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Prosthetic rehabilitation of a shrunken orbit with a modified stock ocular prosthesis: Restoring aesthetic harmony: A case report

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Abstract
Ocular prostheses play a crucial role in rehabilitating patients by restoring facial symmetry, enhancing aesthetics, and improving psychological well-being. This case report describes the rehabilitation of an ocular defect using a simplified approach with a stock ocular prosthesis aimed at restoring and replacing facial structures with artificial substitutes. The goal is to improve the patient's appearance, preserve the health of the remaining structures, and consequently promote both physical and mental well-being. The report outlines clinical steps, including impression taking, color matching, and prosthesis customization, to achieve a natural appearance in a shrunken orbit. Stock prostheses offer a cost-effective and time-efficient solution that does not compromise aesthetics.
Future trends in ocular prosthetics focus on bio-integrated and smart devices that enhance functionality and user experience. Over the years, advancements in material science and digital technology have significantly improved the function, longevity, and biocompatibility of ocular prostheses.
This case report also explores various types of ocular prostheses, including stock and custom-made options, and highlights the latest developments in Computer Aided Design (CAD), 3D printing, and biocompatible materials.

Keywords: Maxillofacial prosthesis, customized ocular prosthesis, shrunken orbit, artificial eye, facial rehabilitation, aesthetics

Introduction

Eyes are the most noticeable and expressive feature of our faces. Eyesight profoundly shapes our daily lives and is crucial among our senses, its true value is frequently unappreciated until vision is lost or impaired. Loss of an eye due to congenital defects, trauma, injuries, or tumours can significantly impact a person's functionality, appearance, and psychological well-being, often leading to challenges in social interactions, self-esteem, and daily activities [1, 2].
There are three main surgical approaches to managing severe ocular conditions: Evisceration, enucleation, and exenteration. Evisceration removes the interior parts of the eye while leaving the sclera and sometimes the cornea intact. Enucleation involves completely removing the eyeball along with part of the optic nerve within the orbit. The most extensive procedure, exenteration, involves the removal of the entire orbital contents, including the extraocular muscles [3, 4].
Ocular prostheses can be provided to patients who have lost eye structures due to evisceration or enucleation. Acrylic resin eye prostheses are generally classified into three main types: custom-made prostheses that are crafted from an impression of the eye socket for an individualized fit, pre-manufactured or stock prostheses that come in standard sizes, and modified pre-manufactured prostheses that have been adjusted through various techniques to suit the patient's needs [5, 6]. Custom-made prostheses generally provide a better fit, increased comfort, and more natural aesthetics compared to stock prostheses [7-8]. Stock prostheses offer the advantages of affordability and immediate availability; however, they frequently lack the personalized fit and natural esthetics of custom-made prostheses, potentially affecting patient comfort and satisfaction over time [8-10].

Selecting appropriate materials for ocular prostheses is crucial to ensure biocompatibility, durability, and an appealing appearance. Polymethyl methacrylate (PMMA) is widely regarded as the standard material for ocular prosthetics due to its compatibility with body tissues, ease of customization, and long-lasting performance [11-12]. Emerging materials such as medical-grade silicones, hydrogels, and surface-modified polymers are being explored to enhance wearer comfort and reduce irritation. Moreover, innovations in nanotechnology and surface engineering have led to prostheses with improved tear film stability, antimicrobial effects, and greater colour retention, improving both function and aesthetics [11].

This clinical report describes an effective and economical method for fabricating ocular prostheses by combining a stock iris with a custom-made sclera, achieving both functional restoration and aesthetic improvement.

Fig 1: Preoperative photograph of the patient-shrunken left eye orbit

Fig 2: Ocular Defect of eye

Case Report

A 31-year-old female 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 her left eye, which had been missing for three years (Figure 1, 2). The patient's history revealed trauma to the left eye followed by enucleation. Clinical examination revealed that the ocular socket was lined with healthy conjunctiva, which moved synchronously and showed no evidence of inflammation or infection. On examination, the defect presented with a healthy tissue bed with scar formation because of which the orbit appeared contracted. Due to the patient's limited financial resources, a modified stock ocular prosthesis was recommended as the most feasible option. To help alleviate anxiety and ensure cooperation, the patient was thoroughly informed about the treatment process and its limitations. Before beginning the procedure, detailed explanations were provided regarding the semi-customized ocular prosthesis, which would consist of a custom-made sclera combined with a stock iris.

Procedure: Ocular impression

Primary Impression

To start with, the patient's eye was first irrigated with saline solution and cleaned with cotton and gauze. A thin layer of Vaseline was applied to the patient's eyelids, eyebrows, and the skin surrounding the ocular defect. A customized impression tray with an attached injector was created by connecting the hub of a 10 ml syringe to facilitate the primary impression of the ocular socket. Light viscosity elastomeric impression material was slowly injected to minimize air bubbles. The tray was initially positioned beneath the upper eyelid and then under the lower eyelid. The patient was instructed to close her eyes, allowing excess material to escape through the perforations in the tray. While the material set, the patient performed a sequence of eye movements side to side, up and down, and circular motions to capture a detailed impression with well-defined borders [14] (Figure 3).

Fig 3: Primary impression of patient eye socket using light body

Once the impression material had set, it was carefully removed from the anophthalmic socket. The impression was then thoroughly examined to ensure there were no air bubbles and that all surface details were accurately captured. Beading and boxing were performed on the impression before pouring a primary cast using Type IV dental stone (Kalrock, Kalabhai, India) [13, 14].

Secondary Impression

After preparing the cast, a custom clear tray with drilled holes was fabricated, polished, and finished to be used for the secondary impression. The tray had to be trimmed and adjusted in the eye. Then final impression was made with light body elastomeric impression material similar to the primary impression method (Figure.4). The goal was to achieve an ideal curvature and ensure full contact with the peripheral tissues [14] (Figure.5). The final impression details were recorded using the split cast technique. Initially, the first half of the sectional cast was poured with the impression surface facing upwards. After this layer set, indexing was performed to ensure the correct alignment of the second half. Once the material fully hardened, the two parts of the cast were carefully separated. The final impression was removed to prepare the mold space for fabricating the wax pattern. The final impression was carefully removed to create the mold space needed for wax pattern fabrication [15] (Figure 6).

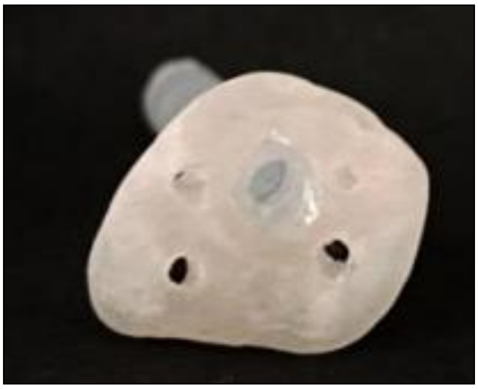

Fig 4: Photograph showing Special tray fabricated to make final Impression

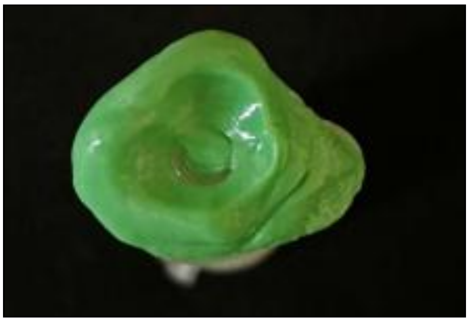

Fig 5: Ocular secondary impression using stock tray

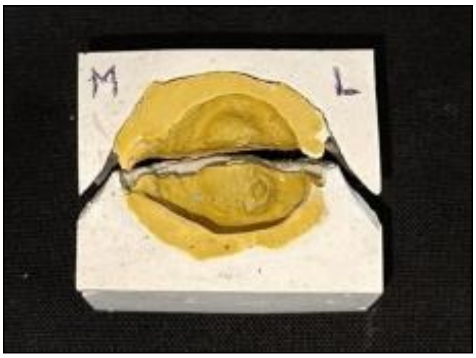

Fig 6: Secondary split cast

Wax conformer or the scleral try-in

A wax conformer was created by pouring melted modeling wax into the master cast, which had been coated with a separating medium. After smoothing, the wax conformer was inserted into the patient's enucleated socket. The volume and contour of the eye socket, eyelids, and surrounding areas were assessed, including a profile view of the patient. The fit was further verified by asking the patient to close her eyes. Additionally, the patient was instructed to perform a series of eye movements to evaluate the retention and stability of the wax conformer.

The patient's iris was selected from a variety of commercially available stock eyes set. The one which closely resembled her unaffected natural eye was chosen. During the trial, the iris was carefully positioned to align symmetrically with the iris of the opposite healthy eye. To achieve accurate placement, a measuring caliper was used, resting against the patient's forehead for precise reference [14].

The facial midline was used as a reference to measure the distance to the center of the natural eye's pupil. This measurement was then transferred and marked on the wax pattern to correspond accordingly on the left side. After removing the wax pattern, the iris was positioned and fine-tuned based on both horizontal and vertical axes with careful attention to this reference point. The symmetry and coordination of the eye movements were also assessed, revealing that the wax trial prosthesis moved in harmony with the patient's natural eye [14, 16] (Figure.7).

Fig 7: Photograph showing wax pattern trial

Flasking

After the wax pattern trial, the secondary impression cast was trimmed to match the dimensions of the flask. The wax pattern was then sealed in place, and the entire setup was flasked following standard laboratory protocols. To prevent the iris from shifting during the dewaxing process, a handle made of cold-cured acrylic was attached to it for stability [14] (Figure 8).

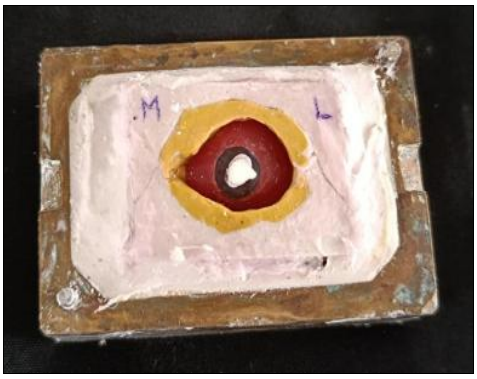

Fig 8: Photograph showing wax pattern invested with handle attachment (acrylic stick)

Dewaxing

During the second pour, the iris handle was embedded into the counter flasking plaster. After the material had fully set, dewaxing was carefully performed to ensure complete removal of all wax from the mold cavity [14, 16, 19].

Packing

At this stage, the tooth-colored, heat-cured polymethyl methacrylate was selected to match the scleral shade of the patient's natural eye. A thin, uniform layer of heat-cured clear acrylic is applied over the iris and surrounding scleral areas to enhance esthetics. The mould is bench-cured and then heat cured to complete polymerization and enhance the prosthesis' durability and appearance [14, 16, 20].

Characterization

Characterization imparts the natural vitality necessary to give the prosthesis a lifelike appearance, enhancing the patient's overall aesthetic. During polishing and finishing, the prosthesis's convexity and contour were meticulously preserved. The acrylic sclera was uniformly trimmed to approximately 1 mm thickness. Soft hues of brown, pink, blue, and yellow were applied over the trimmed surface to match the contralateral natural eye's sclera. The outer edge was detailed with fine red nylon threads to simulate blood vessels (Figure 9). After achieving satisfactory characterization, a thin layer of cyanoacrylate adhesive was applied to secure the coloration and nylon threads. Before insertion, the prosthesis was cleaned and lubricated with an ocular lubricant to maintain a tear film over its surface and facilitate smooth eye movements [14, 16, 17, 19, 20].

After placement of the final ocular prosthesis, its fit, appearance, and coordinated movement with the opposite natural eye were carefully evaluated (Figure.10). Post-insertion, the patient was thoroughly instructed on proper use, handling, limitations, and maintenance of the prosthesis to ensure comfort, functionality, and longevity. These instructions help prevent complications, promote hygiene, and support adaptation for optimal prosthetic outcomes.

Fig 9: Customization of prosthesis

Instructions for the patient to wear the prosthesis and follow its at-home care regimen are provided below:

- Always handle your prosthesis with clean, thoroughly washed hands to prevent contamination.
- It is best to remove the acrylic prosthesis at night to allow the eye socket to rest. To disinfect, soak it regularly in an antibiotic solution to eliminate surface bacteria.
- To minimize the buildup of protein deposits and bacterial growth, have your prosthesis professionally polished at least once a year [14, 18].

Discussion

Constructing an ocular prosthesis involves several challenges, including obtaining an accurate working model without tissue compression, properly aligning the ocular portion with the contralateral eye, replicating the contour and anatomy of the periocular tissues, achieving correct gaze and eyelid opening, and obtaining a satisfactory color match. Additional critical considerations include the choice of material, fabrication technique, and method of prosthesis retention [22].

Ocular rehabilitation after enucleation or orbital defects addresses both functional and psychosocial challenges, as loss of an eye affects facial symmetry, esthetics, and patient confidence. The primary goal of prosthetic rehabilitation is to restore facial harmony, achieve natural eye movement, and improve psychological well-being.

Custom-made ocular prostheses are considered the gold standard due to precise iris and scleral replication, contouring, and synchronized movement with the contralateral eye. However, their fabrication is technically demanding, time-consuming, and requires skilled artistry, limiting accessibility in resource-constrained setting [8].

Customized stock acrylic resin prostheses offer a practical alternative. They reduce fabrication time, do not require specialized artistic skills, and utilize materials readily available in most dental laboratories. These prostheses can also function as immediate postoperative conformers, supporting tissue healing and maintaining ocular dimensions. In this case, careful adaptation and shade matching produced favorable esthetic outcomes and high patient satisfaction, highlighting the clinical utility of stock prostheses [21].

Recent advances in 3D scanning and printing have further enhanced ocular rehabilitation. High-resolution 3D imaging allows precise mapping of orbital anatomy, while additive manufacturing enables patient-specific prostheses with accurate fit, contour, and iris positioning. Digital color matching improves esthetic realism and reproducibility, reducing reliance on artisanal skills and allowing faster, cost-effective production. Integration of 3D technologies with traditional methods creates a hybrid approach, combining the accessibility of stock prostheses with the precision of custom fabrication.

Despite these innovations, limitations persist: stock prostheses may not replicate unique iris or scleral features perfectly, and 3D-printed solutions require specialized equipment and technical expertise. Therefore, individualized assessment remains essential to select the optimal prosthetic strategy.

In summary, the combination of customized stock prostheses and emerging 3D technologies provides an efficient, patient-centered, and accessible solution for ocular rehabilitation, balancing esthetic outcome, functional restoration, and cost-effectiveness.

Conclusion

A well-fitted ocular prosthesis significantly enhances the quality of life for patients with eye loss by restoring facial symmetry, esthetics, and coordinated eye movement. Recent advances in materials and digital fabrication techniques have facilitated highly personalized prosthetic designs, improving comfort, natural appearance, and overall patient satisfaction. Moreover, a multidisciplinary approach involving ocularists, prosthodontists, and mental health professionals ensures comprehensive care, addressing both physical rehabilitation and psychological well-being. Such integrated management supports optimal functional and esthetic outcomes, promoting long-term success and improved quality of life for anophthalmic patients.

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Conflict of Interest
Not available.

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