Case Report

An innovative and simple approach to fabricate a hollow ocular prosthesis with functional lubricant reservoir: A solution to artificial eye comfort

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Abstract

The loss of an eye is an emotional and psychological setback to the patient. An ocular prosthesis is created to restore the lost anatomical structure and to correct the cosmetic defect. The tear reflexes do not function at optimal levels in anophthalmic sockets which make prosthesis wear uncomfortable. This case report presents an innovative hollow ocular prosthesis with functional lubricant reservoir which upon normal blinking would draw the lubricant from the reservoir through an exit hole which spreads over the prosthesis allowing a comfortable and long duration of prosthesis wear.

Key Words: Hollow ocular prosthesis, lubrication, ocular prosthesis

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INTRODUCTION

Eyes are generally a striking feature of the face. The unfortunate loss or absence of an eye may cause significant physical and emotional problems. The fundamental objective in restoring a congenital as well as acquired defect of the eye with a cosmetically acceptable prosthesis is to enable the patient to cope better to face the outside world and return to their accustomed lifestyle. However, in addition to the appearance, comfort is a prime consideration to most wearers. In patients with anophthalmic sockets, blinking and tearing reflexes are either absent or do not function at optimal levels leading to problems such as dryness, discomfort, irritation, bacterial infections, and mucous deposition in prosthetic wearers, all of which makes prosthesis wear uncomfortable.[1,2] Different treatment modalities have been employed but had limited success. An innovative technique to fabricate a hollow ocular prosthesis with functional lubricant reservoir has been presented with the aim of solving the problems associated with impaired tear mechanisms.

The hollow ocular prosthesis with functional lubricant reservoir consists of a reservoir for the lubricant in the superior aspect of the body of the prosthesis. The lubricant reservoir is connected to an access opening on the posterior surface of the body by a passage. The access opening is closed with a removable cap which allows the patient to load the lubricant into the reservoir as well as to

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clean the reservoir as and when required. The prosthesis also has an exit hole for the lubricant, 0.5 mm in diameter on the anterior surface of the prosthesis. It opens into the limbus and it leads to the reservoir containing the lubricant [Figure 1]. During normal blinking action, the upper eyelid creates a negative pressure which draws the lubricating fluid from the lubricant reservoir to the anterior surface of the prosthesis through the exit hole which spreads over the prosthesis by blinking action.

This article presents an innovative technique to fabricate the lubricant reservoir which is simple, easy to construct, affordable, uses readily available materials, is functional, and cleansable. A simple technique to stabilize and secure iris disk during dewaxing and packing and a modified curing cycle to minimize monomer content were followed, and characterization was done with light cure stains which are simpler, quicker, and gives a life-like appearance.

CASE REPORT

An 18-year-old female patient reported to the Department of Prosthodontics for prosthetic rehabilitation of her lost left eye. On eliciting history, it was found that the patient had sustained a shrapnel injury to her left eye, which necessitated a surgical evisceration of the eye. Clinical examination revealed a completely healed left eye socket. Her right eye had normal vision. The patient had no other relevant medical history [Figure 2].

Technique

1. A custom ocular tray was made by pouring autopolymerizing resin into an alginate mold made with a stock ocular prosthesis. Perforations were made in the custom ocular tray to aid in retention of the impression material, and a tunnel was cut out at the center of the custom tray to which a disposable impression tip was attached to deliver the impression material[3]

   The impression was made by injecting light bodied addition silicone material (Aquasil Dentsply) through the prepared tunnel[4] [Figure 3]. The patient was asked to move her eyes in all directions to facilitate flow of impression material into all aspects of the socket. Then, the patient was asked to look directly at a fixed point six feet away at the level of eye allowing impression of the site with the muscles in neutral gaze position
2. The impression was invested first in dental stone till the height of contour and when set a second pour to create a two piece split cast mold[5] [Figure 4]
3. A wax conformer was fabricated by pouring molten baseplate wax into the two pieces split cast, after which it was retrieved and the sharp edges were removed.[5] The rubber stopper from a plunger tip of a tuberculin syringe was used as a removable cap which was fitted into an opening made in the posterosuperior aspect of the wax conformer

   A bevel was placed around the margins of the cap to help in easy removal and placement [Figure 5]. The wax conformer was then adjusted for the satisfactory fit, contours, and comfort
4. An iris disk cut out from a stock eye was attached to the wax conformer using a transparent grid[6] [Figure 6]

A needle cap was attached with cyanoacrylate adhesive to the iris disk [Figure 7]:

- To assess orientation of visual axis
- To stabilize and secure the iris disk during dewaxing and packing.

5. A wire was attached to the rubber cap so that the rubber cap was retained in the same position during dewaxing and packing [Figure 8]

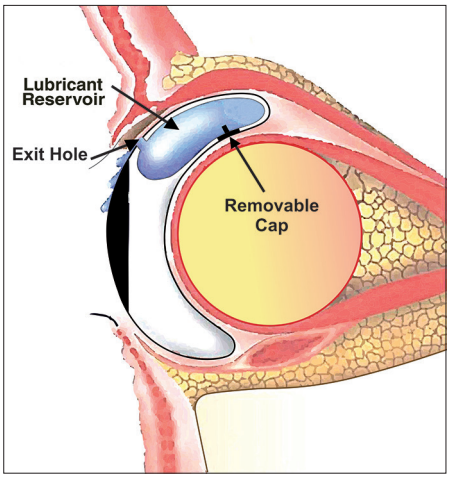

Figure 1: Design of hollow ocular prosthesis with functional lubricant reservoir

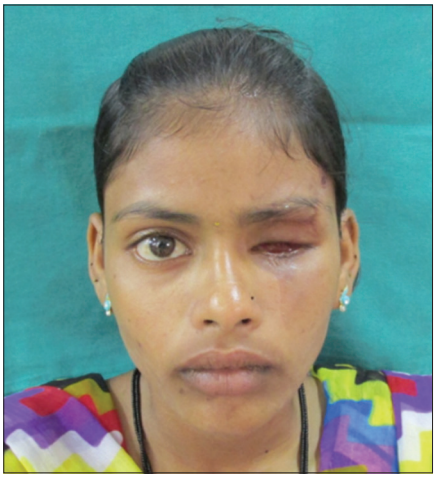

Figure 2: Preoperative photograph

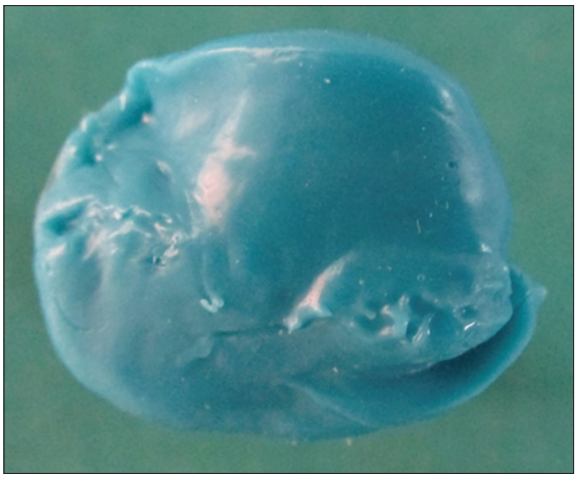

Figure 3: Impression taken with custom ocular tray using light bodied addition silicone

Figure 5: Wax conformer with removable cap attached to its posterosuperior aspect with bevel around the margins for easy removal and placement of cap in the final prosthesis

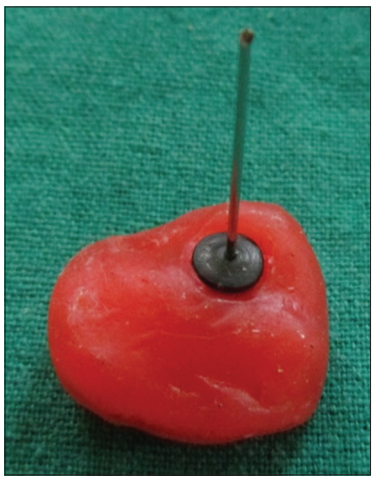

Figure 7: Wire attached to removable cap so that it is retained in the same position during laboratory procedures

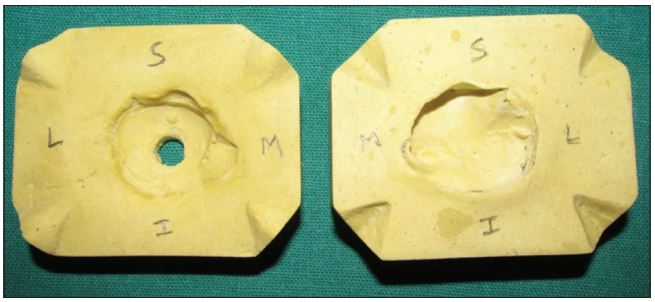

Figure 4: Two pour split cast

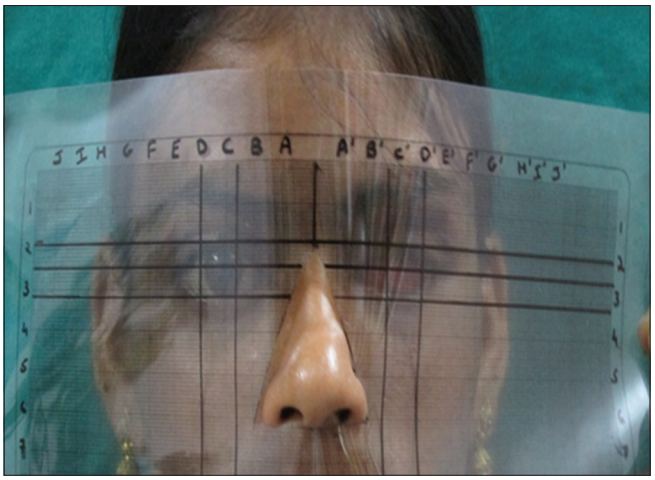

Figure 6: Transparent grid used for accurate positioning iris disk on wax conformer

Figure 8: Needle cap attached to iris disk so that it is retained in the same position during laboratory procedures

6. The prosthesis was invested in a dental flask. Upon separation of the flask after dewaxing, the rubber cap was retained in position by the attached wire and iris disk was retained in position by the needle cap which was attached to it [Figures 9 and 10]

A mixture of clear heat cure acrylic resin and zinc oxide eugenol was packed to achieve a white scleral color.[5]

Lost salt technique was used to create a reservoir for the lubricant in the superior aspect of body of the ocular prosthesis[7] [Figure 11]

7. A modified curing protocol (reverse curing cycle) was followed to minimize the monomer content of acrylic eye.[8] In this technique, the flask was placed in water at 95°C × 20 min and thereafter in boiling water for additional 20 min

The ocular prosthesis was acrylized, retrieved, and finished. All residual salt crystals were flushed out through the opening for the removable cap

8. The prosthesis was tried to check for the extent, fit, comfort, and iris position.

Characterization of the scleral part of the prosthesis was done with the help of (SR Adoro) light cure stains and (Targis Power) light curing unit so as to match the natural eye. Optiglaze protective coating agent (GC America) was applied to protect the characterization [Figure 12]

Figure 9: Upon dewaxing, removable cap is retained in the same position

Figure 11: Packing done with mixture of heat cure clear acrylic resin and zinc oxide eugenol. Lost salt technique used to create reservoir for the lubricant

9. A 0.5 mm diameter exit hole for the lubricant was created on the anterior surface of the ocular prosthesis into the limbus with the help of a suitable bur which connected the reservoir containing the lubricant
10. The prosthesis was disinfected in cidex :2% glutaraldehyde cidex (surgikos, Johnson & Johnson co.), and it was delivered to the patient with instructions as to how to load the lubricant (carboxymethylcellulose eye drops IP 0.5%, extralube).[9] [Figures 13-15]. The removable cap is to be replaced if there is deformation or tear such that it does not fit into the access passage or there is a leakage of lubricant. Patient was instructed to clean the prosthesis with ophthalmic irrigation solution.[9] The chamber was cleaned by removing the removable cap and injecting ophthalmic irrigation solution through a syringe
11. Patient was followed up after 24 h, 1 week, 1 month, 3 months, and then every 6 months. The removable cap was replaced after 6 months due to deformation.

Figure 10: Upon dewaxing, iris disk is retained in the same position

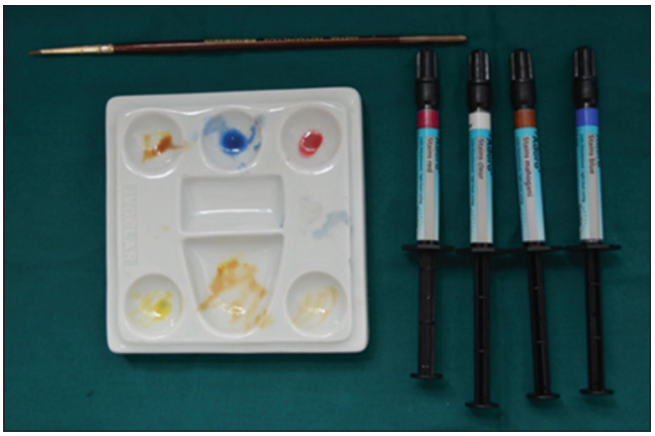

Figure 12: Characterization with Adoro light cure stains

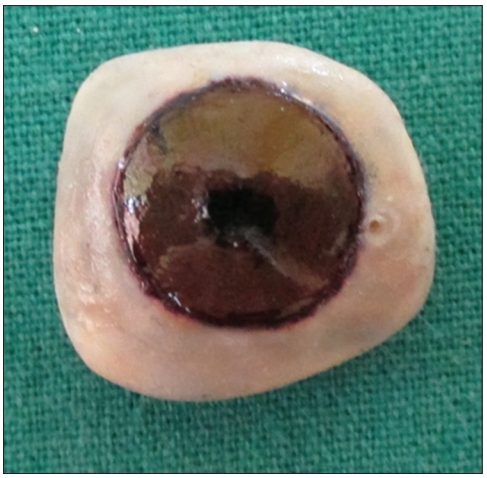

Figure 13: Characterized hollow ocular prosthesis with functional lubricant reservoir with reservoir, removable cap, and exit hole for lubricant (anterior view)

Figure 14: Characterized hollow ocular prosthesis with functional lubricant reservoir with reservoir, removable cap, and exit hole for lubricant (posterior view)

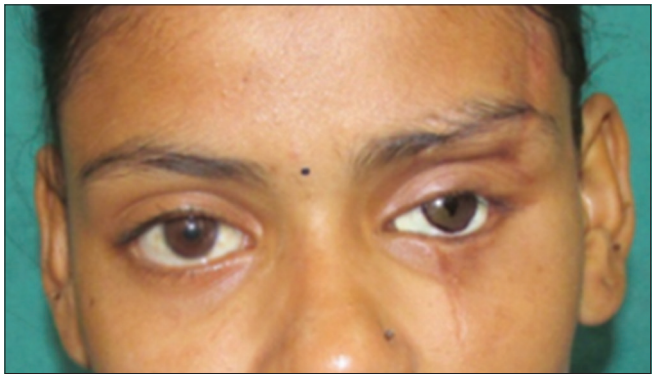

Figure 15: Postoperative photograph

DISCUSSION

In anophthalmic sockets, blinking and tearing mechanisms of eye socket do not operate at all or are insufficient to allow the patient comfortable prosthesis use.[1] In addition to the problem of dryness, continuing problems of bacterial infections are suffered by many prosthesis users.[2]

A number of techniques have been advocated to solve the problem of dry artificial eyes such as lubricant eye drops, commercially available chemically bonded hydrophilic polymer that are applied to artificial eye, solid methyl cellulose lubricant which consists of small solid cylindrical body of lubricant that is inserted under lower eyelid and slowly allowed to dissipate during the day but had with limited success. Kelly from Philadelphia developed self-lubricating ocular prosthesis called speech-language pathology in an attempt to solve the problem of dry eyes.[10]

This article presents an innovative technique to fabricate hollow ocular prosthesis with functional lubricant reservoir in an attempt to solve problems of inadequate lubrication such as dryness, discomfort, irritation, bacterial infections, and mucus deposition over prosthesis thereby allowing long duration of the use of the prosthesis.[2] The patient is instructed to load the lubricant into the reservoir via the removable cap. During the normal blinking action, the upper eyelid creates a negative pressure which draws the lubricating fluid from the reservoir to the anterior surface of the prosthesis through the exit hole which spreads over the prosthesis by blinking action. The hollow ocular prosthesis also improves comfort by reducing the weight of the prosthesis. The lubrication also gives a wet looking anterior surface which gives a life-like appearance. In cases of bacterial infections instead of lubricant, antibacterial eye drops can be loaded in the reservoir.

Despite the continued effort to solve the problem of dry eyes and bacterial growth, the present devices or treatment modalities have not been able to solve this problem successfully and have disadvantages such as increased cost, increased complexity, and being technique sensitive.

Literature mentions techniques in which Styrofoam and lost wax technique have been used in fabrication of hollow ocular prosthesis to reduce the weight of the prosthesis.[11,12] In this case report, the technique presented to fabricate the lubricant reservoir by lost salt technique is simple, easy to construct, affordable, uses readily available materials, is functional, and cleansable. However, it has certain drawbacks such as the design might not be feasible in patients with shallow sockets, difficulty in gauging resin thickness, and it depends on patient compliance for loading of lubricant reservoir.

Accurate placement of iris disk is critical so that the iris is bilaterally symmetrical. Roberts had suggested the use of

a pupillometer for accurate alignment of pupil in ocular prosthesis.[13] However, even though the technique is more precise, it might not be feasible to use pupillometer in every clinical setup. Kumar *et al.* oriented the iris disk on the cast itself according to a previously transferred pupillary mark.[14] The technique presented in this case report involves a simple and inexpensive procedure for positioning iris disk in wax conformer with the aid of transparent grid.[6] The use of the transparent grid allows the operator to precisely locate and position the iris on custom-made ocular prosthesis in relation to natural eye rather than relying on purely visual assessment. However, in cases of facial asymmetry, the markings may be subjective, and there can be influence of parallax as the transparent grid is held at a distance from the face.

In the literature, a lot of emphasis is given to accurate positioning of iris button; however, there is not much emphasis given to maintain and stabilize the position of iris button during laboratory procedures such as flasking, dewaxing, and packing. Few authors have suggested techniques in which an acrylic stem/stalk is attached to iris button before flasking.[15,16] A simple technique to stabilize and secure the position of iris button during dewaxing and packing has been presented. This case report presents a simple technique in which a needle cap is attached to iris disk before flasking to ensure that the same position of iris is achieved in the final prosthesis as it was during try-in thus avoiding squinted eye appearance. It can also be used to assess the orientation of visual axis during try-in.

A modified curing cycle called as reverse curing cycle was followed ensuring elimination of residual monomer by curing at an increased temperature compared to previously documented techniques.[8] The superiority of reverse curing cycle is documented by Jorge *et al.* for denture fabrication.

Resin based stains (SR Adoro) have been used for characterization and to match the natural eye color. Ivoclar vivadent SR Adoro stains are nothing but urethane dimethacrylate (47–48 wt%) and silicon dioxide (49–50 wt %), and these stains are routinely used for characterization of acrylic denture teeth. They have better handling properties compared to acrylic paints and have been able to provide excellent esthetic results. Optiglaze protective coating agent which is a nano-filled, light-cured, protective coating for composites and acrylic indirect composites was applied to protect the characterization. The limitation of this technique is the need of specialized curing equipment. Further studies are required to evaluate the long-term stability of these stains for use in ocular prosthesis.

CONCLUSION

The prosthetic rehabilitation of anophthalmic socket is a challenging process. In addition to esthetics, comfort of the prosthesis wearer should be given prime importance. The hollow ocular prosthesis with functional lubricant reservoir presented in this case report can help solve the multiple problems associated with dry eye socket, as a result provide, comfort for the longer duration of wear of the ocular prosthesis.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Allen L, Kolder HE, Bulgarelli EM, Bulgarelli DM. Artificial eyes and tear measurements. Ophthalmology 1980;87:155-7.
2. Vasquez RJ, Linberg JV. The anophthalmic socket and the prosthetic eye. A clinical and bacteriologic study. Ophthal Plast Reconstr Surg 1989;5:277-80.
3. Miller BJ. Custom ocular impression trays. J Facial Somato Prosthet 1996;2:109-13.
4. Shenoy KK, Nag PV. Ocular impressions: An overview. J Indian Prosthodont Soc 2007;7:5-7.
5. Beumer J 3rd, Curtis TA, Marunick MT. Maxillofacial Rehabilitation. Prosthodontic and Surgical Considerations. St. Louis: Ishiyaku EuroAmerica; 1996. p. 422-6.
6. Guttal SS, Patil NP, Vernekar N, Porwal A. A simple method of positioning the iris disk on a custom-made ocular prosthesis. A clinical report. J Prosthodont 2008;17:223-7.
7. Aggarwal H, Sunit KJ, Raghuwar DS, Chand P, Kumar P. Lost salt technique for severely resorbed alveolar ridges: An innovative approach. Contemp Clin Dent 2012;3:352-5.
8. Jorge JH, Giampaolo ET, Vergani CE, Machado AL, Pavarina AC, Carlos IZ. Biocompatibility of denture base acrylic resins evaluated in culture of L929 cells. Effect of polymerisation cycle and post-polymerisation treatments. Gerodontology 2007;24:52-7.
9. Trawnik WR. Care of the ocular prosthesis. Adv Ophthalmic Plast Reconstr Surg 1990;8:146-8.
10. Kelley KV. Self-lubricating Ocular Prosthesis. US Patent 5,171,265; 1992.
11. Brito Edias R, Rezende JR, Carvalho JC. Light-weight ocular prosthesis. Braz Dent J 1994;5:105-8.
12. Aggarwal H, Kumar P, Singh RD. A simplified method to fabricate a pneumatic ocular prosthesis for large ocular defects. J Indian Prosthodont Soc 2014;14 Suppl 1:106-9.
13. Roberts AC. An instrument to achieve pupil alignment in eye prosthesis.

J Prosthet Dent 1969;22:487-9.
14. Kumar P, Aggrawal H, Singh RD, Chand P, Jurel SK, Alvi HA, *et al*. A simplified approach for placing the iris disc on a custom made ocular prosthesis: Report of four cases. J Indian Prosthodont Soc 2014;14:124-7.
15. Anandkumar V, Mohamed K, MadhanKumar S, Prathibha P, Padmanabhan TV. Simplified approach for prosthetic rehabilitation of an enucleated ophthalmic socket. J Indian Prosthodont Soc 2014;14:289-91.
16. Gupta RK, Padmanabhan TV. Prosthetic rehabilitation of a post evisceration patient with custom made ocular prosthesis: A case report. J Indian Prosthodont Soc 2012;12:108-12.