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A Guide to Creating and Coloring an Orbital Prosthesis in a Sequential Manner: A Case Report

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ABSTRACT

Maxillofacial prosthesis includes all prostheses that restore missing parts of the face. The eyes are the first features of the face to be noticed, so their rehabilitation is one of the most critical procedures and needs a lot of attention to look natural, so it must be done by an expert. Here, we have tried to explain the construction of an orbital Prosthesis in a step-by-step manner so that it can be understood even by beginners. Using the guide in a sequential manner helps to create and color the orbital prosthesis with less complexity and better results, as shown in this case with a four-year follow-up.

Keywords: Impression technique; Ocular prosthesis; Orbital prosthesis.

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Introduction

Maxillofacial prostheses, which restore and replace stomatognathic and associated facial structures with artificial substitutes, aim to improve the patient's esthetics, restore and maintain the health of the remaining structures, and consequently provide physical and mental well-being. The demand for maxillofacial prostheses has been reported to be high [1]. The orbital prosthesis aims to reinstate the esthetics and boost the psychological and mental state of the patient [2]. The loss or absence of an eye may be caused by a congenital defect, irreparable trauma, tumors, a painful blind eye, sympathetic ophthalmia, or the need for histologic confirmation of a suspected diagnosis [3]. Depending on the severity of the situation, surgical management may include evisceration, enucleation, or exenteration. Evisceration is a surgical procedure wherein the intraocular contents of the globe are removed, leaving the sclera, Tenon's capsule, conjunctiva, extraocular muscles, and optic nerve undisturbed. Enucleation is the surgical removal of the globe and a portion of the optic nerve from the orbit. Exenteration is the en bloc removal of the entire orbit, usually involving partial or total removal of the eyelids, and is performed primarily for eradication of malignant orbital tumors [3]. Reproducing the eye to be similar to its counterpart is challenging. The ocular prosthesis must be as identical as possible to the remaining eye, mainly regarding its iris, which determines the color of the patient's eyes. Several studies proposing different iris painting techniques ratify the concern with the fidelity in prosthetic reproduction, using several types of paper, paints, and pigments to simulate the iris button [4].

There exists a sequence of steps for the construction of an orbital prosthesis [5]. The critical areas of fabrication and artistic techniques are of great importance for the successful prosthetic treatment [5]. Some techniques for processing an ocular prosthesis exist [6]. Mathews et al have classified ocular impression and fitting techniques as follows: Direct Impression, Impression with Stock Ocular Tray, Impression with Modified Stock Ocular Tray, Impression with Custom Ocular Tray, Impression using Stock Ocular Prosthesis, Stock Prosthesis Modification, Wax Scleral Blank Technique [7]. Maxillofacial prosthesis treatment is a multidisciplinary approach that is usually performed in educational institutions or hospitals. However, general dentists play an important role in patient management through familiarization with basic treatment concepts and prostheses that patients may present for repair, maintenance, or appropriate referral [8]. The purpose of this article is to describethe step-by-step design, fabrication and coloring of the orbital prosthesis with a custom-made ocular part that is understandable to general dentists.

Case History

An 80–year–old male with a history of cancer was referred to the prosthodontics department, Dental Faculty of Tehran University of Medical Sciences, with the demand of replacing his right eye (Figure 1). He had undergone exenteration surgery for the right eye due to a malignant orbital tumor the previous year. The patient's right orbit and eyelid had been removed and covered completely by skin; the nasolacrimal duct was detectable.No inflammation, pain, and sensitivity-waspresent. He had no systemic problems and it was decided to fabricate an orbital prosthesis for him.

Consent

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

Materials and Methods

The subsequent sequence was followed for his rehabilitation.

1. Sclera molding

In this case, the paper iris disk technique was used, which is one of the most common techniques for custom ocular prosthesis fabrication. A wax pattern almost similar to the sclera of the patient's left eye was shaped, flasked, and processed in acrylic resin (Acralyn-H, Asian Acrylate, Mumbai, India) mixed with 1.5 g zinc oxide powder (Deepashree Products, Ratnagiri, India).

2. Iris disk selection

The iris diameter of the left eye (not including the limbus) was measured (11.4 mm) using a caliper and the basic eye color was determined as a reference for the missing eye. The selected iris disk (Orthocryl, Dentaurum, Germany)was approximately 1 mm smaller than the actual measurement (10.4 mm).

3. Color selection and applying

The necessary pigments (H. Schmincke& Company, Erkrath, Renânia, Germany) were placed on a palette along with several drops of the monomer-polymer syrup (ArtigosOdontológicosClássico Ltda., São Paulo, SP,

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Brazil). The background color was applied to the disk first, using brush strokes from the center to the periphery. After drying of the background color, a coat of the clear syrup was applied and allowed to dry. Characteristic striations, including light brown in the center and green/gray in the environment, were applied and allowed to dry. A second clear layer was then applied. The limbus color was then matched around the periphery of the disk, and a third clear layer was applied. The collarette color was applied over the last clear layer and the final color was evaluated at the water interface. (Figure 2) After a satisfactory color match was confirmed, a final clear layer was applied and allowed to stand for 15 minutes.

4. Connecting the iris disk to the sclera blank

At thistimetheiris's size was marked on the center of the scleral blank. The entire surface of the blank was reduced by at least 1 mm and the marked area was flattened. This area was painted black in the center and gray in the environment to mimic the view of the black spot and limbus, which makes the ocular prosthesis look three-dimensional and more natural when the iris disc would be placed on the sclera. An ocular button was luted to the prepared flat surface with periphery wax, andthen therayon fibers (Factor II) were tacked into a position with monopoly to create the appearance of scleral capillaries, and the assembly was checked to look similar to the existing eye (Figure 3). The scleral blank with the painted iris was placed in the flask. The clear ocular acrylic resin was mixed and placed into the mold space and the flask was then trial packed. Once trial packed, the flask was removed and the location of the iris was verified to ensure that it had not moved during trial packing. Then the flask was closed and the resin processed. Once polymerized, the ocular prosthesis was trimmed and polished using pumice and acrylic resin polish.

5. Making a moulage impression and cast

A ring of boxing wax was made around the patient's eyes and nose and completely matched to the patient's face with clay to form an effective barrier to the undesirable flow of the impression material. The eyebrows were protected by using a light application of petroleum jelly. The patient was mentally prepared for the impression procedure in semi-supine position. Irreversible hydrocolloid (Alginate, Golchay, Tehran, Iran) was mixed with cold water to have adequate working time and applied to the skin surface with a brush to avoid air entrapment. When the area was covered, the opened gauze squares were applied over the entire surface using light pressure to provide mechanical retention for the rigid plaster backing necessary for the removal of the impression without distortion. Fast-set plaster (Parsdent, Tehran, Iran) was mixed to a make-batter consistency and spread over the entire impression surface to a thickness of about 0.25 inches. When the plaster was set sufficiently for removal, the impression was grasped on both sides of the patient's head and lifted gently. The impression was poured with a dental stone type II (Parsdent, Tehran, Iran) (Figure 4).

6. Positioning the ocular section

The working cast was trimmed, a separator was applied to the defect area, and a sheet of pink baseplate wax was softened and adapted to the orbital defect, which forms the basis for positioning the ocular section. A special ruler designed for this purpose was used to place the ocular part in the same frontal, sagittal, and horizontal planes as the normal eye. The ocular section was manipulated into the position that matches the gaze of the right eye when the patient was staring directly to a point at eye level, with at least 6 feet away. The patient was sitting upright without head support when evaluating the ocular position (Figure 5).

7. Forming eyelid pattern

The eyelid aperture was established by softening and placing two small strips of wax over the ocular section. The shape of the lid opening should reproduce the normal eye. To accomplish this purpose, the right eye was mirrored on the left side in Photoshop software (Photoshop CC 2019; Adobe Inc., San Jose, CA). Therefore, the amount of lid opening and the location of the canthus were corrected and simulated. Afterwards, the soft sculpting wax mixture was added with a spatula to roughly fill the remaining contour of the prosthesis out to the area where the margins were to be established. At this point, the final surface contour and skin texture were established by carving in the lines and wrinkles observed around the right eye. Following completion of the fine details in the pattern, the sculpture was placed in its place on the patient's face and verified for fit, direction of gaze, and eyelid aperture.

8. Color matching

At this stage, the process of matching the silicone color with the patient's skin color was performed. The lightest part of the skin color around the patient's lesion was selected and the translucent silicone (DOW CORNING SILASTIC® MDX4-4210) was stained by

trial and error. The pigment was added to the silicone in conservative amounts and blended thoroughly.A small amount of kaolin (Factor II) was added to increase the opacity and value of the silicone. When the color of the silicone approaches the desired base color, a small amount of colored silicone (approximately 2 g) was placed in the center of a folded transparent plastic sheet and was compared with the target base color of the patient's skin (Figure 6). Once a base color had been established, other hues that contribute to the skin's complex appearancewere identified and used for laminar glazes.

9. Molding

For the orbital prosthesis, an indexing method must be applied to position the ocular segment of the prosthesis back into the mold in the same orientation as in the pattern. For this purpose, an arrow mark was engraved on the tissue surface of the ocular segment. The master working cast was duplicated for the mold construction and the negative imprint of the arrow was recorded in the duplicated cast. After the pattern was sealed to the duplicate cast, the pattern and cast were invested in the drag (base portion) of a conventional denture flask. After the stone flasking material was set in the tissue-surface half of the mold, a separating medium was applied to the exposed stone around the pattern. Then the cope (second part of the flask) was placed into position and the second pour of the mold was performed. As soon as the stone was set, the cope and drag were carefully separated, and the softened wax pattern was removed from the mold, leaving the mold surface relatively free of wax residue. Boiling water was used to clean the mold cavity. The hot mold was then coated with a tin-foil substitute in preparation for placing the prosthesis material in the mold cavity. Then the ocular segment was placed on the index part in the drag with cyanoacrylate adhesive. The intrinsic coloration of the laminar glaze was performed in the mold, and then a syringe was used to inject silicone(Factor II, Lakeside, A2) in the area. Once a sufficient amount of silicone had been placed in all areas of the mold and the air bubbles were removed, the flask was closed and pressed to approximately 700 kPa slowly. The mold was placed in clamps and processed according to the manufacturer's instructions. After processing, the flask was allowed to bench cool for one hour. Once the silicone was processed and removed from the mold, the excess flash was removed with scissors.

10. Extrinsic coloration

With the patient present in proper lighting conditions, the accuracy of the intrinsically colored silicone was evaluated, and the value of the prosthesis was corrected with extrinsic coloration. The pigments (Factor II) were mixed with the silicone medical adhesive type A (Dow- Coming, Midland, Ml) and were added in small amounts until the desired extrinsic glaze was achieved (Figure 7).

11. Attaching eyelashes

The surface of the prosthesis was cleaned with methanol, and eyelashes were attached to the prosthesis.

12. Delivery

The orbital prosthesis was delivered to the patient along with the glasses to help cover the margins of the prosthesis. The patient was instructed in the use and care of the prosthesis, including instructions on how to orient and place it, how to use adhesive (Pros-Aide The Original Adhesive 1), and how to maintain both tissue and prosthesis hygiene. Additionally, the patient was advised that the color match depends on the color of their tissues, which may be susceptible to the seasons as well as activity level and environmental temperatures (Figure 8).

Results

The proposed technique enabled the fabrication of an orbital prosthesis that closely matched the patient's facial appearance using a simple, systematic workflow with minimal laboratory facilities. At the four-year follow-up, the patient remained satisfied with the prosthesis, reported improved self-confidence, and was able to use the prosthesis comfortably in daily life. The patient was advised to attend annual follow-up visits to monitor the condition of the prosthesis and the surrounding tissues.

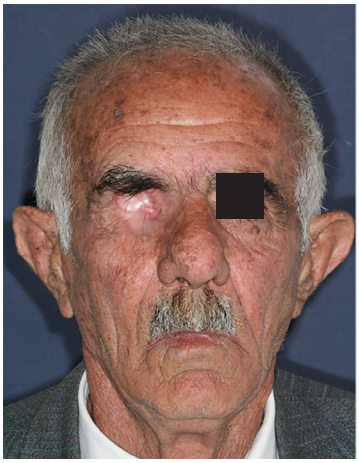

Figure 1. Frontal view of the patient before treatment.

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Figure 2. (a) The background color was applied and checked; (b & c) characteristic striations including light brown in the center and green/gray in the environment were applied; (d) satisfactory color match was confirmed.

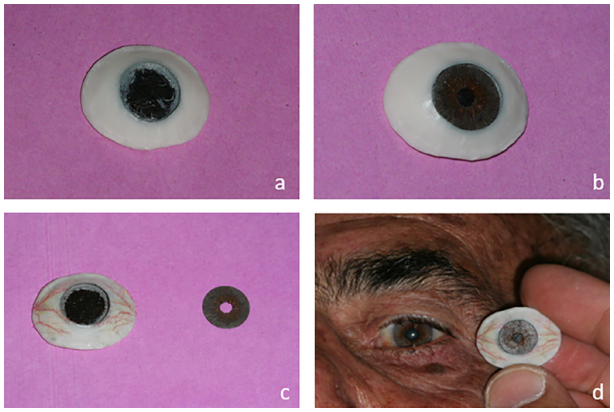

Figure 3. (a) Blank was reduced 1& painted; (b) the iris size was checked to match with the redaction area of blank; (c) the rayon fibers were tacked into the blank; (d)assembly was checked to look similar to the existing eye.

Figure 4. (a) A ring of boxing wax was made around the patient's eyes and nose; (b) irreversible hydrocolloid with opened gauze squares; (c) fast-set plaster was spread over the entire impression surface; (d) cast.

Figure 5. The ocular part was placed in a position that matches to the right eye.

Figure 6. Color matching.

Figure 7. Extrinsic coloration.

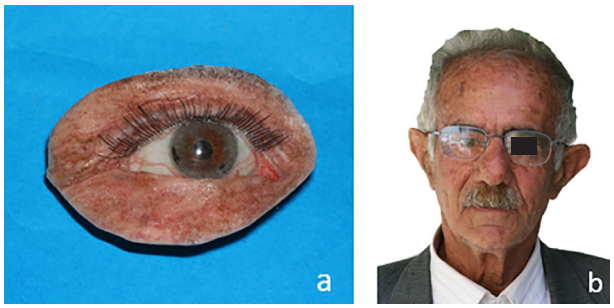

Figure 8. (a) Final prosthesis; (b) frontal view of the patient after treatment.

Discussion

Making an orbital prosthesis is one of the most difficult facial prostheses. This is because prosthetic reconstruction tries to restore a mobile limb with a fixed prosthesis. On the other hand, the eye prosthesis is not only effective in reconstructing the patient's face, but also affects the patient's mental state and social relationships [9,10]. For many years, lost eyes have been replaced with stock or custom-made prostheses. However, a custom-made eye prosthesis is often indicated, providing a more accurate and satisfying aesthetic appearance [3]. Silicone elastomers are one of the popular materials for making facial prostheses. This material is characterized by excellent thermal stability and chemical safety for body tissues. When the defect involves mobile soft tissues, silicone is useful because of its flexibility. Also, the coloring process is possible to create a skin-like appearance with silicone. But elastomer undergoes changes over time, so you should be aware of the possibility of needing to replace facial prostheses [11].

Various methods have been used to maintain the orbital prosthesis, such as skin adhesives, hard and soft tissue undercuts, and connecting the prosthesis to the glasses frame, magnets, or implants. The use of craniofacial implants for retention of the orbital prosthesis frees the patient from the use of adhesives or dependency on spectacle frameworks. Mechanical and chemical irritation associated with the use of adhesives can also be avoided. Moreover, the aesthetic outcome is also improved, as the margins of the prosthesis can be thin, translucent, and blended with the surrounding skin [12]. Orbital implants may appear "integrated" in high-density cortical bone, but the patient should be advised of the possibility of "late failure" and difficulty in maintaining proper hygiene of these implants [13]. In this case, it was not possible to place the implant due to lack of space and unsuitable bone. The usual method that is usually used to preserve the orbital prosthesis is the spectacle frame or the soft and hard tissue retaining undercut, but in our case, the glass frame is used to hide the margins of the prosthesis, whereas available hard and soft tissue undercuts and adhesive systems were used to retain the prosthesis. Adhesive systems and eyeglass frames are used when the orbital prosthesis cannot be supported by implants. The problem with adhesive systems is the possibility of the prosthesis detaching while performing facial movements [14,15]. The integrity of the materials of a prosthetic eye made at Ocular Prosthetics, Inc. will last for at least ten years. However, most people will need a replacement at approximately 3-5 years due to the settlement of soft tissue in the eye socket [16].

Conclusion

This case demonstrates that a structured, step-by-step approach enables predictable fabrication and coloration of an orbital prosthesis using relatively simple techniques and minimal equipment. The described workflow may serve as a practical guide for general dentists and clinicians with limited experience in maxillofacial prosthetics. The favorable four-year clinical outcome and sustained patient satisfaction support the effectiveness of this approach when appropriate case selection, meticulous fabrication, and regular follow-up are maintained.

Conflict of Interest

There is no conflict of interest to declare.

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