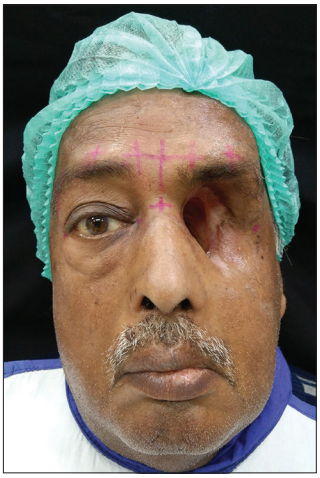

Figure 1: Preoperative view with landmarks

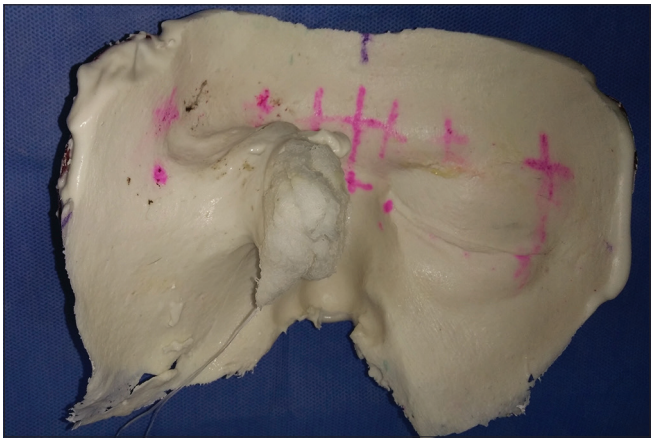

Figure 2: Impression in irreversible hydrocolloid

International). The undercut at the superior aspect of the defect was chosen to retain the conformer as it was postulated to provide a favorable path of insertion with minimum tissue injury simultaneous to providing acceptable mechanical retention due to greater resiliency of soft-tissue lining the undercut and a favorable depth of 5 mm of the undercut. The undercut present at the inferior aspect of the defect was blocked out in order to create a path of insertion for the conformer. Wax-up for the conformer (as shown in Figure 3), was done by adopting a single sheet of modeling wax (Modelling Wax, Dental Products India) of 2 mm thickness in the region of the defect on the secondary analog. The periphery of the conformer wax-up was lined with sprue wax (Wax Sprue, BEGO) of 2.5 mm diameter to create an undercut around the perimeter of the conformer. This undercut was designed to help in retention of the silicone superstructure. The completed wax-up of conformer shell substructure was invested and processed in heat polymerized polymethyl methacrylate (after color matching with the shade of skin in the defect region). The conformer was finished and polished as shown in Figure 4 and Video 1. The retention of conformer was exclusively from the undercut at the superior aspect of the defect and use of adhesives and soft liner was avoided to minimize the drawbacks associated with them. The retention of the conformer was observed to be satisfactory [Video 1]

3. Wax-up of the eye prosthesis: This was done on the conformer substructure positioned on the primary analog. The landmarks on the primary analog were used to assist in orienting the ocular button (Dara Optical Company). An image of the unaffected eye (proportioned to facial measurements in 1:1 ratio), taped with double-sided tape on the primary analog was used to aid in sculpting the wax. Wax was contoured in a pattern simulating the surrounding tissues, mirroring the soft tissues of orbital region on the contralateral side as seen in Figure 5. Clinical trial of the wax-up was performed on the patient to further enhance the anatomic details
4. Functional impression of the periorbital tissues: Wash impression of the wax-up (beyond the perimeter of the conformer) was made in light body consistency of addition polyvinyl siloxane (Aquasil LV, Dentsply) as seen in Figure 6. During the impression making, the patient was asked to perform movements such as smiling, frowning, raising eyebrows, and scowling so as to record the soft tissue in contact with the periphery of the wax-up. Satisfactory wax-up and functional recording of periorbital tissues was attained as shown in Figure 7

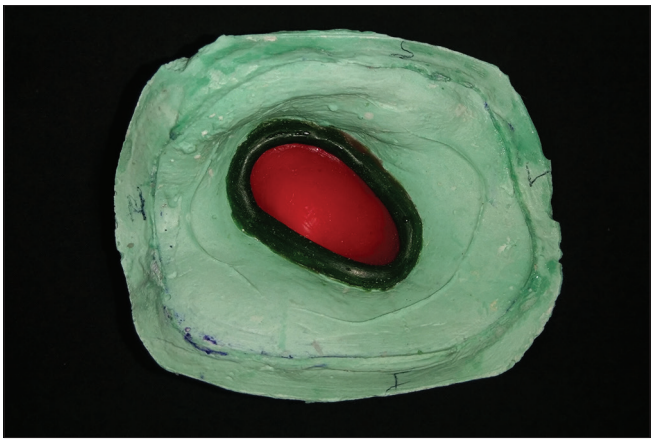

Figure 3: Wax-up of conformer on secondary analog and creation of undercut at the periphery

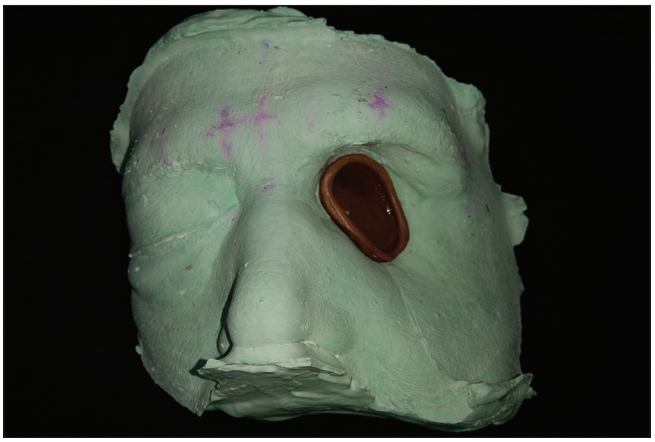

Figure 4: Conformer substructure in heat-polymerized polymethyl methacrylate seated on primary analog

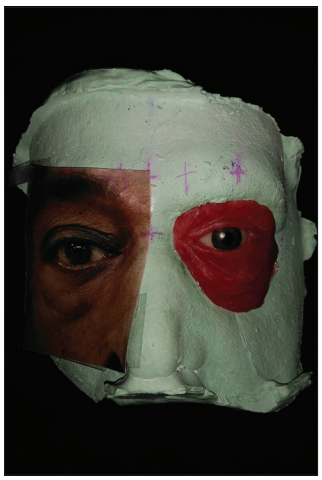

Figure 5: Wax-up of orbital superstructure on conformer in primary analog using proportioned image of unaffected side and landmarks for reference

5. Fabrication of silicone superstructure: The entire complex comprising of the ocular button, the wax-up of the orbital superstructure, and the previously formed conformer substructure, was invested in

Type II gypsum (Dental Stone, Kalabhai) in a varsity flask (Jabbar and Company). During investing, the ocular button was stabilized in the investing gypsum by a peg of 10 mm length and 3 mm diameter (created in self-polymerizing polymethyl methacrylate) (Rapid Repair, Dentsply). The wax and the polyvinyl silicone were eliminated to create mold space. Shade matching was done by trial and error subjective method, seeking opinion from the operator and the patient. The mold space created was packed with room temperature vulcanizing silicone after shade matching (A-588-1 Realistic silicone elastomer, Factor II, Incorporated). After completion of vulcanization at room temperature, the silicone component of the prosthesis was removed, externally stained, and finished.

The prosthesis thus comprised two separate components that obtained mechanical retention from two different mechanisms. The conformer substructure made in heat-polymerized polymethyl methacrylate gained retention from the anatomic undercut (depth of 05 mm) present at the superior aspect of the defect. The silicone prosthetic superstructure gained retention from the mechanical undercut (depth of 2.5 mm) created in the conformer substructure. The prosthesis was tried on the patient and extrinsic coloration was done. The patient was taught to assemble the two components together as shown in Video 1. Satisfactory outcome was attained as shown in Figure 8 and Video 2. Follow-up of the first 12 months showed no adverse tissue reaction and no observed deterioration of prosthesis superstructure and substructure.

DISCUSSION

Mucormycosis (phycomycosis/zygomycosis) is an angioinvasive fungal infection, caused by a saprophytic aerobic fungus, of the order Mucorales. It is transmitted by inhalation of aerosolized spores (3–11 mm) or direct inoculation as a result of trauma. An immunocompromised medical status predisposes an individual to the infection by the fungi. The infection is rapidly progressive and fulminant that can invade the adjacent fat, muscle, fascia, and bone. Treatment is multimodal including surgical debridement, use of antifungal drugs (liposomal amphotericin B and posaconazole), and use of hyperbaric oxygen therapy. Addressal of predisposing factors that prevent the intensification of underlying issues is imperative to prevent a relapse.[10]

In the current case, prosthetic rehabilitation was initiated after resection of the left orbital contents due to mucormycosis. The orbital prosthesis was made in two separate parts intended to be assembled together. The conformer substructure was made in heat-polymerized polymethyl methacrylate. The orbital superstructure was made in room temperature vulcanizing silicone. The

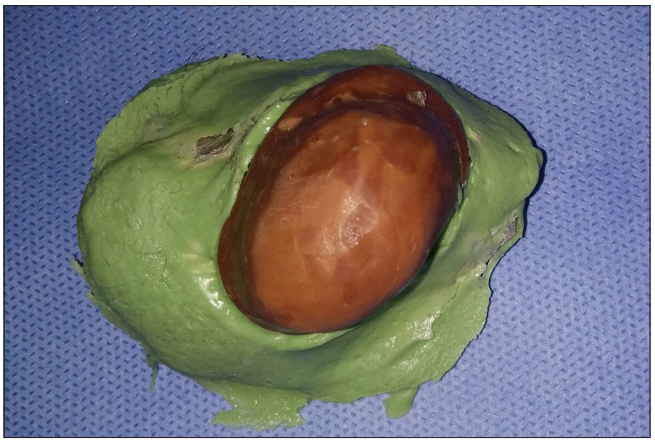

Figure 6: Functional impression of superstructure beyond the conformer boundary

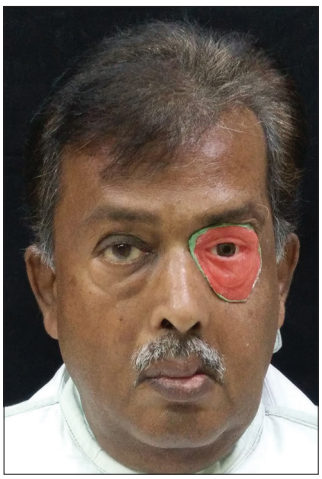

Figure 7: Completed wax-up and functional recording of periorbital tissues

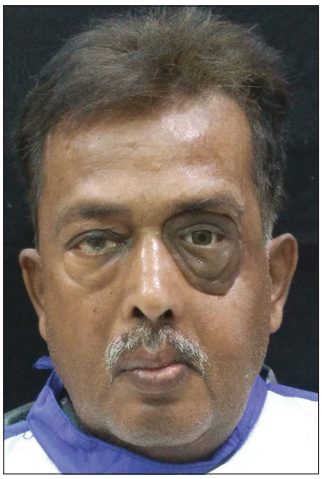

Figure 8: Final prosthesis

objectives underpinning the design of the prosthesis were to maintain the biological health of the underlying postsurgical tissue bed, ensure longevity of the prosthesis, achieve optimal esthetics, and attain adequate retention of the prosthesis. The silicone superstructure provided life-like appearance to the prosthesis. Heat-polymerized conformer substructure minimized tissue contact of silicone, thus minimizing the risk of tissue irritation and recurrence of infection (mucormycosis).[8,9] It has been reported that silicone is prone to surface deterioration in tropical environmental conditions of high heat and humidity and also with the use of tissue adhesives to retain the prosthesis.[11-13] These two causes of silicone prosthesis deterioration were avoided using a conformer substructure. The conformer also provided a scaffold for the silicone prosthetic superstructure. The two-component design of prosthesis (conformer substructure and silicone superstructure) precluded the use of adhesives thus promising longevity of the prosthesis and maintenance of health of the underlying tissue.[11-13] Single-unit prosthesis by laminating the silicone superstructure with the acrylic conformer substructure was avoided to eliminate the risk of unwanted and unpredictable delamination.[9] The two-component design also enabled easy manual dismantling of the substructure and superstructure when required, and cleaning of the two parts with respective cleansing agents. An added advantage of fabricating the prosthesis in two parts is to refabricate the silicone superstructure alone, without remaking the conformer substructure in a situation where deterioration or damage of silicone superstructure occurs and the need to remake the prosthesis arises.[3] This is expected to save resources, time, and eliminate the need to incorporate new "attachment" components during repair.

The current technique overcomes the shortcomings associated with the previously mentioned techniques in the literature. The technique is easy to conduct and economical when compared with the use of magnetic components (to assemble the conformer and silicone prosthesis). This increases the applicability of the technique, especially in areas where there are limited resources or by operators who are early in their learning curve. The mechanical undercut created in the conformer overcomes the limitation of loss of retention over time, as may be seen with magnetic elements.[6] The technique is less expensive, avoids a surgical intervention and does not require a traditional waiting period as needed (for osseointegration) when compared with implant-supported prosthesis.[1,13] This can be considered favorable for patients who can overcome the psychological trauma of social ostracism sooner with the design of the prosthesis described. The deterioration of the prosthesis surfaces that have been reported with the use of adhesives has been avoided using this method. Adhesives are also often associated with the need for frequent reapplication over the course of a day, especially in tropical climate conditions (due to frequent washing away of adhesive due to sweat/cleaning procedure) and restriction of certain lifestyle activities like swimming. The same has also been overcome by the mentioned technique.[3,4,7,11,13] Along the same lines, it is emphasised that the conformer was retained exclusively by anatomical undercut at the superior aspect of the defect and use of adhesives was circumvented. The conformer was also not lined with a soft liners to avert the risk of degradation of liner that occurs with time due to microbial growth, in turn necessitating a refabrication/relining of the prosthesis. The same is viewed as a superfluous exhaustion of resources. Also in an eventuality where such a procedure is indicated, but is delayed or not performed, there is an associated risk of extensive tissue damage due to recurrence of the underlying pathology.[14]

The drawback of the prosthesis is the dependence on patient compliance for assembling the substructure and superstructure while wearing the prosthesis/cleaning. Additional time and procedural steps were required in the fabrication of two separate components when compared with single-unit prosthesis. Dependence on anatomical undercut to retain the conformer may preclude the implementation of design in selected clinical scenarios. In addition to this, the operators observed a color mismatch between the adjacent skin and the prosthesis. The influence of incident light source and background, interoperator variability, and subjectivity during shade selection as well as during intrinsic/extrinsic characterization of the prosthesis, can be the reason for the aforementioned limitation.[15] The same can also be due to the possibility of manual error during the packing of silicone material before vulcanization. It was also observed that the margin of prosthesis lacked a feather-thin finish and the same can be attributed to manual method of carving the wax-up of the prosthesis that often varies with operator dexterity. The latter two errors could have been avoided by utilizing digital methods of processing the prosthesis.[2,16]

CONCLUSION

There are specific clinical conditions like fungal infections where direct contact of adhesive-retained silicone prosthesis is not recommended due to the risk of accelerated deterioration of the prosthesis and to minimize the risk of recurrence of infection. In such cases, the suggested method of retaining the prosthesis is useful so as to attain

the desired objective of maintenance of the biological health of the underlying postsurgical tissue, longevity of the prosthesis, optimal esthetics, and adequate retention. The minimalistic and simple design of the prosthesis in the case described can be considered a step toward improving the social acceptability of patients with orbital defects and provide them a satisfactory quality of life affordably, rapidly, and predictably subsequent to rehabilitation.

Declaration of patient consent

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

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Nil.

Conflicts of interest

There are no conflicts of interest.

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