Individual impression technique by using functional method on the custom ocular prosthesis: a case report

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ABSTRACT
Enucleation leads to contracture of orbital tissue accompanied by reduction in volume and forniceal depth, which results in an inability to sustain a prosthesis. Shallow inferior fornix in contracted eye socket compromises adaptation, retention, stabilization and duplication of palpebral opening similar to natural eye in terms of size, support, contour and convexity make fabrication of custom ocular prosthesis become challenging. Hence, the present article describes the use of ocular prosthesis as conformer to obtain better appearance and enlarge orbital dimension in contracted socket. A 21-year-old male came to Dental Hospital Universitas Sumatera Utara with a complaint of unaesthetic face appearance due to enucleation of left eye in the last 5 years old subsequent to trauma by sharp blades. The patient had already used an ocular prosthesis but lost it 6 years ago and didn't used it until now. In clinical examination, the anopthalmic socket had good posterior wall mobility and absence of infection but, mild contracted socket (Grade 1) with shallow inferior fornix depth was examined. In this case, ocular prosthesis provides aesthetics as well as expanding the lid anteriorly, conjunctiva and fornix posteriorly that were successfully obtained by performing functional impression using imprinted waxed up. This results in a favorable peripheral eye seal.
Keywords: custom ocular prosthesis, waxed up convexity, functional impression, contracted eye socket, conformer

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INTRODUCTION

Eyes are naturally the first features of the face to be noticed. The eye is a vital organ not only in terms of vision but also being an important component of facial expression.[1] The disfigurement resulting from loss of an eye can cause significant psychological as well as social consequences for both the patient and family. This results in the patient becoming visually, esthetically and psychologically handicapped. Restoring the defect with a silicone- or acrylic-based prosthesis not only restores esthetics but also gives back the lost confidence to the patient.[2]

The surgical procedures for removal of an eye, are classified by Peyman, Saunders and Goldberg into three general categories as evisceration (where the contents of the globe are removed leaving the sclera intact), enucleation (most common, where the entire eyeball is removed after severing the muscles and the optic nerve) and exenteration (where the entire contents of the orbit including the eyelids and the surrounding tissues are removed.[1] Enucleation leads to contracture of orbital tissue accompanied by reduction in volume and forniceal depth results in an inability to sustain a prostheses.[3]

Adequate retention of the ocular prosthesis in the anophthalmic socket requires a well-formed inferior fornix, which in turn requires sufficient conjunctival length and a deep recess. Contracted socket is a condition characterized by fibrosis of the anophthalmic socket where shallow or obliterated fornix is a key finding in different stages of the disease and it occurs secondary to conjunctival shrinkage. Shallow inferior fornix occurs possibly as there is no globe and so the inferior rectus muscle is at a higher level in the socket with subsequent elevation of the lower lid retractors and their connections including the fornical conjunctiva.[4]

Several classifications to grade a contracted socket have been published in the literature. The most widely used clinical classification is the Gopal Krishna classification, where the contracted socket is divided into five grades, such as Grade 0: a healthy socket with deep and well-formed fornices, Grade 1: shelving or shallowing of the lower fornix, Grade 2: loss of the superior fornix along with the inferior fornix, Grade 3: involvement of all four fornices (superior, inferior, lateral, and medial), Grade 4: involvement of all four fornices along with a reduction in the horizontal palpebral fissure length or HPFL, Grade 5: recurrence of contraction after repeated failed attempts at reconstruction.[3]

Early management of an ophthalmic socket prevents loss of volume in the anterior orbital area and facial asymmetry. A fundamental objective when restoring an ophthalmic socket with an ocular prosthesis is to enable the patient to cope better with the difficult process of rehabilitation. A mul-

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tidisciplinary management and team approach are essential in providing accurate and effective rehabilitation and follow-up care for the patient. Therefore, the combined efforts of the ophthalmologist, the plastic surgeon and the maxillofacial prosthodontist are essential to provide a satisfactory ocular prosthesis.[5] A properly fitted and accepted custom ocular prosthesis has following characteristics retains the shape of the defect socket, prevents collapse or loss of the shape of the lids, provides proper muscular action of the lids, prevents accumulation of fluid in the cavity, maintains palpebral opening similar to the natural eye, mimics the coloration and properties of the natural eye, has gaze similar to the natural eye.[6]

Ocular prosthesis can be classified as stock shell or ready-made and custom-made prosthesis. The close contact of custom-made ocular prosthesis with the tissue bed improves tissue health by reducing fluid accumulation in tissue-prosthesis interface thereby decreasing the chances of tissue irritation and bacterial growth. Custom ocular prostheses are also known to distribute the pressure more equally and decrease the incidence of conjunctival abrasion as compared to stock ocular prostheses.[5]

CASE

A 21-year-old male patient reported to the Department of Prosthodontics, RSGMP USU with the chief complaint of missing left eye. Patient history revealed that he had an injury type of trauma from sharp blades to the left eye when he was 5 years old, then underwent surgical removal of his entire eyeball eyes (enucleation). The patient once used an artificial eye but had lost it 6 years ago and never use anything until now. Upon examination the ocular defect was healed properly with good mobility of the posterior wall of the ocular defect during full excursive movement, absence of infection, and adequate volume to support the prosthesis. The palpebral fissure was examined in both open and closed position to rule out any anatomical as well as physiological abnormality. The narrowing of inferior sulcus was also examined in this case (Fig.1).

The rehabilitation treatment plan for this case

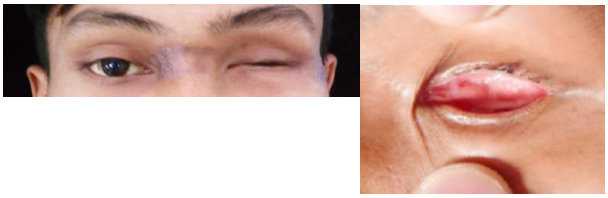

Figure 1 Pre-treatment Photograph

was ocular prosthesis fabrication with custom ocular. Procedure was initiated with application of petroleum jelly to the eyebrows and skin to prevent the impression material sticking to the eyelashes. Then, primary impression was made with irreversible hydrocolloid material (Alginate; Aroma Fine Plus, GC) and a cast was made from type II gypsum on which a special tray was fabricated using visible light curing acrylic with numerous perforations for escape of the impression material (Fig.2). Material was injected into the socket (Fig.3a). After the material had set, impression was retrieved from the socket and checked to ensure that all the surfaces were recorded (Fig.3b).

Figure 2 Custom Tray

Figure 3A Injection of impression material into the socket; B primary impression with alginate

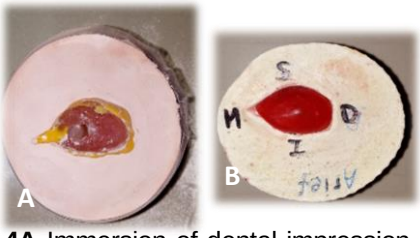

Figure 4A Immersion of dental impression in type II gypsum; **B** wax try-in

A two-piece dental stone cast was poured to immerse the lower part of the impression (Fig.4a). After the stone had set, separating media was applied on the surface, then a second layer was poured. Marking was made on all the four sides of cast for proper reorientation of the cast. Next, the wax pattern was fabricated by pouring the molten wax into the molds. The wax was properly contoured and carved to give it a simulation of the lost eye. (Fig.4b). The wax pattern was tried in patient's socket and checked for size, comfort, support, fullness, and retention by performing the functional movements.

Then, mark the convexity of the wax-up in the form of the peak of the eye convexity and the line

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that marks the medial-distal canthus (Fig.6). The convexity of the waxed-up results is then implanted into the putty (not passing through the largest circle) (Fig 7a), custom tray and the handle were then made using self-curing acrylic resin on the putty mold (Fig.7b) and make an escape hole as a place for excess of impression material. Custom tray was finished, polished and tried to the patient (Fig.8).

Figure 6 Wax try-in

Figure 7A Impression of waxed up convexity using putty; **B** custom individual tray

Figure 8 Custom tray try in

The final impression was made with light body addition silicone impression material. Before taking impression, impression tray was made and polished to prevent any irritation to the tissues inside the socket. The custom tray was tried in the socket following the marking line in order to adjust the custom tray sitted in the center of the socket. For final impression, the patient was instructed to tilt the head backward then, light body polyvinyl siloxane impression material (Elite P&P, Zhermack) was injected into the entire left eye socket and at the tray. The tray that had been filled with material was inserted back into the socket. Once filled, the head was moved back to the vertical position and the patient was directed to move his eyes up and down with various eye movements to record the functional impression (Fig.9A). This will facilitate the flow of the impression material to all aspects of the socket. Patient was asked to look at a distant spot at eye level with his gaze maintained in a forward direction. After the material was set, cheek, nose and eyebrow regions were massaged to break the seal. While the patient gazed upwards, the cheek was pulled down and the inferior portion of the impression rotated out of the socket. Impression was checked for accuracy and excess material was trimmed (Fig.9B).

A two-pour technique was carried out using type IV gypsum to obtain the working cast. A wax

Figure 9A Functional impression; **B** custom individual tray impression

pattern was made by pouring modelling wax into the functional defect area of the cast. The size and the iris position were marked using IPD ruler by asking the patient to gaze straight at an object kept at a distance of 4 feets (Fig.10A) then, the color of iris was obtained by matching with the adjacent eye using oil painted (Fig.10B). Iris button was then produced according to the results of measurements that have been made (Fig.10C).

Figure 10A IPD ruler for measurement of iris size and position; **B** Iris painting with oil painted; **C** iris button

Second try- in of the wax pattern was done to verify size and support from the tissues in order to achieve ease of simulation of eye movement and eyelid coverage. The patient was instructed to fix the gaze of the natural eye in front and at eye level. The position of iris was determined by centertering in relation to the inner and outer canthus and upper and lower lids. Iris button implanted in a predetermined wax pattern followed by try in. (Fig.11A). During flasking, the iris button was secured in its determined position using an acrylic mount (Fig.11B). After dewaxing procedure, packing and curing were done with the selected shade of heat cure tooth colored acrylic resin.

Figure 11A Wax try-in with iris button; **B** flasking of wax and iris button

Afterwards, putty index was made as the reference for sclera in order to reduce the convexity of the sclera and the iris button about ± 2 mm. The sclera staining was performed following the patient's original eye where the sclera was put back on the flask, packed, heated, and cured with clear acrylic resin to restore the sclera concavity (Fig. 12A). The prosthesis was recovered, polished, dis-

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infected and inserted in patient's left eye socket (Fig.12B). During insertion, the ocular prosthesis was evaluated for its esthetic, retention, comfort and ease of performing various eye movements. Post insertion instructions were given for insertion and maintenance of prosthesis.

Figure 12A Heat cured clear acrylic resin, **B** post ocular prosthesis rehabilitation

DISCUSSION

There are three general surgical treatment procedures used as primary treatment modality in the surgical removal of the eye such as evisceration, enucleation and exenteration. Enucleation is the surgical removal of the globe and a portion of the optic nerve from the orbit.[7] After enucleation, a plastic conformer and corticosteroid antibiotic ointment is placed in the socket. The plastic conformer is left in place for 4-6 weeks to reduce edema and maintain the socket contours for a prosthetic eye. When surgical site is well healed and dimensionally stable, fabrication of an ocular prosthesis may be undertaken. Early management of an ophthalmic socket prevents loss of volume in the anterior orbital area and facial asymmetry.[5] Choudhury stated that enucleation leads to tissue constriction around the ocular cavity with complications such as enophthalmos and superior sulcus defect.[8]

A number of methods have been employed for early socket expansion in contracted socket mainly mechanical or tension wire expanders, pressure conformers, hydrogel expanders, external prosthesis and progressive-sized conformers. With the first two methods, overly aggressive pressure or tension expansion, often inducing harmful scarring by forcing the socket to conform to the shape of the pressure template.[10,11]

The mechanism behind eye expansion with progressive-sized conformers is the following: while the lids are expanded via anteriorly directed pressure, the conjunctiva and fornix are expanded via posterior and radially directed pressure and therein lies several rubs: each conformer has to be incrementally larger than the previous, but not so much larger that it is painful or impossible to place in the cul-de-sac. However, if it is too easily placed, it may be too small to have dramatic effect on lid dimensions. At the same time, the conformer has to be bulky enough to exert sufficient posterior pressure to induce conjunctival expansion, but not so bulky as to extrude from socket, while still exerting enough anterior pressure to effect lid growth.[9]

Nowadays, hydrophilic expanders have also being used. In the beginning, this hydrophilic substance has a hard consistency and is placed in their dry, contracted states. By taking up water, it expands gradually to their full size via osmosis of surrounding tissue fluid, with up to a tenfold increase in volume. The amount and rate of expansion can be engineered and very precisely controlled. After reaching the proper dimensions of anophthalmic cavity with expander prosthesis, it is possible to install the conventional ocular prosthesis, as has been described before on the current case reported. Besides reconstructing face aesthetics, the ocular prosthesis also restores muscle tone, reduces eyelids atresia and clears tear ducts, restoring the motor facial functional normality.[9]

External prosthesis is indicated for anophthalmic socket grade 1-3 to be used over the anterior surface of the socket and with support on the fornix in order to provide a better appearance. This external prosthesis is good if there is fornix support and adequate orbital volume. The benefits of this external prosthesis are less painful, replaceable, and accepted by parents due to cosmesis. The disadvantages are temporary and needs replacement.[11]

When prosthesis is customized to the patient using proper impression technique, distribution of pressure will be equal to. In addition, intimate adaptation of the modified prosthesis to the tissue surface of the defect increases the movement of the prosthesis and enhances its natural appearance. Other important step in making accurate impression is the close adaptation of the mucosal surface of the ocular prosthesis to the posterior wall of the eye socket. Using light body as an impression material is advantageous because it flows easily and records the details of the eye socket in the functional form which in turn aids in the proper adaptation and ease of functional movements of the ocular prosthesis. The impression was checked for an accurate recording of the posterior wall, the position of palpebrae in relation to the posterior wall, and the greatest extent of superior and inferior fornices of the palpebrae denoting precise impression.[12]

In this case, patient was chosen to use custom ocular prosthesis instead of stock ocular prothesis because custom achieves intimate contact with the tissue bed which helps in restoring natural eye movements without pain or discomfort. Besides

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that, custom-made eye prosthesis simulates the characteristics of the companion eye, helps in restoring the normal facial appearance and gives better movement of eye lids, distribution of pressure enhanced fit, comfortable, and enhanced esthetics gained from the control over the size of the iris, pupil and color of the iris and sclera, obtains exact color match of the sclera and blood vessels. Meanwhile, stock ocular prosthesis available in standard sizes, shapes, and colors and they can be used for interim or postoperative purposes.[13,14]

Enucleation involves removal of the eyeball proper and leads to an enophthalmic socket with a shrunken eye, which has a crippling effect on patient's emotional and social life.[8] A contracted socket with inadequate superior and inferior fornices, with palpebral fissures of unique size and shape and with inadequate anterior-posterior socket depth presents with numerous retention and cosmetic complications. Conformers are used as prosthetic treatment for a contracted socket to expand and shape it.[15] In the case report, the condition of anopthalmic socket post enucleation was categorized in grade 1 (shelving or shallowing of the lower fornix) that has been occurred for a long time because he had lost his ocular prothesis for 6 years that caused narrowing of inferior conjunctiva fornices and constricted of occular cavity volume which affected the fabrication of ocular prosthesis. Ocular prosthesis in this case was used to provide aestethics as well as expand the lid via anteriorly, conjunctiva and fornix via posteriorly. These were successfully be obtained by performing functional impression using imprinted waxed up that had been tried and checked for size, comfort, support in order to get adaptation, retention, stabilization and similar palpebral opening with favorable peripheral eye seal.

Adaptation, retention, stabilization and similar palpebral opening with natural eye of ocular prosthesis in contracted eye socket can successfully be obtained by performing functional impression using imprinted waxed up as custom tray for getting favorable peripheral eye seal.

REFERENCES

1. Agrawl KK, Mall P, Alvi HA, Rao J, Singh K. Fabrication of custom-made eye prosthesis for anophthalmic paediatric patients: 2 case reports. J Interdiscipl Dent 2012; 2(2):128-31.
2. Sethi T, Kheur M, Haylock C, Harianawala H. Fabrication of a custom ocular prosthesis. Middle East Afr J Ophthalmol 2014; 21(3): 271–4.
3. Bhattacharjee K, Bhattacharjee H, Kuri G, Das JK, Dey D. Comparative analysis of use of porous orbital implant with mucus membrane graft and dermis fat graft as a primary procedure in reconstruction of severely contracted socket. Indian J Ophthalmol 2014;62(2):145-53.
4. Mohamed FK, Ibrahiem, Sahar TA, Abdelaziz. Shallow inferior conjunctival fornix in contracted socket and anophthalmic socket syndrome: a novel technique to deepen the fornix using fascia lata strips. J Opthalmol 2016: 1-6.
5. Nafij BJ, John KK, Adam H, Mohammad KA. A complete procedure of ocular prosthesis: a case report. Int Med J 2013; 20(6): 729-30.
6. Thakar P, Patel JR, Sethuraman R, Nirmal N. Custom ocular prosthesis: a palliative approach. Indian J Palliat Care 2012; 18(1): 78–83.
7. Surya NP, Rojina S, Galav A, Prakash KP, Raj KS, Pramita S. Custom ocular prosthesis for enucleated eye: a case report. J Coll Med Sci Nepal 2016; 12(2).
8. Schellini SA, Dib RE, Limongi RM, Mörschbächer R. Anophthalmic socket: choice of orbital implants for reconstruction. Arq Bras Oftalmol 2015; 78(4): 260-3.
9. Santos DMD, Andreotti AM, Iyda BG, Dekon SFC, Goiato MC. Expander eye prosthesis assisting ocular rehabilitation in child with eye loss. J Clin Diagn Res 2017;11(8): ZD06-ZD08.
10. Essawy RAE, Abdelbaky SH. Successful conjunctival socket expansion in anophthalmic patients until the age of 2 years: an outpatient procedure. Clin Ophthalmol 2016;10:1743–8.
11. Changal N, Khandekar RB. Eye conformers as socket expanders in children: experience at a tertiary eye hospital in central Saudi Arabia. Cureus 2021;13(2):1-8.
12. Chodury M, Banu F, Natarajan S, Kumar A, Padmanabhan TV. Ocular implants with custom ocular prosthesis. Cureus 2018; 10(2): 1-14.
13. Meenakshi A, Pradeepa TS, Agarwa S. Prosthetic rehabilitation of an ocular defect: A case report. Int J Appl Dent Sci 2019; 5(1)
14. Rao SB, Akki S, Kumar D, Mishra SK. A novel method for the management of anophthalmic socket. Adv Biomed Res 2017;6:1-4.
15. Arbaz S. Ocular prosthesis-a simulation of human anatomy: a literature review. Cureus 2012; 4(12):e74.

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