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Simplified Technique for Orbital Prosthesis Fabrication: A Clinical Report

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Abstract

Loss of orbital content can cause functional impairment, disfigurement of the face, and psychological distress. Rehabilitation of an orbital defect is a complex task, and if reconstruction by plastic surgery is not possible or not desired by the patient, the defect can be rehabilitated by an orbital prosthesis. The prosthetic rehabilitation in such cases depends on the precisely retained, user-friendly removable maxillofacial prosthesis. Many times, making an impression of the orbital area with an accurate record of surface details can be a difficult procedure. The critical areas are making a facial moulage, mold preparation, and attaching the retention device, particularly when eyeglass frames are used. This case focuses on these hindrance factors. A simple basket was used for the impression tray to obtain the facial moulage. A putty mold was used, and attachment of the prosthesis to a retention device was accomplished with positional distance. This method proves to be an economical and simple way of making an orbital prosthesis.

Acquired facial defects often present with extensive disfigurement, disability, social reaction to the functional impairment, and stress. Techniques used for rehabilitation of maxillofacial defects play a vital part in treatment success, making it possible for the patient to become a part of society while minimizing psychological trauma.[1] Various prosthetic techniques are offered for rehabilitation of maxillofacial defects. Wolfaardt et al[2] illustrated a technique that offered a mold suitable for fabricating duplicate maxillofacial prostheses. In this technique, an orbital prosthesis wax pattern aids in obtaining the space for the ocular portion, and improved stone is filled in to the space created by removal of the ocular prosthesis. Jooste et al[3] described the technique of facilitating the trial closures for the fabrication of multiple prostheses by disassembling the master cast side of the mold into four sections. Chambers et al[4] fabricated an auricular prosthesis by preparing the custom-made polyvinyl chloride flask and made use of autopolymerizing resin for significant parts of the mold. A study by Jebreil[5] reported that the renewal time for orbital prostheses was once or twice every year. The explanations for the frequent remake were variation in color, marginal failure of the prostheses, change in the defect, and surgical reconstruction of the defect. The main cause was due to use of adhesives, routine cleaning, ultraviolet light, and air pollution, ultimately resulting in the refabrication of the prosthesis.[6-8] These refabrication procedures necessitated that the mold possess enough strength to accept the internal stresses caused by the acid dissolution and elastic pull during the recovering process.

An accurate facial moulage is a prime requisite for obtaining an accurately fitting facial prosthesis. There are a variety of techniques for making a facial moulage. The impression materials used for recording facial defects vary from impression plasters and hydrocolloids to elastomeric impression materials.[9] An ideal impression material should have the ability to record the defect, adjacent structures, and engageable undercuts with minimal distortion. To prevent the soft tissue deformation by the weight of the material, the impression material should have low viscosity, be fairly flexible, and be used with minimum bulk.

The success of most maxillofacial prostheses depends on retention (i.e., adhesives, magnets, eyeglass frames, and osseointegrated implants). Long-term use of adhesives may lead to skin allergies and also necessitate the formulation of a substantial quantity of supportive ingredientsin the adhesive to provide a

high degree of retention.[10] Sometimes, prostheses can make use of magnets.[11] In addition to being a costly choice, magnetism may be lost or magnets may corrode, preventing long-term use. The established method of improving retention is by the use of osseointegrated implants,[12,13] but this type of treatment is contraindicated by factors such as added surgeries, operating cost, insufficient bone, and former radiation to the area.[14] Retention by means of eyeglass frames makes for easier placement of the orbital prosthesis and guarantees accurate reproducible positioning of the restoration, as the slightest error in position will bear identifiable notice of the prosthesis.[15] In addition, frames provide an extra high array of bonding, especially to acrylic prostheses.

The major hindrance for obtaining an accurate facial moulage when using irreversible hydrocolloid impression material is the uncontrolled flow of material resulting in a messy job. This disadvantage is overcome by the advent of elastomeric impression materials, but use of elastomers can be a costly affair, particularly in a facial impression where a large amount of material must be manipulated.

An alternative technique of using economical material (irreversible hydrocolloid) with a modified impression tray to block the overflow of material on the patient's face was attempted in this case. No documented evidence is reported on facial impression techniques in cases of patients with incompetent lips. The impression technique was exclusively designed by the second author. This clinical report summarizes a procedure of an impression technique with a unique impression tray for patients with incompetent lips. The prosthesis retention is provided by an eyeglass frame attached to the orbital prostheses, which fit into the orbital defect. This helped in better retention of the eye prosthesis and also satisfied the esthetic needs of the patient.

Clinical report

Clinical findings

A 32-year-old female patient reported to the Department of Prosthodontics, AECS Maaruti Dental College and Research Center, Bangalore, India, with a complaint of a missing right eye due to an acid attack 5 years ago. She complained of an unesthetic-looking right orbital area. Clinical examination showed that skin in the defect area had undergone massive contraction and exhibited scars affecting patient's esthetic perception. The defect was large (3 × 2 cm) and predominantly involved the right orbital area with scars extending onto the whole right half of the face, including the forehead (Fig 1). The defect area remained without any possible undercuts, and therefore very little scope of retention of the prosthesis. For complete prosthetic rehabilitation of the patient, an acrylic orbital prosthesis attached to a retention device, such as eyeglasses frames, was planned.

The rehabilitation planned in this case would obtain a good facial moulage and was a simple, unique method with very minimal materials. Compared to the conventional technique, this case used a modified impression tray, customized patency created in the nose impression, a putty index made of lips, and mold preparation for the definitive prosthesis.

Prosthodontic procedure

Prior preparations for impression procedure

A modified impression tray was required to obtain an accurate full facial moulage and to limit the flow of impression material during the procedure. A commonly available oval plastic basket was modified by cutting through the basket with a heated sharp instrument. Once cut, the base portion of the basket was discarded, and the top half of the basket was smoothened with files and used as the impression tray for the face (Fig 2). The other critical aspect of the facial moulage record was capturing the details of the maxillary anterior teeth and gingiva, as the patient had incompetent lips at rest. A putty index of the exposed maxillary anterior teeth and gingiva was made and set aside (Fig 3). The purpose of the putty index was intended to limit the flow of material into the patient's mouth during the facial moulage making procedure. The patient's nose impression was recorded with putty impression material, and the patient was asked to breathe through the mouth while the nose impression was taken (Fig 4). Once set, the putty nose impression was removed from the patient's face, and holes were created in the impression corresponding to the position of the nostrils. Again, the nose impression was checked on the patient for comfortable breathing.

Recording the impressions

The drape was positioned on the patient, and petroleum jelly was smeared on her eyebrows and eyelashes to make removal of impression material easy and to lessen discomfort. Cotton plugs were positioned in the patient's nostrils to prevent the accidental entry of the impression material. The customized plastic impression tray was positioned on the face, and the gaps present between the facial outline and the tray were filled with a wetted gauze piece (Fig 4). Preparations were done to mix a large amount of irreversible hydrocolloid impression material in one increment and with an added quantity of cold water, giving a smooth fluid mix with a late set. The patient was instructed to close her eyes and to breathe comfortably through the holes provided in the secured nose impression. Irreversible hydrocolloid material (Algitex, DPI, The Bombay Burmah Trading Corporation, Mumbai, India) was poured carefully onto the patient's face while stabilizing the tray on the face with the previously made putty index of maxillary anterior teeth and putty nose index also positioned. The impression material was poured gradually and gently until it covered the entire face; care being taken not to cover the nostril holes of the nose impression and without trapping tiny air pockets. Orthopedic plaster was reinforced onto the alginate. Over the plaster, three mounds of plaster were made to act as a tripod stand during impression inversion (Fig 5). The tray filled with impression material was allowed to set. The impression was gently removed in one piece without tearing the impression.

Formulation of the moulage

The impression thus obtained was inverted and supported on the prepared mounds. The dental stone (Kalastone, Kalabhai Dental Corp., Mumbai, India) was mixed and vibrated onto the boxed impression until it covered the widest part of the

Figure 1 Patient's right orbit defect area.

Figure 4 Nose impression with putty.

Figure 2 Plastic basket used as impression tray.

Figure 5 Irreversible hydrocolloid impression material reinforced with orthopedic plaster.

Figure 3 Putty index made of incompetent lips.

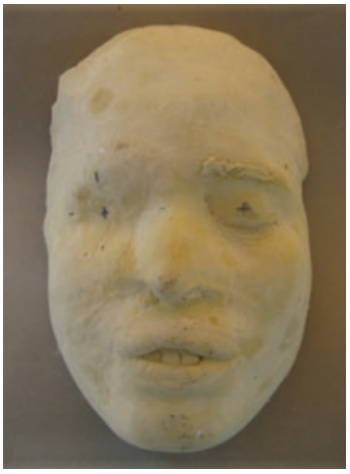

Figure 6 Prepared facial moulage.

Figure 7 Wax pattern fabricated on facial moulage.

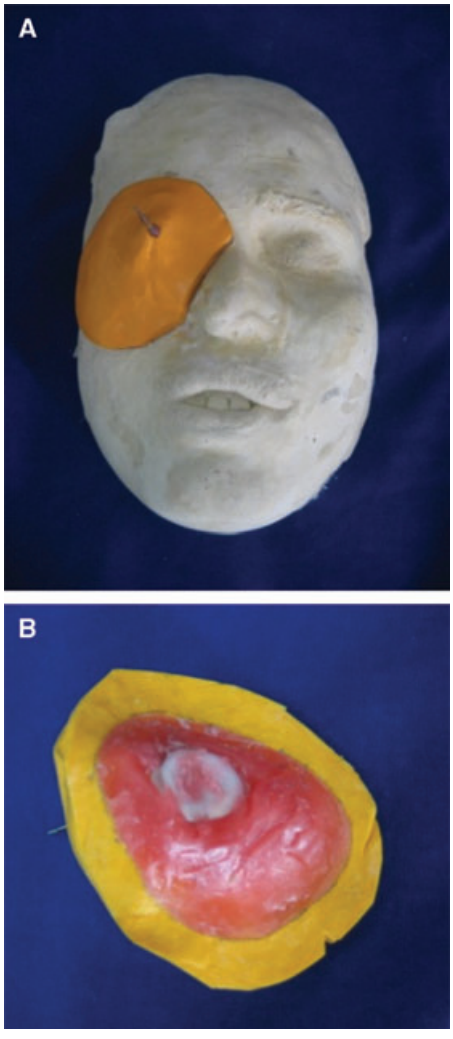

Figure 8 (A) Putty mold on palpebral side of wax pattern. (B) Under surface of wax pattern with mold.

Figure 9 Pencil marking on the cast coinciding with orientation groove of putty mold.

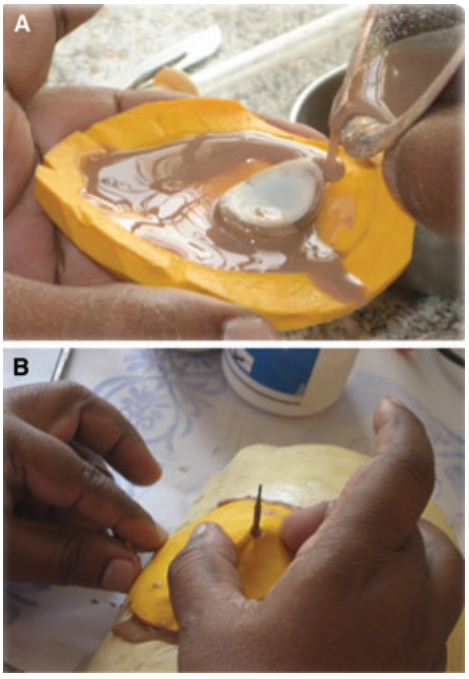

Figure 10 (A) Packing the putty mold. (B) Repositioning of the mold on the cast.

Figure 11 Processed orbital prosthesis.

Figure 12 Trial of prosthesis.

Figure 13 Fastened adhesive tapes on orbital prosthesis and skin of face.

Figure 14 Positional orientation of orbital prosthesis to frame.

hollow impression. Once the stone was set, the cast was separated from the impression (Fig 6).

Wax pattern fabrication

Appropriate ocular shells [4 mm (diameter) × 3 mm (thick)] were selected. Lines were marked in the orbital defect of the cast to harmonize the position of the ocular shell with the

Figure 15 Prosthesis and eyeglasses fixed with putty removed in one piece.

Figure 16 Polished orbital prosthesis.

Figure 17 Patient with prosthesis in place.

contralateral eye position of the cast. Molten wax (Modelling Wax, Elite Dental Products, Nanded, India) was poured into the defect area gradually to prevent incorporation of air voids. Soaking the master cast with wax pattern in cold water would prevent the wax pattern sticking to the stone. Once the wax cooled, the wax pattern was recovered (Fig 7). A wax pattern trial was done in the defective eye area to check the contours and to scrutinize the harmony with the natural eye.

Investment of wax pattern

When appropriate contours had developed, the wax pattern was ready to be invested. Instead of a denture flask, putty

impression material was used as an investing medium preventing the use of a large maxillofacial flask. A slender metal rod with an acrylic ring was attached to the superior surface of the eye shell with the help of monopoly (1:10 polymer to monomer ratio mixed in water bath and stored at 4°C).[16] Once the adherence was secured, putty material was incrementally added onto the palpebral surface of the eye shell with the material winding around the metal rod to the acrylic ring; thus the acrylic ring acted to hold the putty material in place (Fig 8). After the putty material was set, the excess material was cut, and an orientation groove was cut in the mold to ensure the repeated positioning of the putty investment in the same position (Fig 9). Wax was eliminated by flowing the hot water onto the wax pattern. Color matching was done by matching the patient's skin color adjacent to the defect area. The matching was done by adding the acrylic color (burnt amber and sunset yellow in the ratio of 4:1) into the monomer and mixing with clear-cure acrylic (DPI Heatcure, Dental Products of India). The color-matched acrylic material was filled in the putty mold and pressed onto the master cast making sure the putty's orientation groove coincided with the pencil mark on the cast (Fig 10). The putty mold was stabilized onto the cast with thread pressure to maintain the thickness of the margin. Curing of the prosthesis was done with bench and night curing according to manufacturer's recommendations. The prosthesis was recovered, trimmed, and polished (Fig 11). The finished prosthesis was tried on patient's right orbital defect (Fig 12).

Attaching the prosthesis to the retention device

Adhesive tapes were fastened onto the patient's skin securing the orbital prosthesis in place (Fig 13). The retention device eyeglass frame was positioned onto the patient's face, and the gap between the lateral end of the prosthesis and the side frame of the eyeglass frame was filled with putty (Zhermack, Rovigo, Italy) (Fig 14). The purpose of this technique was to fix the positional distance between the frame and prosthesis during the process of attaching the other end of the prosthesis to the frame. After the putty was set, the prosthesis, along with the frame, was removed in one piece (Fig 15). The medial end of the prosthesis and the nose retention portion of the eyeglasses were made to adhere by means of self-cure acrylic material. Once the acrylic was bonded onto the plastic eyeglass frame and held the prosthesis to the frame, the putty that had been inserted was removed. Finally, the rough surfaces of the acrylic adhering to the eyeglass frame were finished and polished (Fig 16). The prosthesis was placed in the right orbit area and checked for fit and harmony with the natural eye (Fig 17).

Patient instructions

The patient was taught the placement, removal, maintenance, and hygiene procedures for the prosthesis. She was cautioned to avoid contact with alcohol or solvents to protect the prosthesis from crazing of the acrylic resin.

Discussion

The critical aspect of orbital prosthesis fabrication is the esthetic element involved in the process, because even the slightest difference in the position of the eye and the color of the prosthesis will reflect on the social interaction of the patient. In a few patients, rather than creating a natural appearance, it may end up with the patient undergoing further psychological trauma over poor prostheses, particularly in orbital defect patients where it is difficult to mimic the exact contour and appearance of the normal eye. Hence, orbital prosthesis fabrication is a feasible alternative to the other local reconstructive treatments when esthetic and functional profiles are high.[17]

Exclusively for the present case, the modified impression tray was designed by the second author to simplify the procedure with very minimal materials while at the same time rendering satisfactory results. Obtaining an accurate facial moulage is of primary concern. Many available materials were tried to limit the flow of impression material onto the face, including aluminum-wire frames, thermoplastic custom trays, and visible light-cured resins.[4] This reports on the novel idea of the impression tray being used as a primary tool for recording the facial impression. Primarily, a simple oval plastic box modified and used for the impression reduced the difficulty normally faced with the conventional method. The widened top half of the plastic box confined the flow of impression material onto the sides of the face during the recording process. Cost-effectiveness, comfort, and accuracy of impression are also benefits of this technique. Despite sophisticated advances in the field of impression techniques and materials, currently the preferred method for making facial moulage is the use of irreversible hydrocolloid supported by Plaster of Paris backing. The weighty nature of the material limits surface detail reproduction, and poor dimensional stability is aggravated by the exothermic heat generated during the set of the plaster.

Second, patency of holes for ease of breathing was facilitated with the premade putty material nose impression, which usually will be made by keeping plastic tubes during the impression process in a conventional technique. As a result, the inverted edge will occur in the corresponding facial moulage, leading to the scoring of the cast, and subsequently the loss of the surface detail. Third, the putty index made of the maxillary anterior teeth was of special significance as it acted as a barricade to avoid the entrapment and flow of alginate impression material into the oral cavity, particularly because the patient in this case had an open mouth because of her incompetent lips. Although there was a need to obtain the cast of only the orbital defect area, the objective of achieving the complete cast of the face was mainly to judge the harmony of the orbital wax pattern with the contralateral eye and face. The full cast also helps with analyzing the placement of the prosthesis on the cast. In addition, the entire cast helped the putty mold with orientation grooves positioned in the same location during the packing process.

Obtaining the truthful mold from the custom sculpted orbital pattern is the most challenging step for the final successful outcome of the prosthesis. To attain this stage, precise reproduction of sculpted pattern holds an essential role. Acrylic resin, epoxy resin, and dental stone are some of the mold-fabricating materials. According to Beumer et al, "Stone molds are relatively easy to construct, accurate and inexpensive; however, the stone is fragile in the palpebral area and susceptible to fracture."[18] Surface details pertaining to esthetics will be concealed if the prosthesis is fabricated from the broken stone mold. The

technique described in this case offers an improved version involving an easy preparation of mold suitable for fabricating several orbital prostheses by use of elastomeric putty material, which otherwise would be made of improved stone.

Choice of processing material can be decided by the clinician. Silicone is preferred for the fabrication of orbital prostheses, since marginal adaptation and natural-looking qualities of material are superior.[19] Lack of chemical/mechanical bonding with the eyeglass frame, thus reducing retention, and frequently incurring allergies caused by the material render silicone as a less usable material.[10,20] When the prostheses are restricted to only the orbital area, we prefer methyl methacrylate material for processing. Acrylic resin is a durable material, which helps in the better adherence of prostheses to the eyeglass frame. The rigidity of acrylic resin is seldom a problem, as the tissue bed is rarely movable. Flexible materials are significant in situations where the defect drifts beyond the orbital area and come across movable tissue beds. Implant treatment ranks better than silicone and acrylic materials; however, controversy regarding the placement of implants in the orbit has been documented. Studies show a higher failure rate result because of poor remodeling capacity of bone-implant surface and lack of stabilizing bone volume in proximity to the frontal sinus.[21,22] Orbital implants may appear "integrated" in high-density cortical bone, but these implants occasionally show "late failure." It is recommended that orbital implants should only be placed in patients who are fully informed of the potential risk associated with late failure and the difficulty in maintaining proper implant hygiene.[23]

Undercut areas influence the selection of material used for retention. The conventional material used is skin adhesive. In patients presenting with engageable orbital undercuts and defects restricted only to the orbital area, flexible material will be beneficial. On the other hand, in cases with complete loss of orbit and contracted skin without any possible undercuts, the eyeglass frame retention method may be beneficial because eyeglass frames are easier to place in an accurate, reproducible prosthesis position. As plastic eyeglass frames were chosen to attach the prosthesis, the adherence was also made more firm, as acrylic material was used for the orbital prosthesis. The benefits of silicone or skin adhesive are nullified because of allergic reaction. This troublesome factor was lessened with the use of eyeglass frames. One of the limitations of eyeglass frames attached to a prosthesis is the sliding down of the frames during forward postures due to prosthesis heaviness. Generally, when eyeglass frames are used for retention, either a custom eyepatch or adhesives are advised so that asymmetrical deformation of the prosthesis will not be apparent. For this patient, lace, which hung behind the head, was tied to both ends of the glasses frame to prevent change in position of the prosthesis; however, in extreme degrees of contractures, particularly following severe burns of the face, as in this case of acid attack, where hardly any results were expected even after major plastic surgery, an eyeglass prosthesis was provided so that, when the patient wears the eyeglasses, the prosthesis covers the socket and closely matches the other eye. Acrylic prostheses with eyeglass frames are much superior to the older methods of silicone adhesive systems, because heat-cure PMMA has better biocompatibility,[24] and silicone orbital prostheses have a relatively short lifespan (on an average of 1.5 to 2 years).[25]

Summary

Orbital defects can cause functional impairment, disfigurement of the face, and psychological distress. A patient with an orbital defect was provided with an orbital prosthesis attached to an eyeglass frame. The prosthesis involved procedures accomplished with easy breathing during the impression procedure and use of minimal materials with greater accuracy of surface detail record and easy preparation of the mold. The advantages of this method are good facial moulage, easy preparation of a mold acceptable for multiple orbital prostheses for the same patient in case of degradation, restoration of function, cost effectiveness, and greater patient comfort. In addition, the prosthesis design helps to ensure retention during function, which is of paramount importance. This technique also avoids other invasive methods. Hence, it may be recommended as a simple and accurate method of rehabilitation of an orbital defect.

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