Case Report

Prosthetic management of anophthalmic socket with inferior orbital deficiency using custom acrylic ocular prosthesis: a case report

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ABSTRACT

Introduction: Loss of the bulbus oculi may result from congenital anomalies or trauma. In severe trauma, enucleation is often required, entailing removal of the entire eyeball while preserving adjacent muscles and tissues. However, trauma may also damage the periocular muscles, compromising the fit and mobility of an ocular prosthesis, thereby complicating rehabilitation. The aim of this case report is to describe the clinical procedure and outcomes of fabricating a custom ocular prosthesis for a post-enucleation patient with compromised periocular muscle support due to trauma, with an emphasis on the importance of individualized prosthesis design to achieve optimal fit, aesthetics, and patient satisfaction. **Case Report:** This case presents the fabrication of a custom ocular prosthesis for a 40-year-old male patient who lost his left eye in a motorbike accident seven years ago. He previously used a prefabricated ocular prosthesis, which was ill-fitting, uncomfortable, and prone to dislodgement, negatively impacting his confidence and daily activities. His occupation as an online motorcycle taxi driver emphasized the need for a stable and aesthetically pleasing prosthesis. The rehabilitation process involved impression-taking using polyvinyl siloxane, wax scleral pattern try-in for contour and retention assessment, acrylic sclera formation, iris and pupil positioning, and final prosthesis placement. **Conclusion:** This case report highlights the clinical challenges and solutions in managing an anophthalmic socket with inferior orbital deficiency through the use of a custom acrylic ocular prosthesis. The compromised support of the inferior periocular structures necessitated a highly personalized approach to ensure proper prosthesis retention, mobility, and aesthetic integration. Through accurate impression-taking, iris positioning and meticulous customization, the prosthesis successfully restored facial symmetry, improved patient comfort, and enhanced psychological well-being. This case underscores the value of patient-specific prosthetic design in complex ocular rehabilitation scenarios, particularly those involving post-traumatic muscle loss.

KEYWORDS
Post-enucleation, anopthalmic socket, custom ocular prosthesis

INTRODUCTION

Maxillofacial prosthodontics is a specialized field that combines science and art to restore missing facial structures, providing patients with a lifelike appearance. A critical aspect of this discipline involves creating ocular prostheses that not only achieve acceptable aesthetics but also restore facial symmetry, thereby helping anophthalmic patients regain their typical appearance.[1]

The eyes are the most noticeable feature of the human face. Such a significant facial feature loss may result from malignancy, congenital condition, painful blindness, irreversible injury, or sympathetic ophthalmia. The patient's physical, psychological, and emotional well-being are all greatly impacted by this loss. According to estimates, there are 3.5 globe injuries for every 100,000 people, with men accounting for over 80% of open globe injuries. Pupils are more likely to get injuries from sharp objects (such as writing utensils, scissors, or knives) that penetrate the globe directly. Often, blunt trauma (such as from motor vehicle collisions, fights, or hammering injuries sustained at work) is the reason. The most common cause of globe rupture in the elderly is falling.[2–6]

Recent advancements in ocular prosthesis technology have introduced more efficient, cost-effective methods for fabricating customized prosthetic eyes. One notable development is the utilization of the grid method for precise iris positioning in acrylic ocular prostheses. This technique enhances the accuracy of the prosthetic eye's alignment with the natural eye, ensuring improved symmetry and a more natural aesthetic appearance.

By using a structured approach, the grid method simplifies the iris placement process, reducing fabrication errors and the need for extensive manual adjustments. Additionally, this method provides a more economical alternative to traditional handcrafted techniques, making high-quality ocular prostheses more accessible to a broader range of patients. The implementation of such innovations not only improves the visual appeal of prosthetic eyes but also enhances wearer comfort and confidence, ultimately contributing to improved psychological and social well-being for individuals with ocular loss.[7–12]

The surgical techniques used to remove an eye are divided into three techniques: exenteration, enucleation, and evisceration. Evisceration is the process of removing the globe's contents while leaving the cornea and occasionally the sclera in place. Its elimination results in a loss of volume. Due to the intact extraocular muscles, the eviscerated globe implant has exceptional movement. A thickness of at least one millimeter is necessary. Sclera shell removal is typically done at night by patients since the remaining globe is typically quite sensitive.[3,9,10]

Enucleation is the surgical removal of the eyeball after the eye muscles and the optic nerve have been severed. Adequate space is created for fabricating the ocular prosthesis. It is the movement of the fornix in the enucleated socket that provides the mobility to the artificial eye. An enucleation is contraindicated in cases of intraocular malignancy with evidence of orbital spread: these patients generally require an exenteration.[3,13] Exenteration is the removal of the entire contents of the orbit, including the extraocular muscles. The eyelids may or may not be involved. Exenteration defects in some instances may be allowed to heal by secondary intent but adequate space must remain in the resultant defect to allow the prosthesis to be positioned superiorly and posteriorly enough for a good cosmetic appearance.[3,13,14]

An ocular prosthesis can be fabricated once the surgical site is dimensionally stable and fully healed. The disfigurement associated with the loss of an eye can cause significant physical, psychological and emotional distress. An ocular prosthesis is a simulation of human anatomy using prosthetic materials to create an illusion of a perfectly normal, healthy eye and surrounding tissues, as well as to maintain the volume of the eye socket.[15]

This case report describes the manufacture of a custom ocular prosthesis made of acrylic in a case of eye loss due to a motorbike accident with poor inferior orbital muscle support with a diagnosis anophthalmicus ocular sinistra post enuclease et causa trauma in a male patient. The uniqueness of this case lies in the prosthetic management of a socket with inferior orbital deficiency, which posed challenges in achieving proper retention and symmetry.

A customized approach was required to accommodate the anatomical limitations and restore both function and aesthetics. The aim of this case report is to present a clinical protocol for managing an anophthalmic socket with compromised muscle support using a custom-fabricated acrylic ocular prosthesis, highlighting the significance of individualized techniques in achieving optimal rehabilitation outcomes.

Case Report

The patient, a 40-year-old male, sought treatment at the Department of Prosthodontics, Dental and Oral Hospital, Padjadjaran University, due to the loss of his left eyeball following an accident twenty-five years ago. Over the years, he had relied on a prefabricated ocular prosthesis; however, he frequently experienced discomfort and insecurity regarding his appearance. The prosthesis often felt unstable, causing it to shift or even fall out unexpectedly, which significantly impacted his confidence in social and professional settings.

As an online motorcycle taxi driver, the patient was particularly concerned about his appearance when interacting with passengers. He often felt self-conscious about his artificial eye, fearing that others would notice its poor fit or asymmetry. This insecurity led him to adopt coping mechanisms, such as consistently wearing sunglasses, even in situations where they were not necessary, to conceal his prosthesis. While this provided a temporary sense of reassurance, it did not address the underlying discomfort and dissatisfaction he felt. Additionally, his right eye frequently became strained and fatigued due to the increased reliance on it for vision, further exacerbating his daily challenges. The patient expressed a strong desire for a more comfortable and aesthetically pleasing custom ocular prosthesis that would not only restore his facial symmetry but also enhance his confidence and overall quality of life.

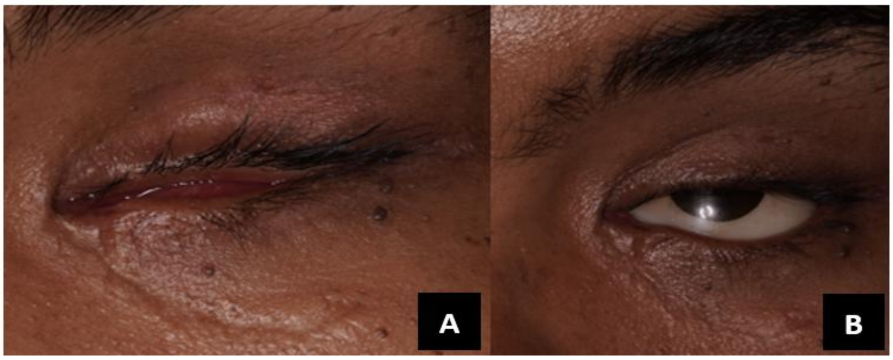

Figure 1. The image of an accident scar on the inferior orbit is visible and the pre-Fabricated ocular prosthesis. (Figure 1a. The morphology of orbital sulcus, Figure 1b. The old prosthesis)

The examination of the eye socket revealed a healthy conjunctiva without signs of infection or inflammation covering the posterior wall of the anophthalmic socket as well as limited eye movement due to poor inferior muscle support from the accident. (Figure1) Examination of the previous prosthesis revealed asymmetry of the iris and pupil and poor fitting of the prosthesis. (Figure 2)

In this case, a comprehensive evaluation was conducted to establish a definitive diagnosis of the patient's left eye loss. Differential diagnoses included phthisis bulbi, microphthalmia, congenital anophthalmia, and post-traumatic ocular atrophy. However, based on the history of a severe motorbike accident and surgical records, the confirmed diagnosis was anophthalmicus ocular sinistra post enucleation et causa trauma. A personalized treatment plan was developed, considering the anatomical challenges posed by inferior orbital muscle deficiency, which significantly affected prosthesis retention and mobility.

Figure 2. The pre-fabricated ocular prosthesis

The rehabilitation process began with a preliminary impression using alginate to assess the general socket contour, followed by a detailed anatomical impression using polyvinyl siloxane. A wax scleral trial was conducted to evaluate volume restoration and lid support. The iris and pupil were aligned using the grid method, ensuring symmetry with the contralateral eye. The final prosthesis was fabricated using heat-cured acrylic (PMMA), polished, and carefully inserted after necessary adjustments. The patient was instructed on hygiene practices and prosthesis handling, and was scheduled for regular follow-up visits.

The prognosis is favorable, as the custom prosthesis successfully restored facial symmetry, improved comfort and retention, and had a positive impact on the patient's psychological and social well-being. This case emphasizes the importance of individualized prosthetic design in managing complex anophthalmic sockets with orbital deficiencies.

The treatment steps taken were as follows: at the first visit, the patient filled out an informed consent form. Then, the process proceeded with making individual tray spoons using self-cured acrylic material, which was supplemented with a straw for access to insert the impression material with a size adjusted to the size of the patient's orbital socket. To start, sterile sodium chloride solution is used to clean the patient's eye and get rid of any debris or dirt. The patient is next given a try-on with the impression tray.

Ocular impression was carried out using polyvinyl siloxane (light body) impression material and an acrylic tray spoon that has been provided with retention. The patient is instructed to sit up straight and relax. The operator then lubricated the eyebrow area with petroleum jelly then the eye socket was cleaned with an injection of saline solution and dried. The impression material was injected into the socket slowly and evenly until the impression material flows into the orbital and palpebra area.

The patient was instructed to keep his eyes open then place the impression tray on the orbital area. The PVS was injected with the light pressure while the patient is instructed to perform functional movements. The impression tray was removed when the PVS material had set. Check the eye socket again to make sure there is no impression material left in the socket. The mold was disinfected with alcohol spray and cast in plaster. After all stages are completed, the impression is sent to the laboratory (Figure 3).

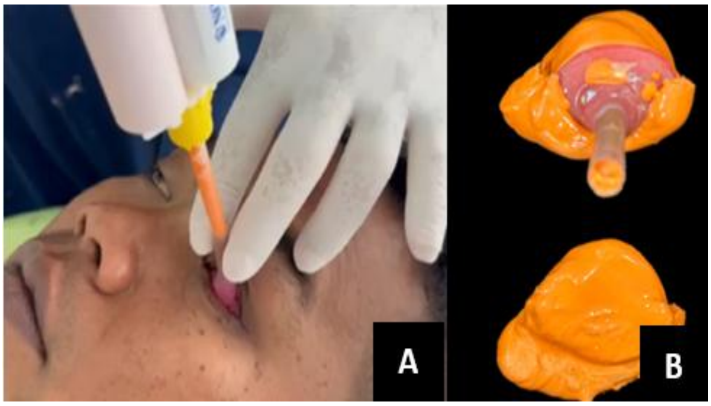

Figure 3. Inject the impression material into the right(Figure 3a. Impression process, Figure 3b. The result of orbital impression)

At the second visit, a sclerae wax template was made. The sclerae wax template should be comfortable so as not to cause irritation. The movement of opening and closing the eyelids and the shape of the eyeball must be observed from all directions—movements include left, right, upward, downward, and rotational directions—to ensure comfort, retention, and stability so that it resembles the other eye. Factors to consider at this stage include the suitability of the eyeball shape, convexity and the ability of the eyelids to open and close, aesthetics, stability and retention. (Figure 4)

Figure 4. Try in Scleral shell template with wax

At the third visit, the pupil location and color were determined by placing the edge of the PD roller in the form of a point on the sclerae using a pencil or permanent marker. The diameter of the original iris was measured using a sliding caliper. The sclerae was removed from the eye socket, then a circle of the iris is made according to the diameter of the original iris using a compass centered on the pupil point that was made previously. (Figure 5 and 6)

Figure 6. Try in the scleral shell with polymethylmethacrylate and measuring the midline of the pupil

Figure 7. Determine the iris diameter using a sliding caliper

At the laboratory stage, the iris is made by reducing the anterior surface of the sclera to a depth of 1-2 mm using a fraser according to the diameter determined for clear acrylic and making details on the sclera. The circle was made according to the diameter determined for the pupil and iris. Coloring was done in the crater that has been made previously using brown acrylic paint for the iris and black for the pupil. After the eye prosthesis had been colored, it was then enhanced with red thread, which was glued using power glue to represent the blood vessels in the eye. Then, the eye prosthesis was coated with clear acrylic at a thickness of 1-2mm. (Figure 8 and 9)

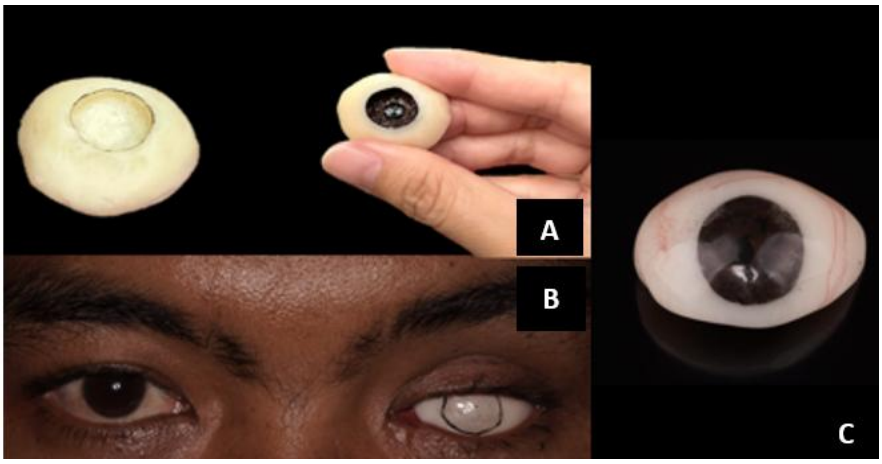

Figure 8. Stages of creating the iris and pupil (Figure 8a. Crater of prosthesis, Figure 8b. Limbus border, Figure 8c. Custom made ocular prosthesis)

Figure 9. Custom ocular prosthesis after polishing and finishing

During the fourth visit, the patient was instructed to sit upright and relax. Then, the practitioner inserted the eye prosthesis and instructed the patient to make functional movements to glance left, right, up, and down. The comfort and movement of the prosthesis in the socket were evaluated, convexity and ability of the eyelid to open and close to check aesthetics, retention, and stabilization. (Figure 10)

Figure 10. Custom ocular prosthesis inserted

After insertion, the patient should be given instructions: Hold the prosthesis carefully and use clean hands. Remove the prosthesis once a day, if necessary, and wash it under warm water and soap with a soft, clean cloth. Keep the eye moist by inserting the prosthesis into the eye, in water when removed, and never let the prosthesis come into contact with alcohol or any solvent. Instructions for removing and inserting the prosthesis: remove the prosthesis by pulling the lower eyelid down, looking up, and pulling the lower margin of the prosthesis with one finger. The prosthesis must be wetted before insertion into the eye socket. The use of a custom ocular prosthesis is more well-fitting and comfortable compared to a prefabricated one. In this case, the patient felt more comfortable, confident, and satisfied with the care provided. Follow-up is carried out 24 hours after insertion, one week later, and once every 6 months if necessary.

DISCUSSION

An ocular prosthesis can be fabricated once the surgical site is dimensionally stable and well healed. The disfigurement associated with the loss of an eye can cause significant physical, psychological, and emotional problems. An ocular prosthesis is a simulation of human anatomy using prosthetic materials to create the illusion of a normal healthy eye and surrounding tissue, as well as to maintain the volume and contour of the eye socket.[1,7,8,15–17]

There are two types of eye prostheses: custom and prefabricated. Prefabricated eye prostheses have the advantage of requiring less time to manufacture because there are no stages of production required in a laboratory. There are three sizes and iris color options for prefabricated eye prostheses. However, due to the discomfort and risk of infection caused by the gap in size between the prosthesis and the eye socket, which creates a fluid-filled space that harbors bacteria, this type of eye prosthesis has drawbacks. Another drawback is that the iris color mismatch leads to cosmetic issues.[17]

In the fabrication of custom ocular prostheses, several challenges may arise that can impact the final outcome and patient comfort. One of the primary difficulties is obtaining an accurate impression of the anophthalmic socket. An improper impression technique can result in a poorly fitting prosthesis, leading to discomfort, irritation, or even infection due to mucus accumulation in the space between the prosthesis and socket tissues. Additionally, precise iris positioning is crucial to achieving symmetry and a natural aesthetic appearance. Errors in iris placement can result in misalignment with the contralateral eye, which may reduce the patient's confidence.[11,18,19]

Another challenge involves selecting the appropriate color and scleral characterization, as minor differences in color or vascular patterns can significantly affect the overall aesthetics of the prosthesis. Once the prosthesis is fitted, regular follow-up is essential to monitor the adaptation of the prosthesis and the health of the surrounding tissues. Potential complications include allergic reactions to acrylic materials, ulceration due to uneven pressure distribution, or changes in the socket that may necessitate further prosthetic adjustments.[18–20]

Custom ocular prostheses are prosthetic devices fabricated by a prosthodontist using laboratory procedures. Custom ocular prostheses are made from acrylic material and have the advantage of being very comfortable to use because they are made to match the contour of the patient's eye socket. From an aesthetic perspective, custom ocular prostheses are better because the sclera and iris painting are tailored to the other eye using photographic reference of the patient's eye. Custom ocular prostheses are more acceptable to patients because they better match the shape of the patient's eye socket and are more aesthetically pleasing. Indications for custom ocular prostheses are after evisceration and enucleation surgery. Contraindications for custom ocular prostheses are patients who are allergic to acrylic materials and eye sockets that lack sufficient retention.[18]

In this particular case, the patient's primary complaints were discomfort, instability, and poor aesthetic integration of the previously used prefabricated ocular prosthesis. Following the fabrication and insertion of the custom ocular prosthesis, these issues were effectively resolved. The improved fit and retention were evident during the wax scleral try-in and confirmed at the time of final prosthesis placement. The patient reported immediate comfort upon insertion and expressed increased confidence due to the natural appearance of the prosthetic eye.

Follow-up evaluations conducted at one week and one month post-insertion showed no signs of irritation, infection, or displacement. The prosthesis remained stable during daily activities, including those related to his occupation as a motorcycle taxi driver. These outcomes highlight not only the functional and aesthetic success of the treatment but also reinforce the importance of long-term follow-up to assess socket health, prosthesis integrity, and ongoing patient satisfaction. Regular follow-up visits are essential to ensure the continued success and durability of the prosthesis, allowing early detection of complications such as material degradation, socket volume changes, or mechanical trauma.[18-20]

The limitation of this study lies in the fact that certain aspects of the manufacturing process still rely on manual intervention, which restricts the full potential of automation in the fabrication of ocular prostheses. While technological advancements have improved precision and efficiency in prosthesis production, the reliance on handcrafted elements introduces variability in the final outcome, potentially affecting consistency in fit and aesthetics.

Furthermore, this study did not extensively evaluate the long-term biomechanical compatibility and durability of the fabricated prostheses under prolonged use. Factors such as material degradation, patient adaptation, and structural integrity over extended periods remain areas that require further investigation. Future research should focus on enhancing automation to minimize human error, ensuring a standardized fabrication process while maintaining customization for individual patients. Additionally, long-term clinical studies assessing the durability and functional performance of ocular prostheses in various environmental and physiological conditions will provide deeper insights into improving patient outcomes and satisfaction.

CONCLUSION

The custom-made prosthesis provided improved retention, comfort, and symmetry, which positively influenced the patient's confidence and overall quality of life. The patient, who previously experienced considerable discomfort and psychological distress due to an ill-fitting, prefabricated prosthesis, benefited greatly from a personalized, custom-fabricated solution. The success of the rehabilitation underscores the importance of accurate impression-taking, precise iris positioning, and individualized prosthesis design in managing complex post-enucleation cases. The implication of this case highlights the critical role of prosthodontic precision and customization in achieving optimal outcomes, particularly for patients with orbital muscle deficiencies resulting from trauma.

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