

Fabrication of a Custom Ocular Prosthesis : A Case Report

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Abstract

The restoration of facial aesthetics and psychological well-being for anophthalmic patients is a primary goal of maxillofacial prosthodontic rehabilitation. Ocular defects, whether congenital or acquired through trauma or pathology, significantly impact a patient's self-esteem and social interaction. This article describes a comprehensive clinical technique for the fabrication of a custom ocular prosthesis using heat-polymerized acrylic resin. The procedure emphasizes the importance of an accurate impression of the ocular defect to establish the precise contours of the socket, which is essential for achieving a natural eyelid drape and optimal prosthetic mobility. Key clinical steps include socket evaluation, custom impression making, wax pattern refinement, iris orientation, and intricate scleral characterization. The use of custom-painted iris discs and the incorporation of simulated vascular elements allow for a high degree of aesthetic realism [2]. Furthermore, the manuscript details the processing, finishing, and polishing protocols necessary to ensure a biocompatible and scratch-resistant surface, minimizing the risk of infection or inflammation [1]. By following this systematic approach, clinicians can provide a prosthesis that not only restores the patient's appearance but also ensures long-term comfort and functional success.

Keywords: Artificial Eye, Ocular Prosthesis, Scleral Characterization, Iris Painting, Acrylic Resin, Maxillofacial Prosthodontics.

Introduction

Facial features serve as the most critical non-verbal means of human communication, and the eyes, in particular, are central to an individual's identity and social presence [1]. The loss of an eye, whether due to congenital anomalies, traumatic injury, or surgical intervention for malignancies (such as retinoblastoma or uveal melanoma), results in significant physical and psychological trauma. Anophthalmic patients often experience a profound loss of self-esteem and may withdraw from social activities due to the perceived facial deformity. Therefore, the primary goals of treatment with ocular prostheses are to restore facial aesthetics, improve self-esteem, and facilitate the social reintegration of the patient [1].

An ocular prosthesis is defined as an artificial replacement for a missing eye that provides realism and symmetry by duplicating the natural color, contour, and size of the contralateral eye [2]. Indications for ocular rehabilitation include patients who have undergone enucleation (removal of the entire globe), evisceration (removal of the internal contents of the globe), or those presenting with congenital

microphthalmia (abnormally small eye) [1]. While stock ocular prostheses are commercially available, they often lack the precise fit and personalized aesthetic characterization required for optimal results. A custom-fabricated prosthesis, conversely, is designed to fit the unique topography of the individual's ocular socket [1]. This customized fit leads to better distribution of pressure, enhanced mobility of the prosthesis, and a more natural eyelid drape [1, 2].

The material of choice for fabricating these prostheses is typically medical-grade, heat-polymerized acrylic resin (polymethyl methacrylate). This material offers several advantages, including high durability, ease of characterization, biocompatibility, and the ability to be highly polished to a glass-like finish [1]. A poorly finished or irregularly shaped prosthesis can lead to localized inflammation, conjunctival infection, and psychological distress [3]. Consequently, a systematic clinical and laboratory protocol is essential to achieve a successful outcome that satisfies both the functional and aesthetic requirements of the patient.

Case Report

A 42-year-old male patient reported to the Department of Prosthodontics and Crown & Bridge with a defect in her right eye. The defect was caused by retinoblastoma which is very common tumour of infancy & childhood. On inspection contents of eye has been removed due to carcinomatous growth, right muscles of an eye and eyelids intact. On examination, no inflammation was present, no pain, no sensitivity present. The muscle function of both the upper and lower eyelid seemed normal. Like many of the cases reported in our department, for this case also we decided to fabricate a custom ocular prosthesis.

Materials and Methods / Clinical Technique

The fabrication of a custom ocular prosthesis requires a meticulous sequence of clinical and laboratory steps. The following technique outlines the procedure from initial evaluation to final insertion.

1. Patient Evaluation and Socket Examination

The process begins with a thorough clinical examination of the anophthalmic socket. The clinician must assess the health of the conjunctival lining, the depth of the superior and inferior fornices, and the mobility of the ocular muscle remnants as shown in Figure 1. It is critical to ensure the socket is free of infection or significant inflammation before proceeding with the impression. The contralateral natural eye is carefully observed under indirect natural light to record the color, diameter, and unique morphological elements of the iris, such as the pupillary collar and the limbal ring [1, 2].



Figure 1 Pre-op



Figure 2 Impression

1.2 Impression Technique

To provide a truly customized fit, an accurate impression of the ocular defect is necessary to register the internal topography of the socket [4]. The patient should be placed in an erect and relaxed position, either

seated or standing, to allow the socket tissues to be recorded in their natural drape during active posture [2].

1.2.1 Tray Selection

A custom tray or a modified stock tray can be used. In cases where the socket is highly irregular, a custom tray is fabricated from a preliminary impression or by modifying a stock ocular tray [1].

1.2.2 Impression Procedure

Dental impression materials such as irreversible hydrocolloids (alginate) or medical-grade silicones are commonly employed [1]. The material is injected into the socket using a syringe while the patient is instructed to gaze straight ahead at a fixed point [2]. This gaze minimizes muscular movement that could distort the impression. The impression must capture the full depth of the superior and inferior fornices to ensure the stability of the final prosthesis as shown in Figure 2.

1.2.3 Master Cast

Once the material has set, the impression is removed and used to pour a working cast in dental stone. The cast is properly sectioned to allow for the retrieval of the subsequent wax pattern [3].

1.2 Wax Pattern Fabrication

As Figure 3 shown a wax representation of the ocular globe is created by pouring molten baseplate wax into the lubricated stone cast [3]. The wax form is retrieved, smoothed, and polished for clinical try-in. During the try-in, the clinician evaluates the eyelid drape, the movement of the wax pattern, and the prominence of the “corneal” area. By palpating both socket areas simultaneously with the patient’s eyes closed, the clinician compares the globe sizes and modifies the wax form to duplicate the shape and volume of the natural eye [2]. The wax form is adjusted until the eyelid opening and contour match the contralateral side as closely as possible [2].

1.3 Iris Positioning and Orientation

Accurate positioning of the iris is vital for a realistic appearance and to avoid the “staring” look associated with poorly aligned prostheses. The pupil coordinates of the prosthetic globe are determined by measuring the relationship of the natural pupil to the facial midline and the medial and lateral canthal regions [2, 3]. These coordinates are marked on the wax pattern, and its orientation is evaluated in the patient’s socket. The patient is asked to look up, down, and sideways to ensure the pupil remains centered during typical eye movements. Once the location is accepted, the marked area is excavated to form an iris chamber. This chamber is cut to a depth equivalent to the natural iris plane [2].

1.4 Scleral Characterization and Iris Painting

A custom-painted iris disc is prepared using quality artist paper or an acrylic disc, typically ranging from 11 to 13 mm in diameter [2, 3].

1.4.1 Iris Painting

The basic color of the iris is applied using radial brush strokes. Highlight colors, such as the pupillary collar and the darker limbal ring, are added to match the natural eye exactly. The pupil is then painted in a size comparable to the average response of the natural pupil to light, often using India ink [3].

1.4.2 Scleral Characterization

The processed scleral white resin globe is lightly reduced on its outer surface. Soft color tones of blue, yellow, pink, or brown are painted onto the sclera to match the patient’s natural tissue [3]. Red nylon fibers

are meticulously placed to represent the subconjunctival vasculature, focusing on the density and pattern observed in the natural eye ^[2, 3].



Figure 3 Wax Pattern



Figure 4 Flasking

1.5 Processing and Curing

As shown in Figure 5 and Figure 6, the characterized globe is returned to the original stone matrix. A layer of clear heat-polymerized methyl methacrylate resin is processed over the modified surface ^[4]. This clear layer reestablishes the corneal contour and provides a protective, transparent covering over the painted iris and scleral characterization. The processing must be performed using a controlled heat cycle to ensure a seamless bond between the white and clear acrylic layers and to minimize residual monomer ^[1, 3].



Figure 5 De-waxing



Figure 6 Processing and Curing

1.6 Finishing and Polishing

As shown in Figure 7, after retrieval from the flask, the prosthesis is trimmed and polished to a high finish. Achieving a scratch-resistant, glass-like surface is critical, as any surface roughness can lead to the accumulation of microorganisms and protein deposits, causing discomfort or infection of the socket tissues ^[1]. Polishing is performed using flour of pumice on a wet rag wheel, followed by a high-shine agent like chalk or a specialized acrylic polishing compound ^[2].



Figure 7 Final Prosthesis



Figure 8 After Insertion

1.7 Insertion, Adjustment, and Postinsertion Instructions

The finished prosthesis is placed into the ocular defect and evaluated for eyelid drape, contour, iris color, and dimension [3,4]. Final adjustments to the periphery or contour are made as needed to ensure maximum comfort and mobility as shown in Figure 8.

1.8 Patient Instructions

1.8.1 Insertion and Removal

The patient is taught to remove the prosthesis by pulling the lower eyelid down and gazing upward, allowing the lower margin of the prosthesis to be expelled. Insertion involves sliding the prosthesis under the upper eyelid while gazing downward [3,5].

1.8.2 Hygiene

The prosthesis should be removed and washed with mild soap and tepid water at least once a day, or more frequently if mucus accumulates [5].

1.8.3 Maintenance

Patients should be advised to handle the appliance with care to avoid scratching the polished surface. Regular follow-up appointments (typically every 6 to 12 months) are scheduled to evaluate tissue health and the condition of the prosthesis [5].

Discussion

The fabrication of a custom ocular prosthesis offers significant advantages over the use of premanufactured stock eyes. The primary benefit is the establishment of a precise defect contour through the individual impression process, which ensures better adaptation to the conjunctival fornices and a more natural appearance [1]. A personalized prosthesis distributes the weight of the acrylic resin evenly across the socket tissues, reducing the risk of tissue irritation and encouraging better prosthetic mobility [1,3].

In contrast, stock prostheses often fail to fill the socket accurately, leading to a sunken appearance of the eyelids and reduced movement [3]. While stock eyes may be faster to deliver, they lack the aesthetic integration achieved through custom iris painting and scleral characterization [3,6]. The ability to match the specific shades of blue, yellow, or brown in a patient's sclera, along with the precise replication of their vascular pattern, is essential for a "living" appearance [6].

However, the process is not without challenges. One significant limitation is the risk of implant exposure or tissue erosion if the prosthesis is inadequately fitted or if its surfaces are rough [6]. Maintaining the color stability of the iris painting is also a concern; exposure to ultraviolet rays or certain cleaning agents can cause bleaching or staining over time [1,3]. Research indicates that oil paints generally offer superior long-term color stability compared to some water-based alternatives when used for iris characterization [3].

Clinical Significance

A well-fabricated ocular prosthesis is an essential component of maxillofacial rehabilitation. It not only restores the physical volume of the orbit but also provides the patient with the confidence to engage in daily life without the stigma of a visible facial defect. The precision of the fit directly correlates with patient comfort and the long-term health of the ocular socket [1,2].

Conclusion

The successful fabrication of an ocular prosthesis is a blend of clinical precision and artistic skill. By

utilizing a systematic approach that includes an accurate socket impression, meticulous iris orientation, and detailed characterization, clinicians can achieve exceptional aesthetic and functional results. Heat-polymerized acrylic resin remains the material of choice due to its durability and biocompatibility, provided it is polished to a high standard to prevent tissue irritation ^[1, 7]. Ultimately, the provision of a custom ocular prosthesis is a vital intervention that profoundly improves the quality of life and psychological well-being of anophthalmic patients.

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