Surgical Rehabilitation of a Continuous Orbital and Maxillary Defect from Rhino-Orbital Mucormycosis Utilising Digital Technology - A Case Report

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Abstract

Rationale: COVID-19 has led to a resurgence in cases of mucormycosis, especially the rhino-orbital form affecting the oral cavity, nasal, orbital and cerebral regions. **Patient Concerns:** The surgical treatment in this patient led to the exenteration of orbital contents and segmental maxillectomy of the affected side leading to facial disfigurement and inability to masticate. **Diagnosis:** A combined mucormycosis-associated oro-orbital defect was present leading to a communication between oral and orbital cavities. **Treatment:** Rehabilitation utilising digital technology for removable prosthesis was planned for the combined orbital and oral defect. **Outcomes:** The independent intraoral and orbital prosthesis reduced the mobility of the orbital prosthesis while performing functional movements. The advancements in digital technology led to the convenient and resilient fabrication of prostheses for large facial defects. **Take-away Lessons:** The prosthetic rehabilitation of a continuous orbital and oral defect with a hybrid of both digital and conventional means provided an aesthetic, feasible and financially sound solution to the patient.

Keywords: Hollow obturator, orbital exenteration, segmental maxillectomy, three-dimensional printing

Introduction

The key to salvage life in mucormycosis is early diagnosis with aggressive medical and surgical management.[1,2] Radical management of facial defects leads to surgical resection of the maxilla along with orbital exenteration.[3,4] The combined oro-orbital defect following surgery has led to immeasurable problems such as vision loss, facial disfigurement, respiratory infection and hyper-stimulation of the cranial nerves with social and psychological issues.[5] In such cases, the problem faced by the prosthodontist is the retention and aesthetics of the prosthesis. The advances in digital technology have led to the rehabilitation of such defects with better accuracy and precision. This case report discusses the rehabilitation of a combined oro-orbital defect through a hybrid of both digital technology and conventional means.

Case Report

A 55-year-old female reported with the chief complaint of a missing right eye along with multiple missing teeth in the upper arch. Medical history revealed surgical exenteration of the right eye with ipsilateral segmental maxillectomy following COVID-19-associated mucormycosis. Extraoral examination revealed a completely healed orbital tissue bed with communication with the oral cavity [Figure 1a]. Intraoral examination revealed right segmental maxillectomy extending from the distal aspect of the lateral incisor anteriorly to the tuberosity posteriorly (Aramany's Class II defect) [Figure 1b]. All possible treatment options were explained to the patient; however, the patient was willing to a minimally invasive treatment plan; hence, a

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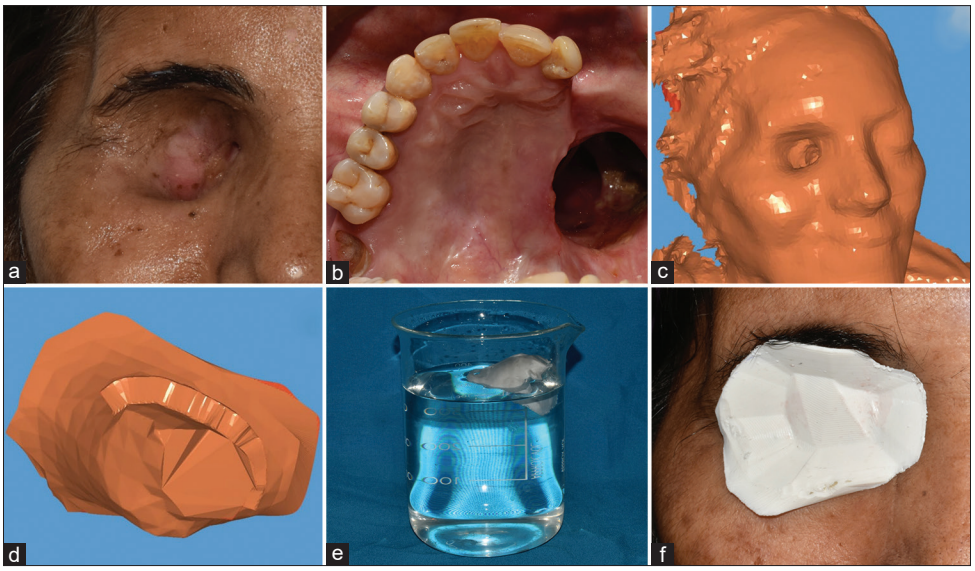

Figure 1: (a and b) Extraoral and intraoral defect, (c) 3D reconstruction of the data, (d) Digital designing of conformer with mechanical grooves, (e) Depiction of hollowness of conformer, (f) Trial of conformer

removable cast partial obturator with orbital prosthesis was planned.

Fabrication of the orbital prosthesis

The extraoral defect was scanned using an extraoral scanner (3D System Sense 1st Gen 3D Scanner, USA), followed by 3D reconstruction of data using 3D modelling software (Autodesk 3DS Max® Software, USA) [Figure 1c]. The orbital conformer was designed with a concavity in the facial aspect to incorporate a bulge of stock iris and mechanical grooves on the inferior surface [Figure 1d] to enhance the retention of the prosthesis. The conformer was made hollow using the "Hollow" function in the software, and vent holes were designed to prevent hydraulic pressure during 3D printing. The medical-grade polylactic acid (PLA) was activated, and 3D printing (Accucraft i250D Printer, India) of the conformer was carried out. The hollowness was ensured by its tendency to float in water [Figure 1e]. The conformer was adapted in orbital defect and evaluated for the fit [Figure 1f]. The conformer was picked up [Figure 2a] using light-body consistency addition silicone material (Avue Gum Light Body, Maharashtra) and later relined with clear heat-cure acrylic resin material. The conformer was picked up in facial moulage impression and poured to create a master model of the defect region. A stock artificial eye with an iris in close resemblance to the natural eye was chosen, and arbitrary iris positioning was carried out using a Vernier Caliper [Figure 2b]. Following wax-up and sculpturing of the prosthesis, the final iris positioning was verified by a Fox plane analyser and millimetre grid attached to the spectacle framework. The bite fork was stabilised with wax rim and teeth in the contralateral arch using putty material, following which a marking corresponding to the centre of the iris of the natural eye was made on the horizontal bar of the plane analyser. The horizontal bar was unscrewed and rotated, followed by the transfer of the marking to the defect site [Figure 2c]. An acrylic stalk was placed over

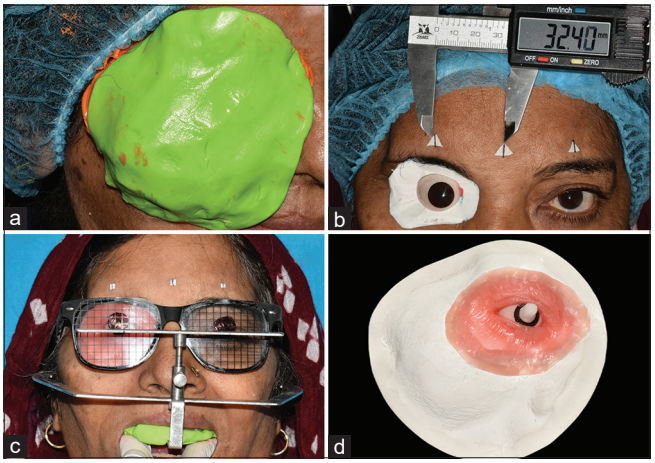

Figure 2: (a) Facial moulage impression with conformer pickup, (b) Transfer of the distance between the glabella and centre of the iris of the natural eye to defect side, (c) Final iris positioning using a Fox plane analyser, (d) Placement of acrylic stalk over the iris

the iris to keep the iris in position [Figure 2d] and prevent its displacement following dewaxing. Packing followed by dewaxing [Figure 3a] and curing of orbital prosthesis was carried out using room-temperature vulcanising silicone material. The final finishing of the prosthesis was done by silicone-compatible burs and wheels [Figure 3b]. The weaving of the eyebrow on the prosthesis was done using the patient's own natural hair. The prosthesis was retained mechanically by engaging natural undercuts and using medical-grade silicone adhesive (Factor-II, USA) [Figure 3c]. Retention of the prosthesis was further reinforced using eyewear previously worn by the patient [Figure 3d].

Fabrication of the intraoral prosthesis

Initially, an interim obturator was fabricated and inserted [Figure 4a]. Surveying of the diagnostic cast was

done, and components of the cast partial denture were planned and carried out. Impression was made using a single-step putty-wash technique, scanned with an extraoral scanner (Dentsply Sirona InLab EOS X5, USA) for 3D construction of data. Prosthesis was designed with Exocad software, and a standard tessellation language (.STL) file was created [Figure 4b]. Following the designing, the STL file was loaded into the printer (Asiga MAX UV 3D Printer, USA), and printing of framework (high-performance CoCrMo 3D printable material, Farsoon, USA) was done. The fit and adaptation of the prosthesis were checked, and the framework was picked up using impression compound and monophasic addition silicone impression material (Aquasil Ultra, Dentsply, USA). The altered cast was obtained [Figure 4c], followed by jaw relation and try-in [Figure 4d]. A 2 mm thick wax was adapted over the defect site, followed by the adaptation of putty in the defect region to form a putty index [Figure 4e]. A glycerine index using glycerine soap was replicated similar to the putty index using a hand carver. Trial closure was done using the putty index, which was later replaced by the glycerine soap index. Following curing, removal of glycerine soap was achieved through access holes made in the bulb portion, application of orthodontic wire and three-way syringe. The hollowness of the prosthesis could be confirmed by the transmission of light and reduced weight of the prosthesis. The intraoral prosthesis was inserted [Figure 4f], and the patient was satisfied with the outcome of the treatment. The patient was reviewed after a week, and minor adjustments were made.

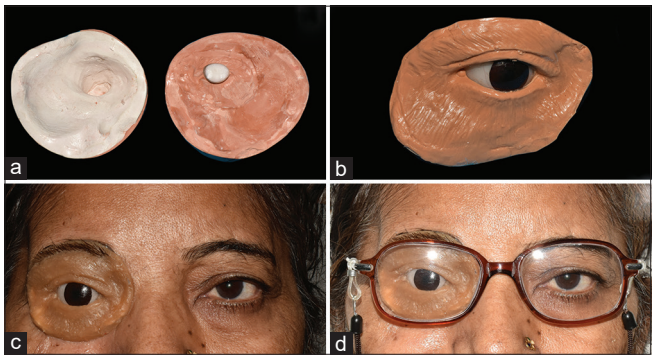

Figure 3: (a) Fabrication of mould following dewaxing, (b) Cured prosthesis, (c) Prosthesis following weaving of eyebrow, (d) Prosthesis reinforced with eyewear

Discussion

The intaglio surface of the orbital conformer fabricated by 3D printed medical-grade PLA material was relined with heat-cure acrylic resin to ensure the biological health of the underlying post-ablative defect towards minimising the risk of recurrence of any infection. PLA was chosen over polymethyl methacrylate due to the easy availability, printer compatibility and added benefits like improved mechanical properties. Furthermore, the conformer was designed with a hollow framework reducing the overall weight of the conformer, thereby enhancing retention of the prosthesis.[6,7]

The extraoral scanning enabled more precise reproduction of the contralateral eye bulb and pupil positions to design the concavity in the conformer accordingly.[8] Iris positioning was done using an innovative approach using the Fox plane analyser. The horizontal rod enabled analysis of the interpupillary line and accurate transfer of iris positioning towards the defect site while maintaining the stability of the analyser. The digital fabrication of the framework of the obturator was done to ensure a more accurate and precise reproduction of the anatomic details to provide a better adaptation of the framework. Glycerine soap was chosen to make the obturator hollow due to its ability to withstand higher temperatures without distortion, easy retrievability and non-adherence to the acrylic resin.[9] A combined orbital and obturator prosthesis retained by means of an attachment could have been a possibility; however, detached prostheses were

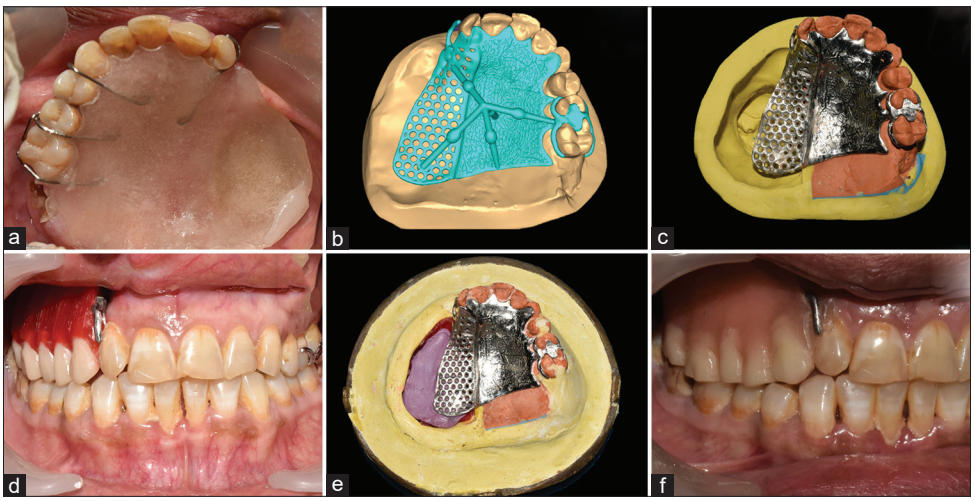

Figure 4: (a) Interim obturator *in situ*, (b) Designing of 3D printed cast partial framework, (c) Adaptation of framework on the altered cast, (d) Try-in of the intraoral prosthesis, (e) Adaptation of putty index between the wax spacer and framework, (f) Intraoral prosthesis *in situ*

fabricated to avoid the mobility and instability of the orbital prosthesis while performing functional oral movements.

Conclusion

The present case report provides a viable treatment modality to rehabilitate a combined orbital and oral defect using digital technology for better adaptation of both orbital and oral prosthesis with the goal to enhance retention and stability of definitive prosthesis. The ultimate goal is to provide a retentive and stable prosthesis to help patients overcome their social and psychological predicaments.

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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