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Prosthetic rehabilitation of acquired orbital defect along with complete rehabilitation of edentulous mouth

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Abstract
Loss of eye, apart from impaired vision has a detrimental effect on the psychosocial wellbeing of an individual. The replacement of the lost eye as soon as possible after the surgery is necessary to improve social acceptance and quality of life. Multidisciplinary management and team approach between surgeon and prosthodontist are essential in providing accurate and effective rehabilitation and follow-up care for the patient. Although various treatment modalities are available it may not be advisable for all the patients due to some medical conditions or economic factors. The present article describes a simplified technique for the fabrication of a Room Temperature Vulcanized (RTV) silicone orbital prosthesis to achieve optimal fit and esthetics.

Keywords: Artificial eye, orbit, orbital defect, orbital exenteration, silicone

Introduction
Artificial eye-making has been practiced since ancient times. The first ocular prostheses were made by Roman and Egyptian priests as early as the fifth century BC. In those days artificial eyes were made of painted clay attached to cloth and worn outside the socket. It took about twenty centuries for the first in-socket artificial eyes to be developed. At first, these were made of gold with coloured enamel. Then, in the latter part of the sixteenth century, the Venetians started making artificial eyes out of glass. These early glass eyes were crude, uncomfortable to wear, and very fragile. Even so, the Venetians continued making them and kept their methods secret until the end of the eighteenth century [1].

The purpose of an orbital prosthesis is to restore the facial appearance to near normal.

Loss of eye can occur from congenital defects, a painful blind eye, sympathetic ophthalmia, tumours, or trauma.

Enucleation is the removal of orbital content from the orbit involving the separation of all the neurovascular connections from the body. *Evisceration* involves the removal of the contents of the eye, while maintaining an intact scleral shell attached to the extraocular muscles. *Exenteration* involves the removal of the globe along with all the soft tissues of the orbit [2].

Rehabilitation of orbital defects is very difficult because it is said that "eye is the mirror of soul" and it requires personalized design for each and every patient.

Case history
A male patient aged 67 reported to the Department of Prosthodontics and Crown & Bridge, Haldia Institute of Dental Sciences and Research, West Bengal, with the chief complaint of difficulty in chewing due to an old broken complete denture. On extraoral examination, we noticed that there was an orbital defect of the right eye as it was surgically removed en-bloc because of mucoepidermoid carcinoma of the right lacrimal gland 10 years back. A well-healed orbital socket lined with a skin graft was observed. The patient did not complain of pain or discomfort in the defect region. Intraoral examination reveals a completely edentulous maxillary and mandibular arch.

Fig 1: Frontal view of the patient with the orbital defect

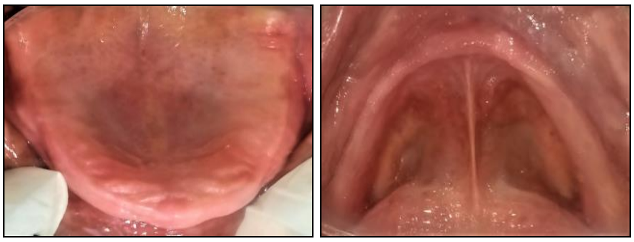


Fig 2: Edentulous maxilla and mandible intra-oral

Treatment plan

The patient has been motivated for the orbital prosthesis. As there was malignancy and financial restrictions of the patient implant-supported orbital prosthesis was not chosen as an option. A thorough examination of the enucleated socket was made to ensure proper healing and the absence of any infections. The site was covered by a skin graft from thigh and there was an undercut present over the right lateral border of the orbital socket. So, the plan was to fabricate an orbital prosthesis with RTV silicone gaining retention from that undercut.

The operator has to formulate a treatment plan based on the appointment schedule given for the fabrication of the complete denture. Rehabilitation options for orbital defects are numerous and the decision rests on the hands of the operator based on the patient's health status and cooperation level, tissue health of the defect site, and above all the financial conditions of the patient and the operator's 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. Final impression of the defect for accuracy by custom tray.
4. Orienting the planned prosthesis in facial harmony.
5. Generating the contours of the prosthesis in wax and assessing the trial prosthesis.
6. Selecting suitable prosthetic material and proper processing method.
7. Shade matching, finishing, polishing, and insertion of the prosthesis [3].

Technique for fabrication

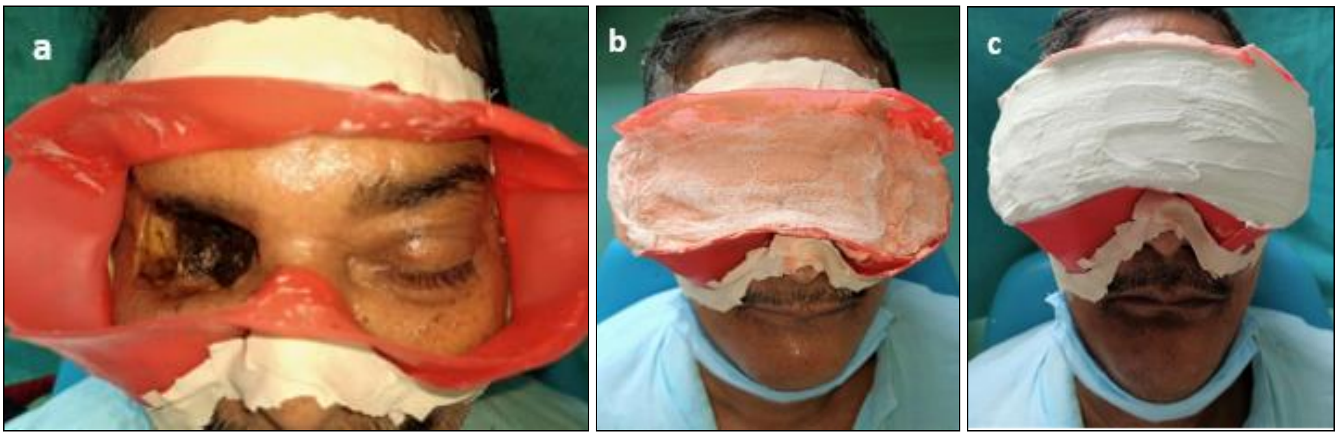
1. Obtaining facial moulage to study the defect and plan the treatment

An accurate facial impression is essential for the construction of a well-adapted prosthesis. Irreversible hydrocolloid was used to make the primary facial impression of both the eyes and face from forehead to nose excluding the nostrils for this patient because it is easy to manipulate, has adequate working time, is non-irritant, has good dimensional stability and is very cost-effective.

The patient was asked to close the other eye passively and the area was lubricated properly with Vaseline and boxed to hold the impression material with the help of modeling wax.

Irreversible hydrocolloid was mixed with chilled water and painted gently over the defect area and on the closed left eye. Next, the box was filled with the remaining material taking care of the fact that there should be an adequate thickness of the impression material minimizing the tissue compression. Wet gauze was placed over the impression material to reinforce it. Dental plaster was mixed and applied over the gauze to stabilize the impression and give adequate body to the impression during the pouring of the cast. Nostrils were excluded from impression so there was no interruption to breathing.

The impression was poured and facial moulage was prepared with Type III gypsum product. This was used for studying the model. The dimension of the defect was 7.4cm in width and 5cm in length.



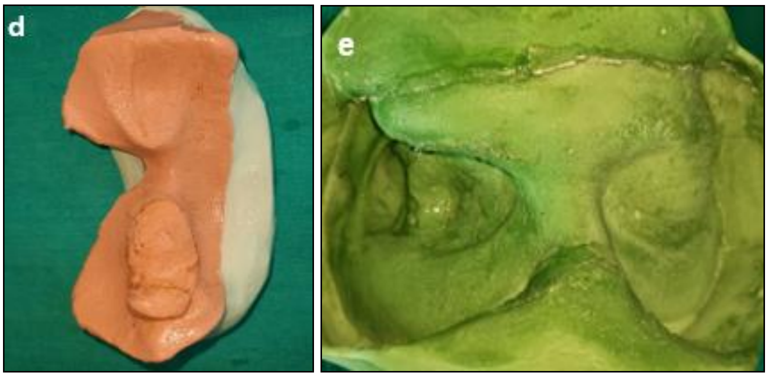


Fig 3: a Boxing the area of interest with modelling wax; b irreversible hydrocolloid impression material with wet gauze; c impression reinforced with plaster; d the primary impression after removal; e Facial moulage of the patient

2. 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 osseointegrated implants [4-9].

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 by means of silicone was planned.

3. Final impression of the defect for accuracy by custom tray

A custom tray fabricated over the defect area to record each and every detail of the defect area as mechanical mode of retention was planned by engaging the undercuts using self-cured acrylic. A double wax spacer of 3mm thickness was given for the impression material. The tray was being perforated for locking and adhesion of the impression material.

Dual-stage, dual-phase impression technique using putty and light body of addition silicone impression (Aquasil) was being proceed as the final impression material.

Beading and boxing were done on the final impression and poured by Type IV Gypsum product and obtained the final model or the working cast.

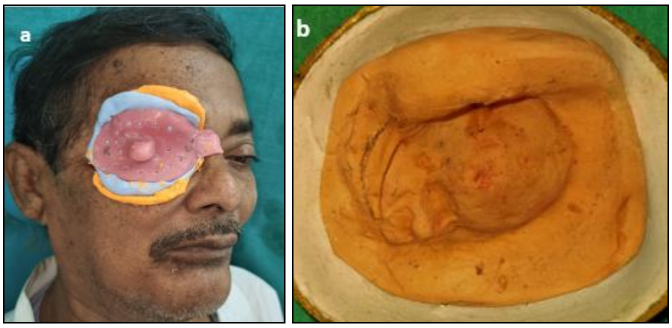


Fig 4: a Final impression by using custom tray; b Final model

4. 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 left eye was selected from an array of stock acrylic eye shells. Accurate alignment of the artificial eye that is inconspicuous to the onlooker is one of the major prerequisites for the aesthetic success of an orbital prosthesis [10, 11].

Facial measurements were used to orient the shell in this case. [Fig.-5] two lines were drawn in the wax conformer. The distance between lines was measured. These facial measurements were transferred to the working model to assist in wax pattern fabrication. The next step is generating the contours of the prosthesis in wax and assessing the trial prosthesis.

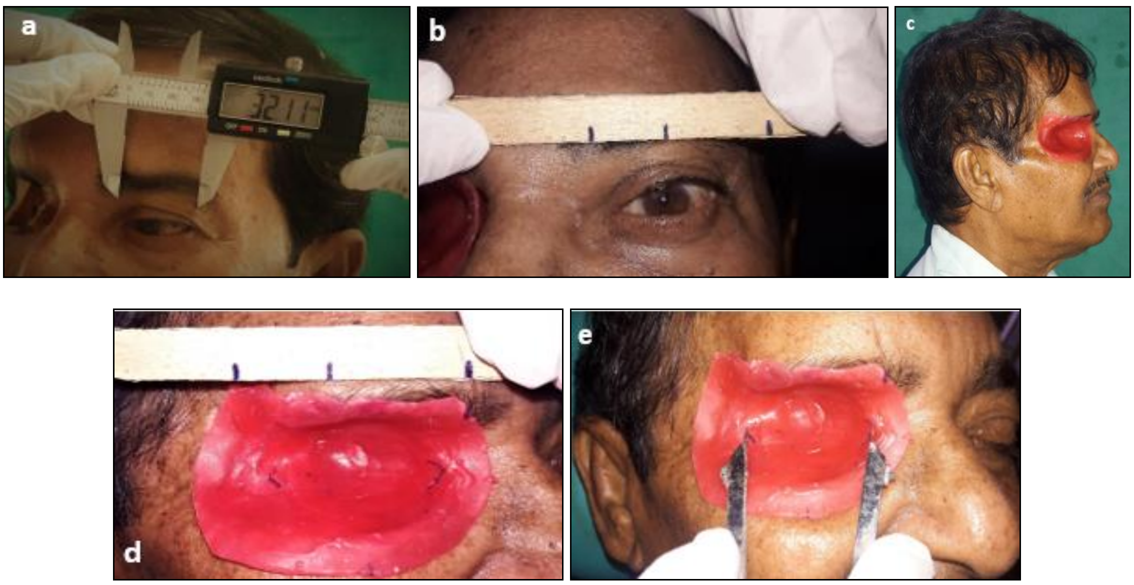


Fig 5: a measurement of the left eye; b. Measurements marked; c Checking the fit and retention of the wax conformer; d marked on the wax conformer; e Measurements taken

5. 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. [12]

Tissue contours of the upper and lower eyelid; inter-lid space crease lines were marked on the wax. [Fig. 6]

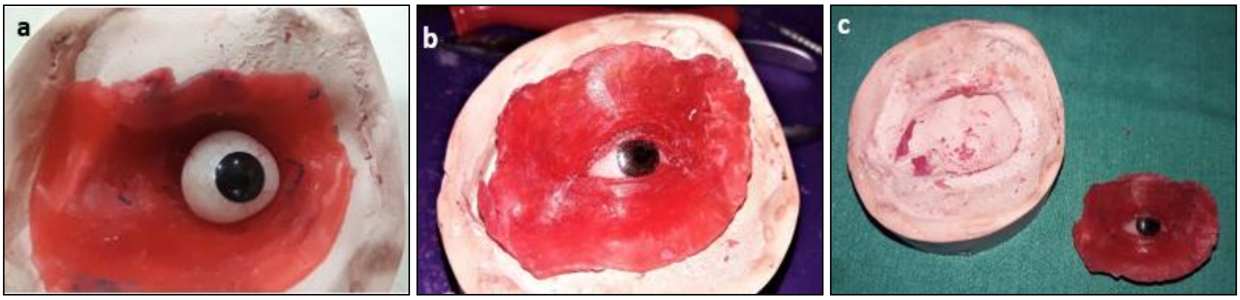


Fig 6: a Placing the eye shell in position b fabrication of wax pattern c separated from the model

Wax pattern trial

The separated wax pattern prosthesis is tried over the patient's face. The eye shell position, and the lid aperture of the orbital prosthesis was assessed. The retention and proper marginal seal were checked with the use of the patient's existing spectacle. Some corrections were made chairside. Once the patient's approval was obtained, the pattern was transferred to the processing cast. [Fig. 7]

Fig 7: a Trial: before making some corrections b, Final wax try-in of the prosthesis

6. Selecting suitable prosthetic material and proper processing method

Materials like porcelain, PMMA, polyurethane elastomer, silicone elastomer, room-temperature-vulcanizing silicone, urethane backed medical grade silicone are reported as maxillofacial material [13, 14].

Here RTV Silicone (room-temperature-vulcanizing silicone) was preferred over others because it is chemically inert and thermally stable. It has skin-like texture, it can be coloured, moulded packed, and cured at room temperature.

Indexing of the eye shell

The trial prosthesis was sealed over the model by the help of modeling wax. Next, it was flasked in regular No. 9 flask. The difficult task in fabricating an orbital prosthesis is maintaining the position of the eye shell without positional discrepancy during processing. So, a self-cured clear acrylic stick was made and attached to the eyeball shell for stabilizing the eye shell during dewaxing and packing. [Fig. 8]

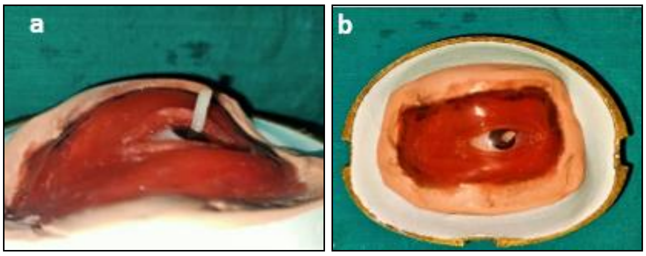


Fig 8: a, b indexing the eye shell

Investing and Processing of the prosthesis

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. The patient was called for a shade matching appointment. On this appointment, the RTV Silicone was mixed with pigments after proper colour matching with the patient's facial colour on chair side. [Fig. 9]

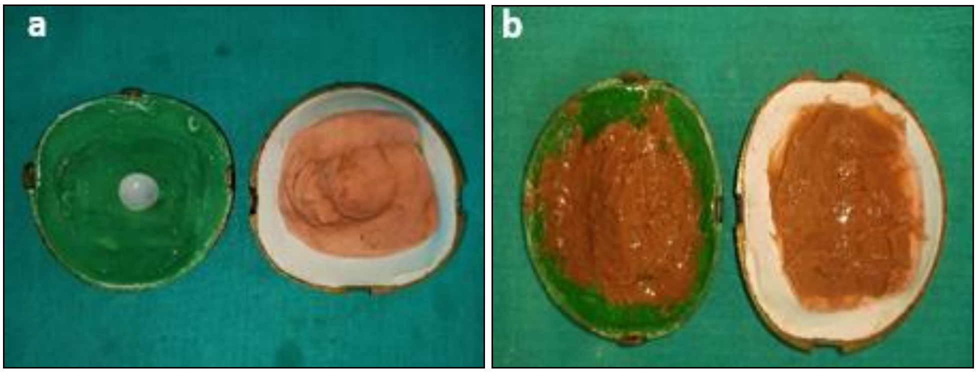


Fig 9: a dewaxing b packing

After packing the lids of the flask were tightly closed and kept for curing for 24 hours as per the guidelines. The next day the prosthesis was retrieved from the mould space. The acrylic stick was detached and excess silicone was cut with the help of a scissor then trimmed and polished. An artificial eyelash was attached with the help of an adhesive. [Fig. 10]

Fig 10: Final prosthesis

Prosthesis insertion

The patient was called for insertion and artificial eyebrows were attached to the same density as it was present on the left eye. The patient was taught to insert the prosthesis into the retentive undercuts present. The margin of the prosthesis was modified. The patient was advised to continue the use of her reading glasses which further helped to camouflage the margins of the prosthesis. [Fig. 11]

The patient was very much satisfied with the aesthetic result of the prosthesis. The patient commented that the prosthesis made him feel self-confident and removed the sense of insecurity.

Fig 11: a b before and after extra-oral frontal smiling view with orbital prosthesis and complete denture c d before and after extra-oral profile view with orbital prosthesis and complete denture

Discussion

The challenges faced during constructing an orbital prosthesis are; obtaining a satisfactory working model without tissue compression, proper orientation of the ocular portion in harmony with the remaining eye, reproducing the contour and anatomy of the periorbital tissues, and determining proper gaze and interlid opening and obtaining a satisfactory colour match [3].

Another problem faced was the selection of the method of retention. As the patient was a carcinoma survivor, he was strictly unwilling for any implant-supported prosthesis for monetary conditions. The other important issue was material selection.

The problem of orienting the eye shell in the defect and in harmony with the remaining eye was solved using facial measurements. [15]

In this case fabrication of orbital prosthesis along with complete denture was a little bit hectic and long clinical hours required. But as the patient was not self-motivated for the orbital prosthesis it was easier to recall him of the appointment for complete denture and also for the orbital prosthesis.

The patient was a spectacle wearer. So, it made the procedure easier to camouflage the finish line of the prosthesis with the spectacle.

Recent advances in rehabilitation using orbital prostheses includes the introduction of two new dimensions. One is blinking eye, where EMG patterns from orbicularis oculi of the normal eye are used in replicating eyelid blinking action in orbital prosthesis using 8 probe EMG receptors and mini-motors [17]. Another dimension is adding vision through the prosthesis by using a Bionic eye which utilizes nanotechnology using nano cameras, encoders, and transducers that relay a signal to the retinal tract and visual cortex thus producing vision. Current prototypes produce a vision which is black & white and hazy. Advanced researches are underway to have a bionic eye with coloured and accurate vision [16].

Conclusion

It is a wonderful task to prosthetically rehabilitate the orbital defect as well as to relieve from the traumatic experience of that individual. Lost eyes have been replaced with prostheses for many years in the form of stock or custom orbital prostheses. Often, however, a custom-made orbital prosthesis that provides a more precise and satisfactory esthetic appearance is indicated, especially for those who have lost orbital structures through orbital evisceration or orbital enucleation [18]. In the treatment of a patient requiring a custom orbital prosthesis, many successful techniques are available to the practitioner. Although implant-retained orbital prostheses play an important role in the success of treatment, conventionally retained orbital prostheses are practical, trouble-free, cost-effective, and successful [19].

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