ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 12, Issue, 03, pp.10740-10746, March, 2020

DOI: https://doi.org/10.24941/ijcr.38267.03.2020

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

FABRICATION OF EYE PROSTHESIS BY USING A NEW TECHNIQUE TO SECURE & ORIENT THE EYE SHELL DURING PROCESSING: A CASE REPORT

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ARTICLE INFO

Article History:
Received 24th December, 2019
Received in revised form
10th January, 2020
Accepted 28th February, 2020
Published online 30th March, 2020

Key Words:
Eye Prosthesis, Eye Shell Orientation, Prefabricated Eye Shell, Custom Ocular Prosthesis.

ABSTRACT

Introduction: Eye prosthesis is a kind of craniofacial prosthesis that replaces a missing or lost natural eye following an evisceration, enucleation or exenteration. Evisceration is a process in which just the contents of the eye ball are removed, in enucleation whole eye ball is removed and if there should arise an occurrence of exenteration eye ball along with its neighbouring supporting structures are expelled. Prosthetic rehabilitation of such cases should be possible by utilizing ocular prosthesis, orbital prosthesis and orbital prosthesis replacing the contiguous supporting tissues respectively. **Background:** A 37-year-old male patient visited the Department of Prosthodontics with a big concern about the difference in colour and size of the present artificial eye. Patient also gave history of trauma to the left eye 6 years back and the usage of the eye prosthesis for the last 3 years. **Method:** The patient was treated with ocular prosthesis by utilizing advanced impression technique to accurately record tissue surface of the eye socket and modified laboratory technique to help in holding the eye shell immovably in position with the assistance of a stainless-steel orthodontic wire. **Conclusion:** The current technique used to protect the eye shell during processing, combined with the modified functional impression technique allowed the artificial eye to move in harmony with the natural eye of the patient without being dislodged by movements.

Citation: ***Jadhav Amit, B., Sanyal Pronob, K. and Priyanka Thorat, B.*** **2020.** "Fabrication of eye prosthesis by using a new technique to secure & orient the eye shell during processing: a case report.", *International Journal of Current Research*, 12, (03), 10740-10746.

INTRODUCTION

Eyes are one of the most essential visible organs of the human body as it renders vision and the ability to see. Eyes play an important role in our everyday lives and are usually the only features of the face to be taken into account. Loss or absence of the eye may be caused by inherent deformity, catastrophic disease, tumour, excessive visual impairment or sympathetic ophthalmia. The disfigurement associated with the loss of an eye can cause significant physical, psychological and emotional problems as well as social seclusion. Most patients experience significant stress, principally due to changing in accordance with the useful incapacity brought about by the misfortune and to societal responses to the facial impedance. Substitution of the lost eye at the earliest opportunity is important to advance physical and mental healing for the patient and to enhance social acknowledgment (Artopoulou, 2006).

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CASE REPORT

A thirty-seven-year-old male patient answered to the department of Prosthodontics, School of Dental Sciences, Krishna Institute of Medical Sciences Deemed University, Karad, with a Chief complaint of distinction in colour and size with the present artificial eye which brought about discouraged eye attachment (Figure 1). Patient gave history of trauma to the left eye 6 years back and utilization of an eye prosthesis in the past 3 years. On examination, mucosa of eye socket was healthy. However, the muscle contraction in the upper lid was intemperate because of expanded time range among enucleation and manufacture of a first prosthesis

Primary Impression: An intraocular tray for primary impression was fabricated with autopolymerising acrylic resin (DPI- Bombay Burmah Trading Corporation Ltd. Mumbai). The convex surface of thumb cushion of right hand was utilized as an index for the fitting surface, to simulate the convexity, size and shape of a normal eye. The tray was adjusted for a passive fit in the patient's eye socket.

Irreversible hydrocolloid impression material (SEPTODONT-Saint-Maure-Des-Fosses-Cedex, France) was stacked in syringe and injected into the socket and on the tray. Patient was situated in erect position with the head tilted in reverse at 45-degree angle while the socket was filled with impression material. The patient was approached to move his eyes both up and down, to the right and to the left side (Figure 2). This facilitated the flow of impression material into all aspects of the socket. Later the patient was approached to look directly at a fixed point 6 feet away at the dimension of the eye. This allows impression of the site with the muscles in a neutral gaze position. After the material set; cheek, nose and eyebrow regions were massaged to break the seal. While the patient gazed upwards, the cheek was pulled down and the lower portion of the impression turned out of the socket. Impression was checked for precision and excess material was trimmed (Figure 3a).

Mould making: After an acceptable impression of the eye socket was been obtained, it was poured in type III dental stone. After setting, cast was removed(Figure 3b).

Special tray preparation and Final Impression: A layer of wax was put as spacer. Special tray was prepared using clear autopolymerising acrylic resin. Tray was then removed from cast and excess tray material trimmed. Tray borders were trimmed approximately 1.5 mm for border moulding. Border moulding was done by applying rubber base impression material (SILAGUM- Dental Avenue (I) Private Limited Andheri (W) Mumbai) in putty consistency on the borders of the tray (Figure 4a). Spacer was removed. The impression of the socket was made with a light viscosity rubber base impression material (SILAGUM- Dental Avenue (I) Private Limited Andheri (W) Mumbai), with an auto-mixing tip.

Prior to make an impression, a thin layer of petroleum jelly was applied on the eyelashes and around the eye socket to prevent the impression material from sticking to the eyelashes. The material was then injected gradually into the socket and as well as to the special tray and the patient was asked to perform various eye and eyelid movements to facilitate the flow of the impression material into all aspects of the socket. The impression was carefully removed from the socket once the material had set (Figure 4b).

Formation of the cast: Beading and boxing of the final impression was done(Figure 5a)and impression was poured by using type IV die stone. After the stone had set impression tray was removed from the cast and impression surface was checked for any voids (Figure 5b).

Fabrication of the wax pattern: Cast was immersed in hot water for few minutes. A layer of cold mould seal (PRODENT- MIDC Zadgaon, Ratnagiri- 415639) was applied over the impression surface of the cast. Molten wax (MAARC-Shiva Product, Vasai East, Palghar-401208) was then poured on the cast. Extra wax was poured to make up for the wax shrinkage. Once the wax solidified, the wax pattern was removed. Sharp edges and undesirable irregularities were eliminated and the portion of the wax that represented the palpebral fissure was re-contoured to form a smooth convex surface (Figure 5c).

Try in of the wax pattern: The wax pattern was inserted into the patients socket to check for proper contour and bulk (Figure 5d). Necessary modifications were done, re-polished and again inserted into the patient's eye socket. This was done until the soft tissue contour and the palpebral tissue resembled the patient's natural eye.

At the time of try- in of scleral wax pattern, it is checked for: (Sonia Bhat, 2010)

- Any area of discomfort or pressure points are relieved if present.
- The eye contour and lid configuration from different angles, with the patient's eyes open and by manual palpation with the eyes closed.
- Centre the height of convexity over the pupil which is usually slightly medial to the midline between the inner and outer canthi.
- The eyelids should close completely over the wax pattern.
- The contours and palpebral fissure should resemble the adjacent normal eye.

Placement of Eye Shell: The shade and size of the iris was determined and marked on the wax pattern using normal eye as the guide. To achieve this exact location, a white paper was secured on the forehead with the help of micropore tape (Figure 6a). The midline of face and the position of the natural iris were marked while the patient was asked to look straight ahead at a distant object. The distance was measured from the midline to the centre of the pupil of the natural eye and the same distance was marked on the left side and engraved into the wax pattern.

The pattern was then taken out and placed on cast. The horizontal and vertical markings on the wax pattern were transferred onto the cast. Keeping this position in mind, a space was created on the wax pattern. The prefabricated eye shell was adjusted according to the horizontal and vertical axis for the placement of the iris of appropriate size and similar shade. The wax pattern was again placed in the socket and compared with the patient's natural eye(Figure 6b). Also, the eye movements were checked for symmetry and function.It was found that the wax pattern showed movements in synchronization and harmony with the patient's normal eye movements.

Base Flasking: After the trial of wax pattern the master cast was trimmed about the size of the flask. The wax pattern was sealed and the whole assembly was invested as it is done for compression moulding laboratory procedures.

Securing and Orienting the position of Eye shell: A new method was devised to fix the position of the eye shell within the flask during processing to function as retentive tag so as to prevent eye shell displacement during dewaxing and packing procedure. A 21-gauge stainless steel orthodontic wire of was bent using universal plier in the centre so that free ends of the wire cross each other forming a loop. Both the free ends were bent adjacent to the loop so that it forms an acute angle. Loop was cemented to eye shell on its cameo surface at a position lateral and downwards to the iris. It is cemented at that position by using cyanoacrylate in such a way that its ends hang freely in the air to get embedded into plaster of counter flask (Figure 7).

Counter Flasking and Dewaxing: The second pour was done in such a way that free ends of the wire were embedded into the plaster of the counter flask.

Figure 1. Preoperative with Old Prosthesis

Figure 2. Primary Impression Procedure

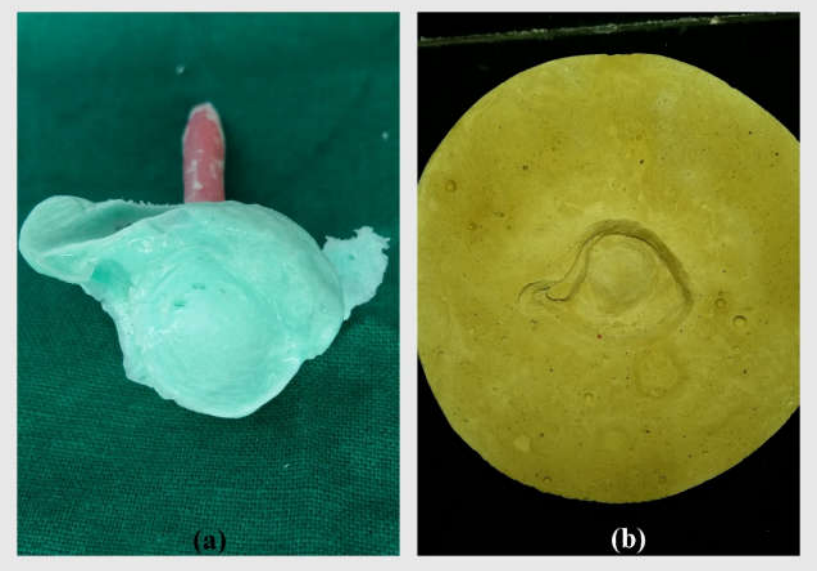

Figure 3. Primary Impression & Primary Cast

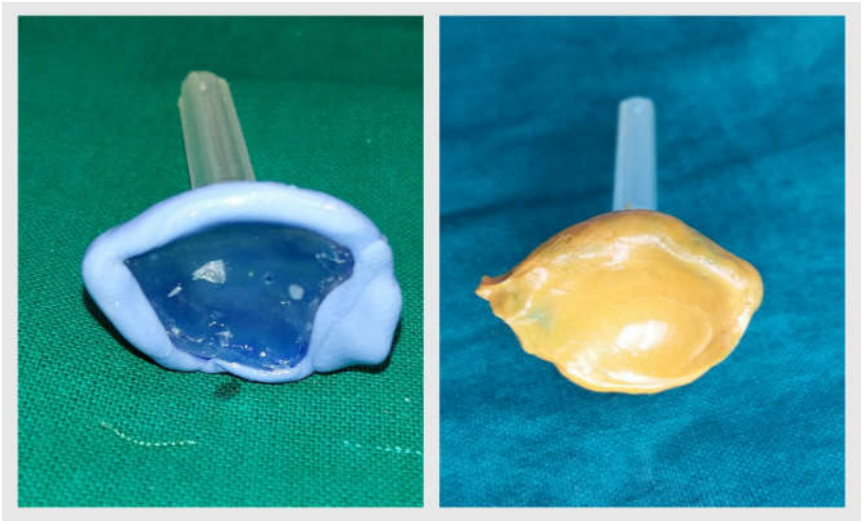

Figure 4. Border Moulding & Final Impression

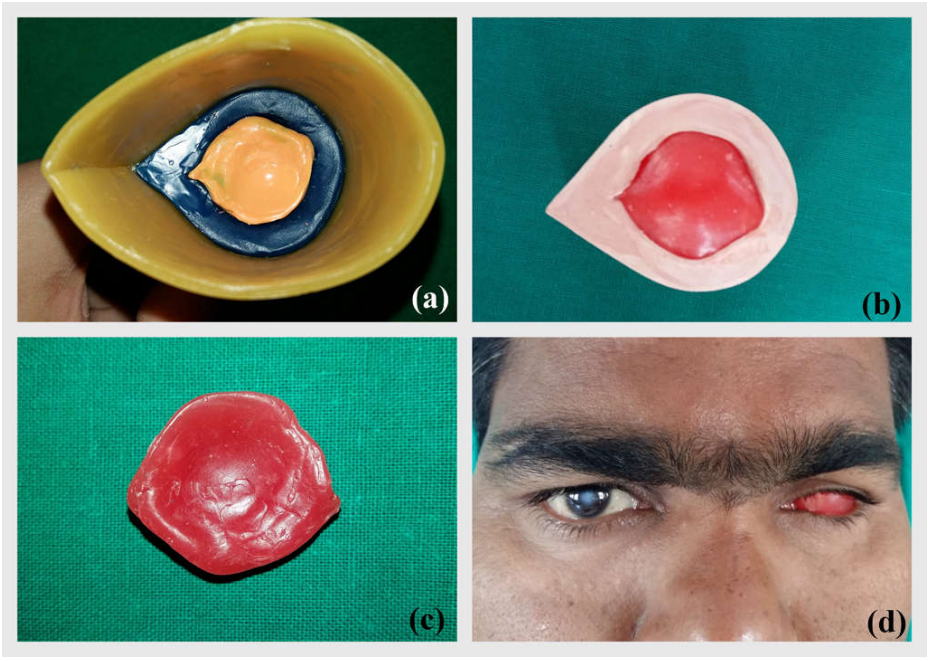

Figure 5. Beading Boxing, Master Cast and Wax Shell Trying

Figure 6. Eye Shell Try In

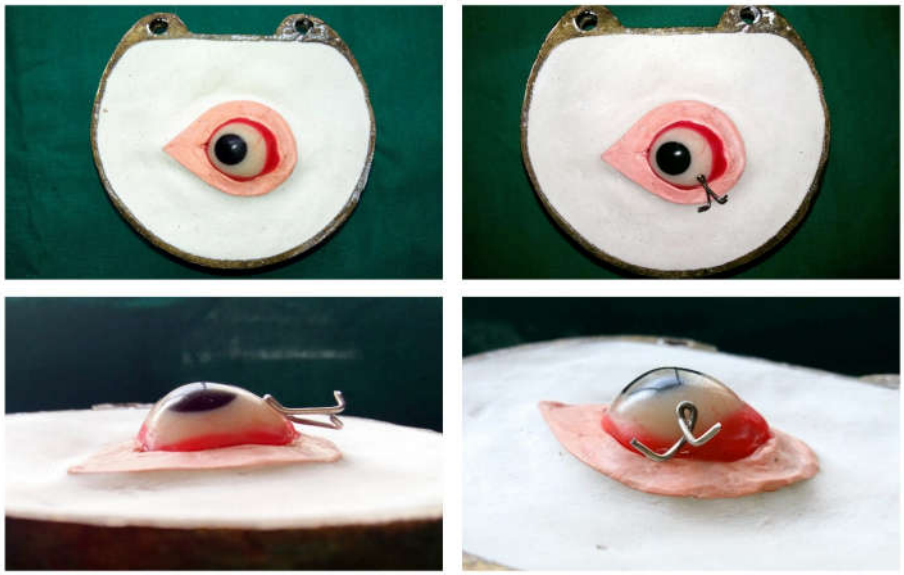

Figure 7. Flasking and Securing Eye Shell with Orthodontic Wire

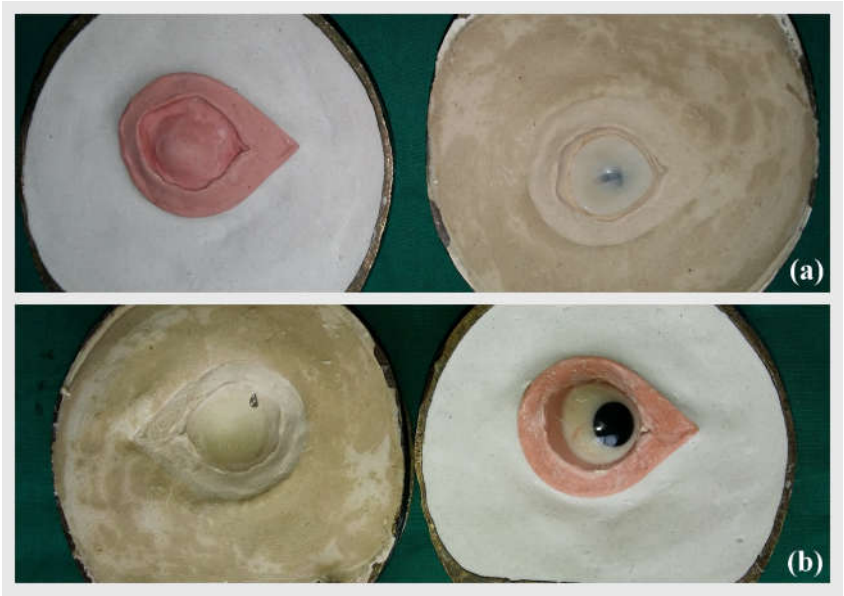

Figure 8. Dewaxing & Processing

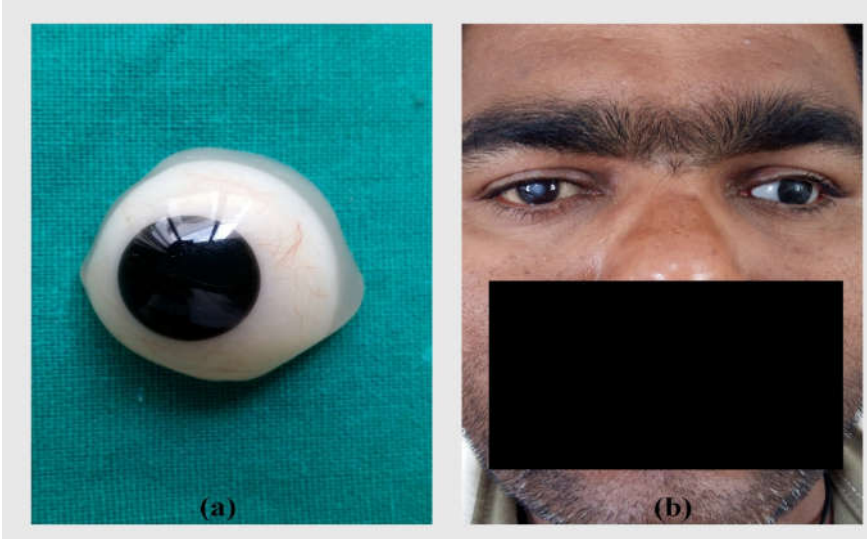

Figure 9. Final Prosthesis & Insertion

Figure 10. Pre & Post-Treatment

Dewaxing was done after the final set, taking care so that there was complete elimination of wax from the mold space (Figure 8a).

Packing and curing: Clear heat polymerizing polymethylmethacrylate (PMM) was used for processing. The heat polymerizing PMM (DPI- Bombay Burmah Trading Corporation Ltd. Mumbai) was mixed and packed in mold area. Processing was done by heating flasks in water bath at 74^{O} C for 2 hours and 100^{O} C for 1 hour as it results in complete polymerization of heat polymerizing material and very less amount of residual monomer (Figure 8b).The acrylized prosthesis was then retrieved from the flask and trimmed to remove the wire and all irregular and sharp surfaces. It was finished and polished (Figure 9a). Prior to the insertion of the polished prosthesis, it was disinfected in a solution of 0.5% chlorhexidine for 5 min **(**Siddhesh Kumar, 2010**).** After disinfection the prosthesis was rinsed in sterile saline solution to avoid chemical irritation. At the time of insertion, aesthetics, fit and the movement of the prosthesis were assessed. Insertion of ocular prosthesis was done (Figure 9b and Figure 10) and post insertion instructions given to the patient as follows

Maintenance of Ocular prosthesis (*Marian Pauly, 2004*):

- The shells can be worn continuously. Clean the prosthesis daily without removing from the socket, while removing it only occasionally for cleaning and disinfecting.
- Wash hands before handling the prosthesis.
- Store the prosthesis in a sterile saline if it is removed for a period of time
- The prosthesis should be professionally cleaned and polished every six months.
- Eye lubricants can be used to increase the lid movements and closure.
- Protective glasses help to decrease dust and irritation within the socket.
- Proper care of prosthesis will increase the comfort, appearance, and longevity of prosthetic eye.

DISCUSSION

An ocular prosthesis is a simulation of anatomy of human eye using prosthetic materials. The basic role of an ocular prosthesis is to keep up the volume of eye socket, create an illusion of a perfectly normal healthy eye and surrounding tissue and facilitate excellent eye movements. It upgrades the appearance as well as the self-esteem and confidence of the patient (Ponnanna, 2012**).** Early management of an ophthalmic socket averts loss of volume in the anterior orbital area and facial asymmetry. A fundamental objective while re-establishing an ophthalmic socket with an ocular prosthesis is to empower the patient to adapt better to the troublesome procedure of rehabilitation (Ow, 1997). A well-made and legitimately arranged ocular prosthesis maintains its orientation when patient performs various movements. There are two options available for counterfeit eye prosthesis, one is a pre-fabricated ocular prosthesis and the other is custom-made. Pre-fabricated prosthesis conveys potential disservices of poor fit, poor esthetics and poor eye movements (Cain, 1982). According to Beumer et al. intimate contact between the ocular prosthesis and the tissue bed is expected to disseminate even pressure, so a prefabricated prosthesis ought to be kept away from (Beumer, 1996).

Moreover, the voids in the prefabricated prosthesis collect mucus and debris, which can irritate mucosa and act as a potential wellspring of contamination, which are limited in custom-made prosthesis (Cain, 1982; Grisius, 1993) Custom-made prosthetic eye fabrication involves complex painting procedures in various stages that are quite difficult and based purely on painting abilities of the operator (Allen, 1969). The technique to fabricate ocular prosthesis in this case report, modifies a pre-fabricated eye prosthesis to a custom-made fit and esthetics. This helped us to overcome the disadvantages of both prefabricated and custom-made ocular prosthesis. The close adaptation of the custom-made ocular prosthesis to the tissue bed obtained by utilizing impression techniques provides maximum comfort and restores full physiologic function to the accessory organs of the eye.

Voids that collect mucus and debris and act as a potential source of infection may also be minimized (Murphy, 1944). Literature demonstrates past utilization of a plastic cylinder to secure the position of iris, but the strength of the plastic cylinder to withstand high compressive forces during flasking and packing and high temperature during dew axing and curing procedures was questionable. Therefore, a new strategy was utilized in the present case to secure the shell firmly in the flask during processing. It was extremely useful in light of its plan and the wire used, as it has its own strength. This technique would likewise be moderately simple to perform, alongside saving on laboratory time.

Conclusion

A short-sighted system for manufacturing the custom ocular prosthesis by using prefabricated eye shell has been recommended here. New technique used for securing the eye shell during processing ensures proper orientation of eye shell within prosthesis. The modified functional impression technique in this case allowed the artificial eye to move in unison with the patient's natural eye without being dislodged by movements. In spite of the fact that the patient can't see with this prosthesis, it has unquestionably re-established his confidence and enabled him to unhesitatingly confront the world.

Acknowledgement

My sincere thanks to Dept. of Prosthodontics & Crown and Bridge. I am also grateful to Krishna Institute of Medical Sciences University for the opportunities endowed upon me.

Conflicting Interest: Nil.

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