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CLINICAL REPORT

# Prosthetic Rehabilitation of an Orbital Defect: A Case Report

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**Abstract** Mutilation of a portion of a face can cause a heavy impact on the self image and personality of an individual. Surgical removal of an eye is a severe handicap to a patient because the most important sensory organ of communication is lost. Depending on the severity of the defect Ocular/Orbital prosthesis are required in these patients for rehabilitation. This case report details the clinical management of a patient following enbloc removal of an eye. Fabrication of a sectional two piece orbital prosthesis has been detailed. The importance of meticulous treatment planning to tackle the challenges faced in fabricating an orbital prosthesis is explained with relevant literature.

**Keywords** Orbital defect · Sectional orbital prosthesis · Inverted anatomic tracing · Posterior indexing method

## Introduction

'Face is the index of the mind' and it is through this face we express our feelings, be it sorrow or joy. Any damage or disfigurement to the face can lead to psychological and social problems. Restoring these patients with a facial prosthesis that facades the defect is a very demanding task. Nevertheless when appropriately made it is the finest service that can be rendered to a patient who feels socially secluded because of the facial deficiency [1–7]. Surgical removal of an eye is inevitable in situations like irreparable trauma, malignant orbital tumours, painful blind eye, and sympathetic ophthalmia [1–3]. Surgical management includes; evisceration, enucleation, or exenteration. Orbital prosthesis is required to rehabilitate patients following exenteration of eye as this surgical procedure involves enbloc removal of the entire orbit, usually involving partial or total removal of the eyelids [1–7].

## Case History

A female patient aged 56 years, reported to the department of Prosthodontics, Tamilnadu Government Dental College & Hospital, Chennai for the replacement of her exenterated left eye. Patient's left eye was surgically removed enbloc because of meibomian gland carcinoma. On examination, a well healed ocular socket lined with skin graft was observed. The patient did not complain of pain or discomfort in the defect region (Fig. 1).

## Treatment Plan

The patient required orbital prosthesis to restore her facial defect. Rehabilitation options for orbital defects are numerous and the decision rests in the hands of the operator. The operator has to formulate a treatment plan taking into consideration pertinent factors like the health and

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**Fig. 1** Frontal view of the patient with the orbital defect

cooperation level of the patient, tissue health of the surgical site, the financial constraints of the patient and the operator skill.

Fabrication of any facial prosthesis involves the following treatment sequence:

1. Obtaining facial moulage to study the defect and plan the treatment
2. Deciding the mode of retention of the prosthesis
3. Orienting the planned prosthesis in facial harmony
4. Generating the contours of the prosthesis in wax and assessing the trial prosthesis
5. Selecting suitable prosthetic material and proper processing method
6. Shade matching, finishing, polishing and insertion of the prosthesis

## Obtaining Facial Moulage to Study and Plan the Treatment

Accurate facial impression is essential for the construction of a well-adapted prosthesis. Various materials, including impression compound, plaster of Paris, hydrocolloids and elastomeric impression materials have been used in making facial impressions [8–12]. Irreversible hydrocolloid was used to make the facial impression for this patient because it is static, easy to manipulate, fast setting, non irritant, elastic with reasonable dimensional accuracy and detail reproduction. To study the case in detail, a full facial impression from forehead region to nose was made with the patient in an upright position and the remaining right eye passively closed. The area was boxed with modelling wax (The Hindustan Dental products, Hyderabad, India) and irreversible hydrocolloid (Tulip–Cavex, Haarlem, The Netherlands) was mixed and painted gently into the defect area and over the closed right eye. Further mixes were made and the entire boxed area was filled. Care was taken to maintain the thickness of the impression material to a minimum to avoid tissue compression. Wet gauze was placed over the hydrocolloid as it was reaching its final set (Fig. 2a). Dental stone

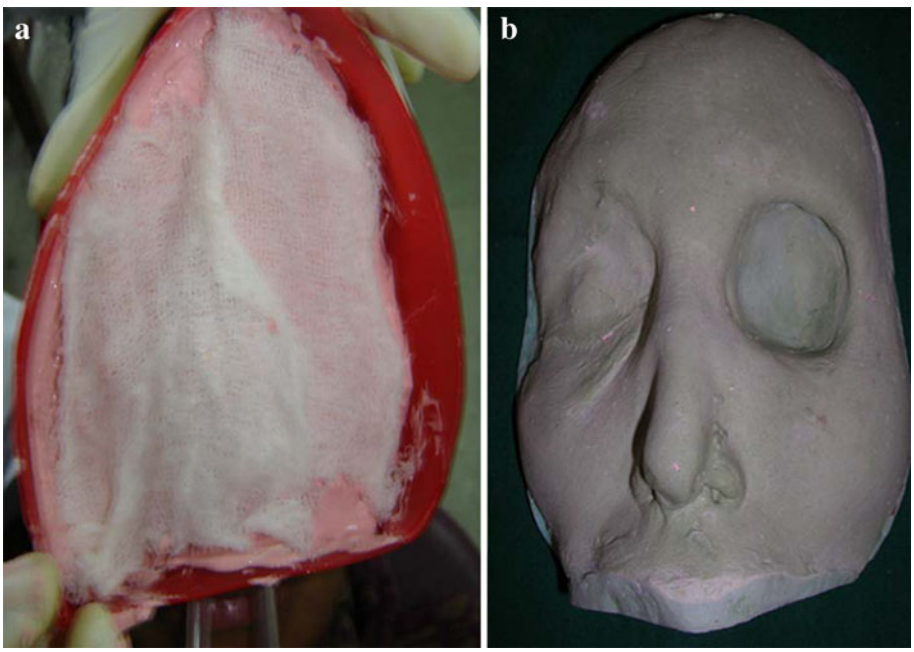


**Fig. 2** **a** Facial impression with irreversible hydrocolloid; **b** Working model of the patient

was mixed and applied over the gauze to stabilize the impression during the cast pouring procedure. Throughout the entire period of impression making uninterrupted nasal breathing was maintained through hollow plastic tubes inserted through the nostrils of the patient. The facial moulage was prepared with type III gypsum product (Gold Stone, Asian Chemicals, Gujarat, India). This was used as the *working model* (Fig. 2b). The defect site was studied on the model. The dimension of the defect was 4.5 × 4 cm in size.

## Deciding the Mode of Retention of the Prosthesis

Retention modes for maxillofacial prostheses range from simpler options like using spectacles, resin bonded attachments, magnets, engaging tissue undercuts, and adhesives to extensive options like using osseo integrated implants [2–7, 13–17]. In the present case, naturally occurring undercuts were evident in the superolateral and inferolateral portions of the orbital rim. Mechanical modes of retention by engaging these undercuts and further by using magnets were planned. So the orbital prosthesis was essentially planned to be made in two parts. The first part was an acrylic stent used to engage the undercut and the second part was the actual orbital prosthesis. The two parts were oriented using magnets.

### *Acrylic Stent Fabrication*

On the *working model*, the entire defect site was blocked with clay except for the planned undercuts in the orbital rim. A 'C' shaped clear acrylic stent running from the superolateral to the inferolateral undercut region along the medial orbital wall was fabricated with auto polymerizing resin (Veracril, Mangalore Dental Corporation, India) engaging the undercut. The thin dimension of the stent allowed flexible insertion and removal from the undercut area. Two magnets were embedded into this clear chemically activated resin stent. The fabricated stent with the magnets were positioned into the defect site of the patient (Fig. 3a) and an irreversible hydrocolloid impression of the defect area with the acrylic stent in place was obtained. The model was prepared with type III gypsum product. This was used as the *processing cast* (Fig. 3b).

## Orienting the Planned Prosthesis in Facial Harmony

### *Selection and Orientation of the Eye Shell*

An eye shell matching the sclera and iris colour of the patient's right eye was selected from an array of stock acrylic eye shells. Accurate alignment of the artificial eye that which is inconspicuous to the onlooker is one of the major prerequisites for the aesthetic success of an orbital prosthesis [18, 19]. For correct orientation of the eye shell in the defect area, many methods are reported in the literature [19]. Facial measurements were used to orient the shell in this case (Fig. 4). The right eye of the patient was maintained in the conversational gaze. A series of vertical lines were marked on the patient's face; line (A) through the midline of the face and line (B) through the pupil of the right eye. The distance between lines (A) and (B) was measured and a vertical line (B') was drawn on the defect side from the midline (A). A horizontal line was drawn passing through the pupil of the right eye (C) and extended through the defect on to the left side of face (C'). The horizontal line (C–C') helped in orienting the shell in correct vertical plane and the vertical lines (B–B') helped in orienting the shell mediolaterally in the defect when the patient presented a normal straight gaze. These facial measurements were transferred to the *working model* to assist in wax pattern fabrication.

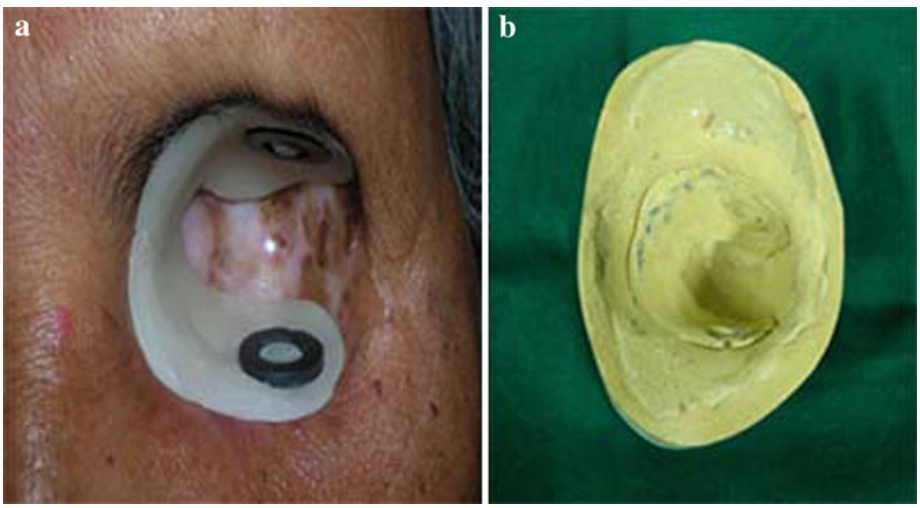


**Fig. 3** **a** Acrylic stent with magnets placed in the naturally occurring undercuts. **b** Processing cast showing the acrylic stent in place


**Fig. 4** Facial measurements used to orient the eye shell in the defect

**Fig. 6** Wax try in of the orbital prosthesis

## Generating the Contours of the Prosthesis in Wax and Assessing the Trial Prosthesis

### *Wax Pattern Preparation*

The *working cast* was filled with wax and the eye shell was oriented using the reference lines. The next step was reproducing the periorbital tissue contours. Carving the anatomic replica of contiguous soft tissues in an orbital prosthesis is an intricate and protracted procedure [8]. Inverted anatomic tracing is a technique where in the individualized contours of the orbital tissues of a patient can be reproduced in the laboratory in the absence of the patient [20]. A 5 × 5 inch OHP sheet was taken and oriented over the right eye of the patient and the lines (A), (B) and (C) were marked on the sheet to orient the sheet during tracing. With an indelible marker, the periorbital anatomy of the right eye was drawn with the patient looking straight ahead (Fig. 5a). Tissue contours like the shape of the upper and lower eye lids, interlid space, the brow shape and the direction and density of the hair were traced on the sheet. The transparent tracing was inverted and oriented with lines (A), (B') and (C') on the surgical defect side (Fig. 5b). This was used to sculpt the wax pattern of the orbital prosthesis as the tracing represented the mirror image of the right eye. The wax pattern thus formed was tried on the patient (Fig. 6). The eye shell position, the lid aperture of the orbital prosthesis was assessed. Once patient's approval was obtained, the pattern was transferred to the *processing cast* (Fig. 7a).

## Selecting Suitable Prosthetic Material and Proper Processing Method

Materials like porcelain, PMMA, poly urethane elastomer, silicone elastomer, urethane backed medical grade silicone are reported as maxillofacial material [2, 4, 6, 7, 13, 21]. PMMA resin was preferred in this case as it was economical and allowed better finishing that helped in maintaining the health of the surgical site.

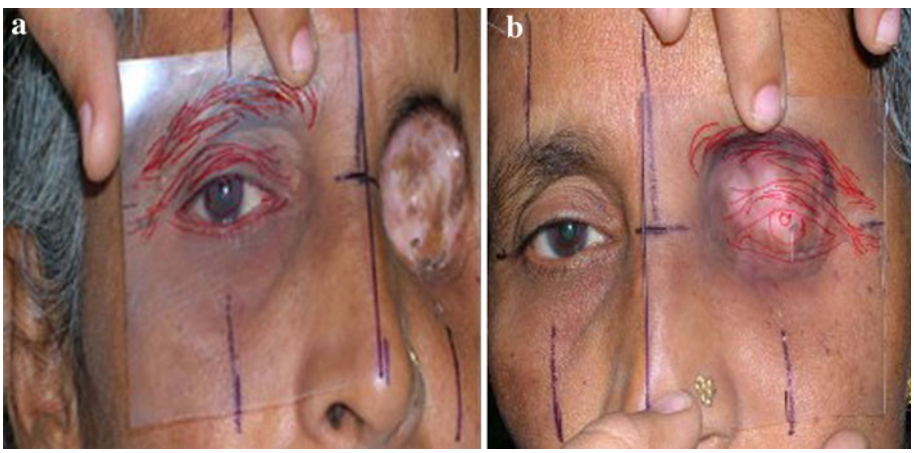


**Fig. 5** Inverted anatomic tracing. **a** Periorbital tissue tracing of the right eye. **b** Tracing of the right eye inverted and oriented on the defect side

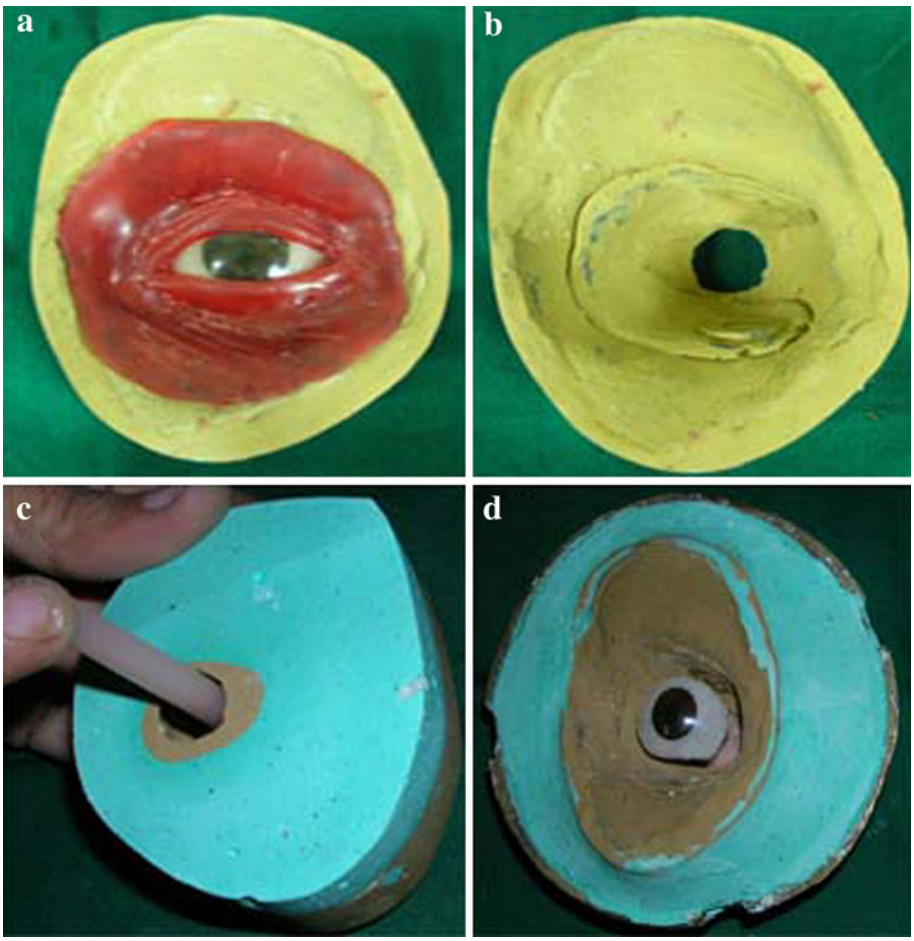


**Fig. 7** Processing of the orbital prosthesis. **a** Wax pattern on the processing cast. **b** Hole made through the rear portion of the processing cast. **c** Posterior indexing of the eye shell. **d** Eye shell is stable after dewaxing

*Indexing of the Eye Shell*

The difficult task in fabricating an orbital prosthesis is maintaining the position of the eye shell without positional discrepancy during processing. Posterior indexing method was used for stabilising the eye shell during processing. A hole was made through the rear portion of the *processing cast* through which a needle cap filled with auto polymerizing resin (Veracril, Mangalore Dental Corporation, India) was inserted to contact and index the posterior surface of the eye shell (Fig. 7b, c). The auto polymerizing resin once set indexed the eye shell in correct position.

*Investing and Processing of the Prosthesis*

Mould materials for prosthesis fabrication that are commonly used are acrylic resin, epoxy resin, silicone, lipowitz metal, dental stone, and light cure material [21]. Dental stone was used for mould preparation as it was easy to construct, accurate, and inexpensive. The processing cast along with the indexed pattern was invested in dental stone and dewaxed (Fig. 7d). The surface of the eye shell was covered with a thin cellophane sheet to protect it during packing of the resin.

Shade Matching. Finishing, Polishing and Insertion of the Prosthesis

The patient was called for shade matching appointment. Heat polymerizing resin (Meliodent; Heraeus Kulzer Ltd, Berkshire, Germany) was mixed to which pigments (MP Sai Enterprises, Bombay, India) were added to match patient's facial skin colour. The mould was filled with the resin, bench cured and then heat polymerized. The prosthesis was retrieved from the mould space after cutting the needle cap. The excess resin was trimmed and finished. The next step was to orient the orbital prosthesis with the acrylic stent. Second pair of magnets was placed over the magnets on the acrylic stent and the whole assembly was positioned in the undercut on the *working model*. Position of the magnets was approximately marked on the rear side of the orbital prosthesis and resin was hollowed out. It was filled with auto polymerizing resin and the second set of magnets was picked up by the prosthesis (Fig. 8a).

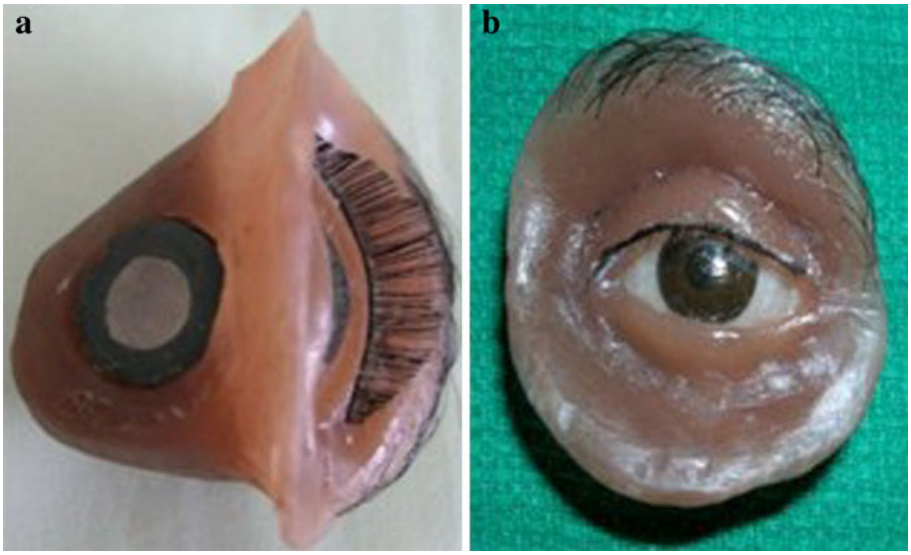


**Fig. 8** **a** Second pair of magnets on the rear portion of the prosthesis. **b** Finished orbital prosthesis

*Prosthesis Insertion*

Patient was called for insertion and artificial eyelashes and eye brows were attached to the same density as it was present on the right eye (Fig. 8b). The patient was taught to insert first the acrylic stent into the undercut region and then to orient the orbital prosthesis in place (Fig. 9a). The mechanical retention provided by the undercut and the magnets made the prosthesis self retentive. Patient was advised to continue the use of her reading glasses which further helped to camouflage the margins of the prosthesis (Fig. 9b). The patient was very much satisfied with the aesthetic result of the prosthesis. The patient commented that the prosthesis made her feel self confident and removed the sense of insecurity

## Discussion

The challenges faced during constructing an orbital prosthesis are; obtaining a satisfactory working model without tissue compression, proper orientation of the ocular portion


**Fig. 9** **a** Orbital prosthesis insertion. **b** The spectacle masked the margins of the prosthesis

in harmony with the remaining eye, reproducing the contour and anatomy of the periorbital tissues, determining proper gaze and interlid opening and obtaining a satisfactory colour match. The other important issues to be addressed are material and method for prosthesis fabrication and the mode of retention of the prosthesis [4, 8, 22].

This case report details the prosthetic rehabilitation of an orbital defect with an orbital prosthesis which was sculpted using inverted anatomic tracing technique [20], processed by posterior indexing method [18] and retained by engaging naturally occurring undercut and magnets [13].

The problem of orienting the eye shell in the defect and in harmony with remaining eye was solved using facial measurements [19]. Inverted anatomic tracing technique helped in copying the periorbital tissue details of the remaining eye. The tracing when inverted served as the blue print for carving the wax pattern for the orbital prosthesis.

The eye shell was stabilized during processing using posterior indexing method. It was preferred over anterior indexing as the later mostly results in damaging the corneal surface of the eye shell [18].

In the present case, the sectional design of the prosthesis helped in engaging the naturally occurring undercut. The mechanical lock provided by the undercut and magnets offered good prosthesis retention and prevented accidental removal by dislodgment.

To remove the speculations regarding the residual monomer content in the acrylic prosthesis that can elicit tissue reaction, the prosthesis and the stent were stored in water for 3 days before insertion to reduce the residual monomer content [16, 17].

## Conclusion

Loss of an eye is a very traumatic experience for an individual. Rehabilitation of such patients both emotionally and prosthetically is really a phenomenal task. Attention to detail is mandatory in each and every step to bring out a satisfactory end result. This clinical report details fabrication of a sectional orbital prosthesis for a female patient following enbloc removal of her left eye. The techniques employed greatly helped in reducing the chair time.

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