Silicone Orbital Prosthesis: A Case Report on Prosthetic Rehabilitation of Orbital Exenteration

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ABSTRACT

The fabrication of an adhesive-retained silicone orbital prosthesis offers an economical and esthetic solution for patients with orbital defects, resulting from neoplastic disorders or extensive facial trauma. This prosthetic design eliminates the need for complex surgical implant therapy or mechanical retention, ensuring a more comfortable and cost-effective treatment option. This case report outlines the step-by-step process involved in the fabrication of an adhesive-retained silicone orbital prosthesis, emphasizing on the material selection, techniques and clinical considerations.

Key words: Adhesives, Orbital defect, Orbital prosthesis, Silicone.

INTRODUCTION

Orbital exenteration (OE) is regarded as a mutilating surgical treatment reserved for rapidly advancing neoplastic disorders or extensive facial trauma with unfavourable ocular involvement. Neoplasia can predominantly develop from orbital tissues, such as, the lacrimal glands and the conjunctiva, or they can infiltrate to the orbit from extensive malignancies of the skin, maxillary sinus, or brain.[1] Midfacial trauma associated with the orbital fractures and damage to the orbital contents generally indicate OE, resulting in significant orbital defects. These defects can cause considerable facial disfigurements, functional difficulties, and an adverse psychological effect on the patient.[2]

Various reconstructive techniques have been employed, such as, split thickness skin grafts (STSGs), regional flaps, and free tissue reconstruction, depending on the type of OE defects.[3] Type I is defined as the simple orbital exenteration. Type IIa involves extended orbital exenteration with loss of a single orbital wall/rim. Type IIb defines an extended orbital exenteration with loss of several orbital walls/rims. Type III describes an extended orbital exenteration with pterional craniotomy, as a surgical approach to the affected brain structures. Type IV is characterized by an extended orbital exenteration with penetrating orbitomaxillary defect, as a result of the resection of extended maxilla or maxillary sinus malignancies.[1] However, the surgical reconstruction is limited by the availability of tissue, the radiation-induced local vascular bed deterioration in tumor patients, the need for routine visual examination of an oncologic defect, and the physical condition of the patient.[4]

Prosthetic rehabilitation can be a convenient alternative treatment option to surgical reconstruction. Various prosthetic materials that can be used in the fabrication of orbital prosthesis include methyl methacrylate, polyurethanes,

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and silicone elastomers. Moreover, optimum retention of the prosthesis plays an important role in the success of the treatment. Various retentive mechanisms for orbital prosthesis have been described in the literature that include eye patches, prosthesis fastened to spectacle frame, extensions from the denture, magnets, adhesives, and osseointegrated implants.[5] However, the prosthetic rehabilitation can also be limited by the mobility of soft tissues surrounding the defects, the difficulty of establishing retention for large prosthesis, the limitations of materials available for the orbital prosthesis and the patient's ability to accept the treatment outcome.[4] Thus, proper pre-prosthetic counselling to the patient regarding all the related factors and the limitations of the treatment can be helpful in achieving optimal treatment outcome.

CASE REPORT

A 50 years male presented to the Department of Prosthodontics in Dhulikhel Hospital, Kavre with the chief complain of missing left eye. The patient had undergone Type IIa orbital exenteration for the treatment of adenocarcinoma of lacrimal gland of the left eye, which had been carried out 2 months back. The surgical reconstruction of the defect had been done with temporalis muscle flap, leading to a large orbital defect on the left side with the loss of lateral orbital rim and extending till the entire length of zygomatic arch, just superior to it (Figure1A, B). The optimal time period for prosthetic rehabilitation is generally after complete healing, typically 2 to 4 months post-surgery.[6] Hence, the procedure was initiated after completion of 2 months post-operative time, following the verification of complete healing of surgical site by the surgical team. No definite bony or soft tissue undercut was present, thus making the retention of the prosthesis more challenging. An adhesive retained silicone orbital prosthesis was planned for the patient.

Procedure:

1. The area of defect was lubricated using vaseline. Impression was made with hydrophilic light-bodied consistency polyvinyl siloxane impression material (Zhermack elite HD+, Italy) in order to record accurate surface details of the soft tissues. Dry gauzes were adapted onto the impression material before it was set (Figure 2A). Quick setting dental plaster (Kalabhai, India) was mixed and applied over the gauze to reinforce the entire impression (Figure 2B).
2. Impression was removed and examined for any defect. Cast was poured in Type IV dental stone (Kalabhai, India) (Figure 3 A, B).
3. A temporary eye shell was fabricated using heat-polymerizing acrylic resin (Figure 4A, B), which was trimmed to a thickness of around 5mm, as the adequate depth was not available in the orbital defect area. A tentative wax pattern was also fabricated over the defect area in the cast, using the facial photographs of the right eye region as a reference (Figure 5A, B). Facial measurements (Figure 5A) were used to orient the temporary eye shell into the tentative wax pattern, while maintaining the position of the head and gaze of the right eye in natural head position.[7] Two vertical lines were marked on the patient's face; the first line through the midline of the face and the second line through the pupil of the right eye. The distance between the lines was measured and a corresponding vertical line was drawn on the defect side from the midline. A horizontal line was drawn passing through the pupil of the right eye and was extended through the defect on to the left side of the face. The vertical lines helped in orienting the shell mediolaterally, whereas, the horizontal line helped in

orienting it in correct vertical plane in the wax pattern. The facial measurements were then transferred onto the working cast with the help of the tentative wax pattern and temporary eye shell (Figure 5B).

4. Initial carving of the eyelid contours and the periorbital tissue contours was done in the laboratory, whereas, the final carving i.e. sculpting the numerous lines and fissures of the periorbital tissues was done chairside (Figure. 6A, B). Sticky wax was used to stabilize the wax pattern onto the master cast during carving procedures. Patient's satisfaction regarding the appearance of the prosthesis was ensured.
5. The margins of the wax pattern were sealed onto the working cast. Widely distributed notches were made along the periphery of the working cast for the accurate positioning of the two counterparts. The separating medium was applied on the working cast. Boxing wax was adapted along its periphery and type IV dental stone (Kalabhai, India) was poured in it to fabricate a two-piece mold.
6. Dewaxing was carried out and the temporary eye shell was maintained in its original position within the counterpart of the working cast.
7. Room temperature vulcanizing (RTV) silicone (Liquid silicon rubber compound) along with intrinsic pigments (Technovent, United Kingdom), to match the basic skin tone of the patient, was packed into the mould (Figure. 7A, B). The silicone was heated in hot air oven for 1 hour at 100°C, cooled, deflasked and trimmed (Figure. 8). The extrinsic pigments (Technovent, United Kingdom) were applied onto the surface of processed silicone to simulate the natural color characterization of the patient's skin.
8. The temporary eye shell was flasked in the metallic ocular flask to create a mould. The shell was then trimmed on the cameo surface, provided that the borders were kept intact. Coloring of the pupil, iris and sclera was done chairside by using acrylic color and monopoly syrup in natural daylight (Fig.9A). Packing of the painted eye back into the original mold was done with the application of a layer of clear acrylic resin on the cameo surface. It was then deflasked and finishing and polishing was done (Figure. 9B). Finally, it was inserted into the orbital prosthesis as the borders of the eye shell guided its original position (Figure. 9C)
9. Synthetic hair was then needled into the eyebrow area and upper and lower eyelids of the silicone prosthesis using 27-gauge syringe needle (Figure. 10).
10. The completed orbital prosthesis was delivered to the patient, retained with adhesives. Silicone adhesive paste was provided to the patient, as they provide excellent adhesion and precise application. Moreover, the size of the prosthesis was relatively larger and required strong hold which could be achieved with silicone pastes. Spectacles were provided to camouflage the prosthesis (Figure. 11). The patient was instructed regarding the maintenance of the prosthesis and hygiene of the defect area.

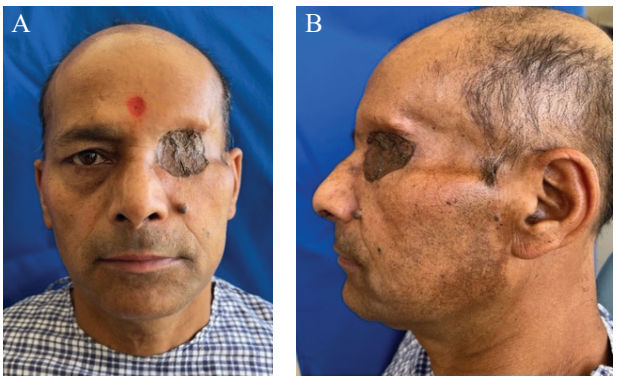

Figure 1: *Pre-prosthetic image. A, Frontal view. B, Left lateral view.*

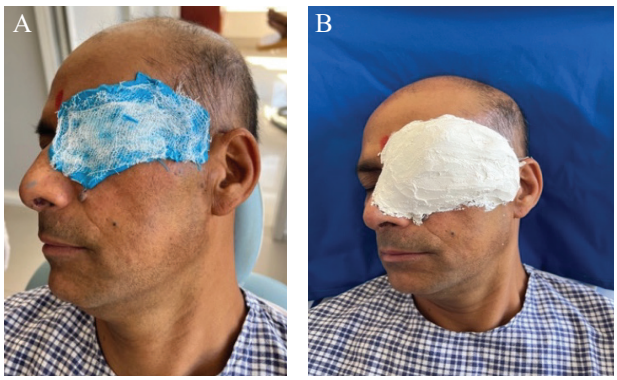

Figure 2: *Direct impression. A, With light-bodied consistency polyvinyl siloxane impression material. B, Reinforcement with quick setting dental plaster*

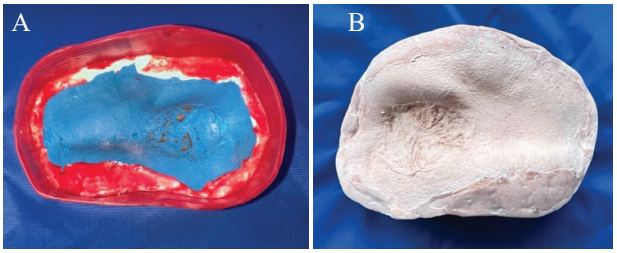

Figure 3: *A, Base formation, followed by boxing along the periphery of the impression. B, Cast poured in die stone.*

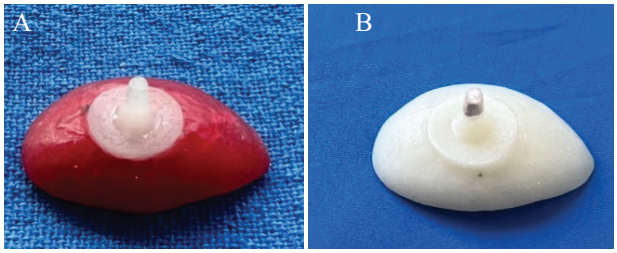

Figure 4: *A, Wax pattern of eye shell B, Temporary eye shell*

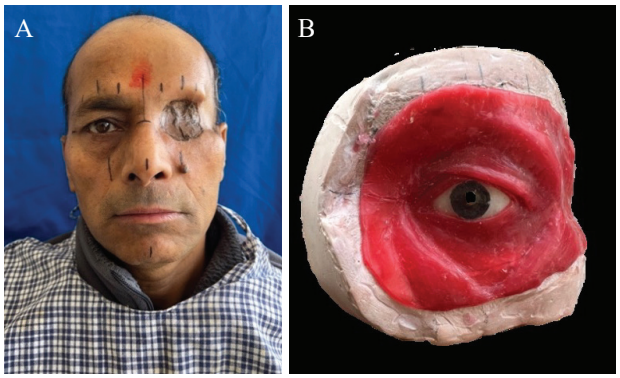

Figure 5: *A, Facial measurements to orient the eye shell. B, Transfer of facial measurements onto the working cast*

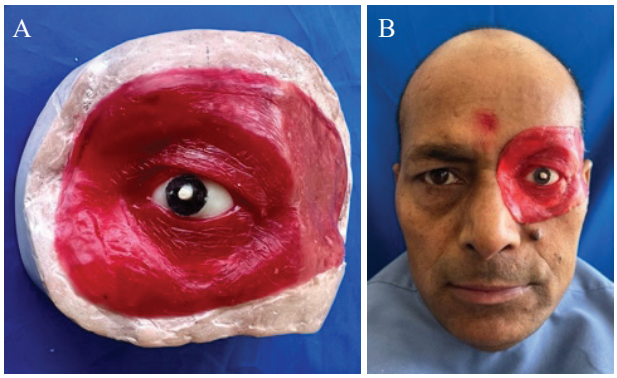

Figure 6: *A, Sculpted wax pattern of eye shell. B, Wax pattern try-in*

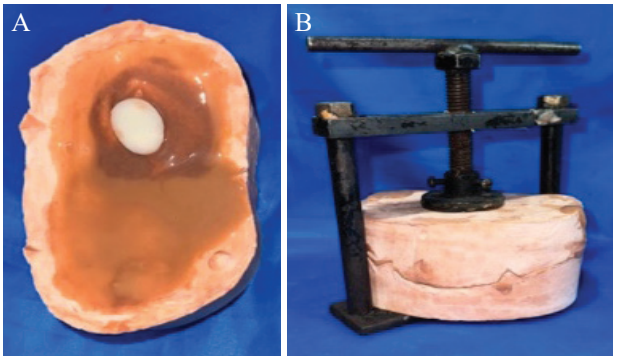

Figure 7: *A, B, Packing of silicone into the mold*

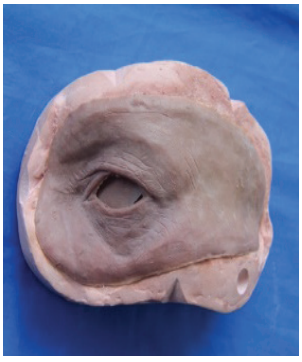

Figure 8: *Processed silicone prosthesis*

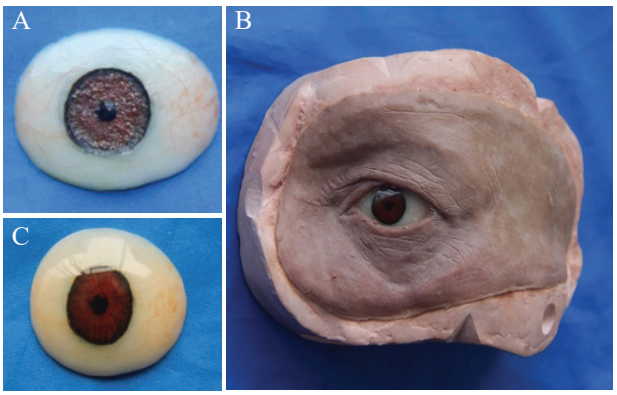

Figure 9: *A, Coloring of the pupil, iris and sclera. B, Finished and poilished eye shell. C, Insertion of the final eye shell into the orbital prosthesis.*

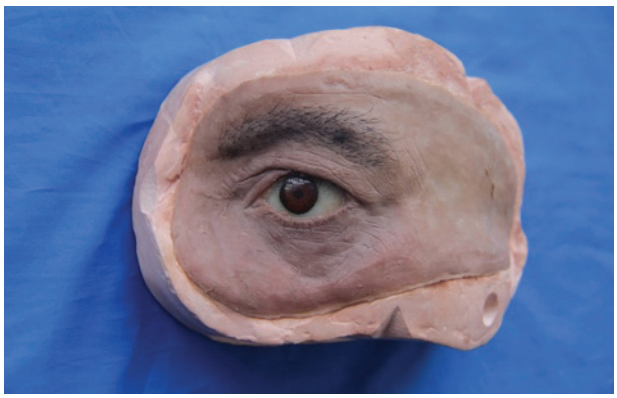

Figure 10: *Final orbital prosthesis with synthetic eyebrow and eyelashes*

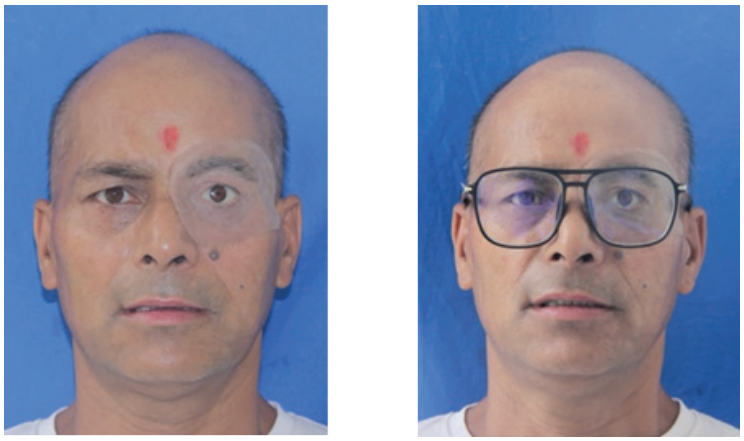

Figure 11: *Insertion of the silicone orbital prosthesis*

DISCUSSION

The loss of an eye and the periorbital structures can have a profoundly detrimental effect on the quality of life of an individual, whereas, the fabrication of an orbital prosthesis can have a significant positive impact on the patient's quality of life.[8] This case report describes the fabrication of an adhesive-retained silicone orbital prosthesis. The most commonly preferred prosthetic material for the fabrication of maxillofacial prosthesis includes methyl methacrylate, polyurethanes, and silicone elastomer, as they can be intrinsically and extrinsically stained to match the patient's skin tone. Among them, RTV silicone was used in this case, as it poses several advantages, such as, ease in coloring and better esthetics with life-like appearance, as the thin margins of the prosthesis can easily blend with the surrounding skin. However, the major drawback of the material includes its lesser durability and the low tear and edge strength, making it highly susceptible to tear, especially at the thin margin areas. Moreover, silicone prostheses gradually deteriorate and lose their color stability, thus indicating the need for additional extrinsic staining, or even refabrication.[2]

Various methods are available to retain the orbital prostheses, which includes use of adhesives, natural anatomical undercuts, mechanical retention, such as, use of spectacles, and osseointegrated implants.[9] Although implant retention provides greater retention and overall treatment satisfaction, and is considered to be the most effective method to retain an orbital prosthesis,[8] it is an invasive and an

expensive treatment option. In case of absence of the natural anatomical undercuts, as in the presented report, the only means of prosthesis retention, other than implants, includes the use of adhesive or the mechanical retention with spectacles. The main disadvantage of using spectacles is that, when the patient removes it, the prosthesis is also removed which can be embarrassing to the patient.[10] Thus, an adhesive retained orbital prosthesis was fabricated, as it is non-invasive, comfortable and more cost effective.

Various types of medical grade adhesive systems are commercially available, such as spray-on adhesives, pastes, double-sided adhesive tapes, and liquid emulsions to retain the prosthesis. The main drawback of these adhesive systems is that they become less effective when the margins of the prosthesis extend beyond the orbit into movable tissue bed areas. Loss of adhesiveness can lead to open junctions and eventual dislodgement of the prosthesis.[2] Other drawbacks include the gradual discolouration and breakdown of the margins, which can affect the overall retention and esthetics of the prosthesis, requiring its refabrication.[8]

Furthermore, in order to achieve optimum esthetics, the eyebrows and eyelashes can be stitched over the eyebrow area and eyelids, instead of superficially attaching them. Additionally, the eyeglass frames can be provided to camouflage the lines of juncture of the prosthesis. Plastic eyeglass frames are usually preferred to metallic frames because they cast larger shadows under which the lines of juncture can be positioned.[4]

CONCLUSION

The fabrication of an adhesive-retained silicone orbital prosthesis involves precise planning, material selection, and meticulous fabrication techniques. It ensures significant advantages, including comfort, stability, natural appearance, ease of application, minimal invasiveness, and enhanced patient satisfaction, thus making it a treatment of choice for many patients. With advancements in materials and techniques, this prosthesis continues to improve in terms of comfort, esthetic appearance and overall better quality of life for individuals with orbital defects.

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