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CLINICAL REPORT

The Ocular Prosthesis: A Novel Technique Using Digital Photography

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Abstract Loss of an eye can cause a significant psychological and emotional disturbance to any patient. An ocular prosthesis helps to re-establish the physical and mental well-being of the patient. This article describes a novel technique along with a case report for fabricating a predictable, esthetic and well-fitting custom-made ocular prosthesis in an attempt to avoid costly and time consuming procedures that may be required in other methods.

Keywords Ocular defect · Artificial eye · Scleral blank · Digital photograph

Introduction

Eyes are generally the first features of the face to be noted [1]. Congenital defect, pathology or accidental trauma to eye may necessitate surgical intervention resulting in the removal of the eyeball [2].

The surgical management ranges from evisceration, enucleation to exenteration depending upon the case and its severity. Evisceration is the removal of the contents of the globe while leaving the sclera and extraocular muscles intact. Enucleation is the removal of the eye from the orbit while preserving all other orbital structures. Exenteration is the most radical of the three procedures and it involves removal of the eye and part of the bony orbit [3].

The disfigurement caused by the loss of an eye can cause significant physical and emotional disturbance. An ocular prosthesis which restores and replaces the natural eye aims to improve the patient's esthetics, restore and maintain the health of the remaining structures and consequently provide physical and mental well-being for the patient [4].

The purpose of this article is to describe a simple and innovative technique along with a case report for the fabrication of a custom-made ocular prosthesis in an attempt to avoid time consuming and expensive procedures that are required in other methods.

Clinical Report

A 44 year old male patient reported to the Department of Prosthodontics, Goa Dental College and Hospital, Bambolim for the prosthetic rehabilitation of his missing left eye. On eliciting history, it was noted that the patient was a construction worker who met with an accident while working. He was operated for the same 2 years back at Goa Medical College, Bambolim by surgical enucleation and was given a stock eye that was ill fitting, uncomfortable and unesthetic. The patient had no relevant medical history.

A thorough examination of the socket revealed a healthy intraocular tissue bed and adequate depth between the upper and lower eyelids with adequate potential to open and close the eyelids (Fig. 1). All the possible treatment options were considered, explained to the patient and a decision was made to fabricate a custom made ocular prosthesis that would appear as real as patient's other natural eye and at the same time provide a comfortable fit.

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Fig. 1 Patient with enucleated socket

Technique

Impression of the left enucleated socket was made with a perforated self-cure acrylic tray that was attached to the tip of a disposable plastic syringe (Unolok, HMD Healthcare Limited, India) using irreversible hydrocolloid impression material (Tropicalgin, Zhermack, Italy). During the impression procedure, the patient was asked to fix his gaze straight at a distant object to allow a good impression with the muscles in a neutral gaze position [5] (Fig. 2).

A two pour cast technique was followed for the master cast fabrication using Type III Dental stone (Kalstone, Kala Bhai Pvt Ltd., Mumbai, India) [6] (Fig. 3) after the beading and boxing of the impression. The master cast was lubricated with a separating medium and molten modelling wax (Deepti Dental Products, Ratnagiri, India) was poured into it to obtain a wax conformer (Fig. 4).

The wax conformer was smoothened and tried in the patient's enucleated socket for the satisfactory fit, contour and comfort (Fig. 5). The size of the iris of the contralateral natural eye was measured at this stage with a measuring ruler and it measured 12 mm.

A high quality digital photograph of the patient's contralateral natural eye was obtained using a DSLR camera (Nikon D5100 with the 18–55 kit lens) (Fig. 6). The image obtained was edited (by mirroring the image and extending the scleral part by use of a cloning tool) keeping iris size 11 mm in the image editing software. CorelDRAW (CorelDRAW Graphics Suite X5, Corel Corporation) and Adobe Photoshop CS4 (Adobe Systems Inc.) were used in

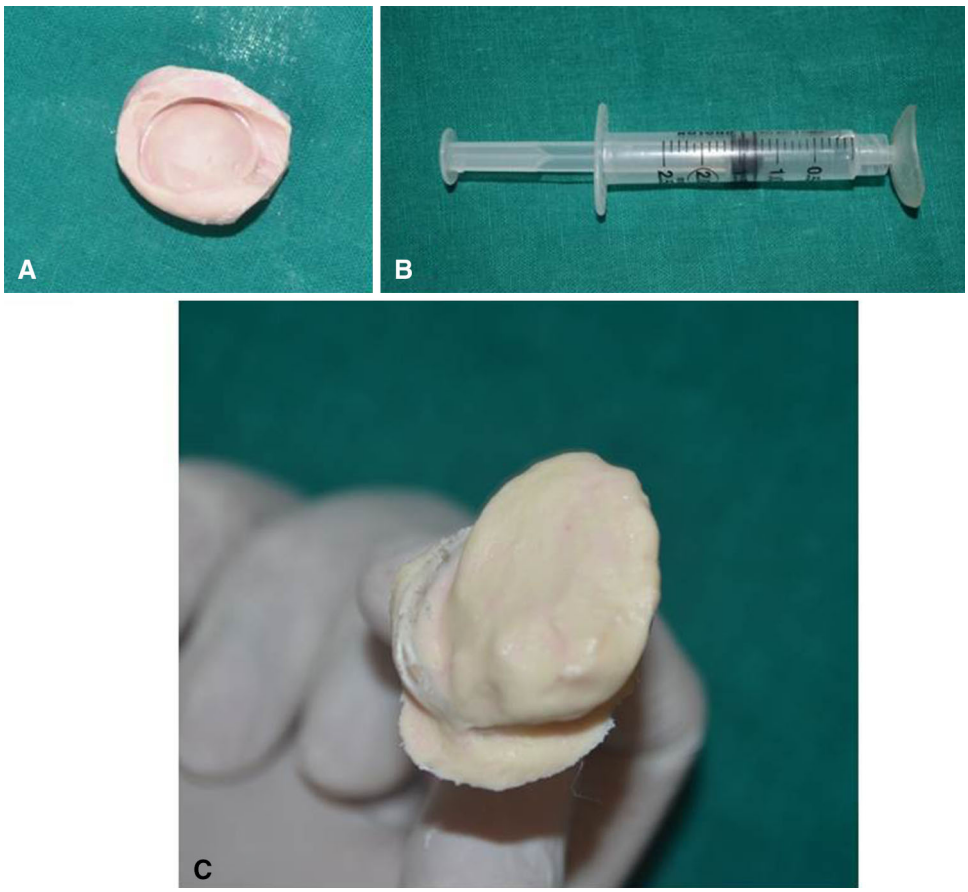

Fig. 2 **a** Alginate mold. **b** Disposable syringe attached to the custom tray. **c** Impression made of the enucleated socket

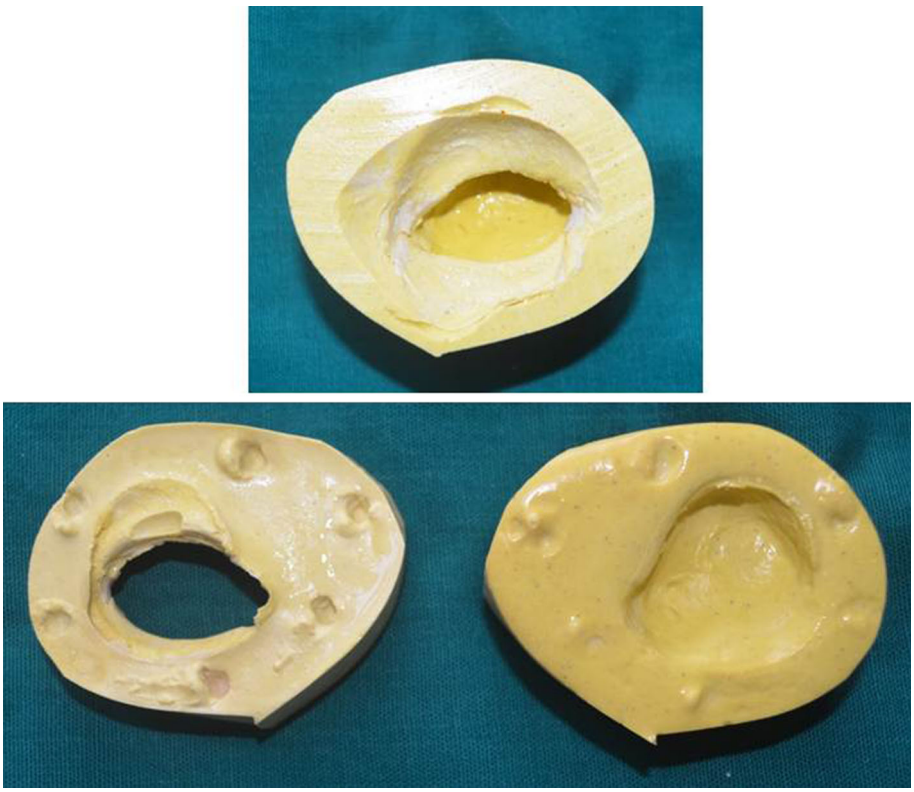

Fig. 3 Two pour cast fabricated from the impression after boxing

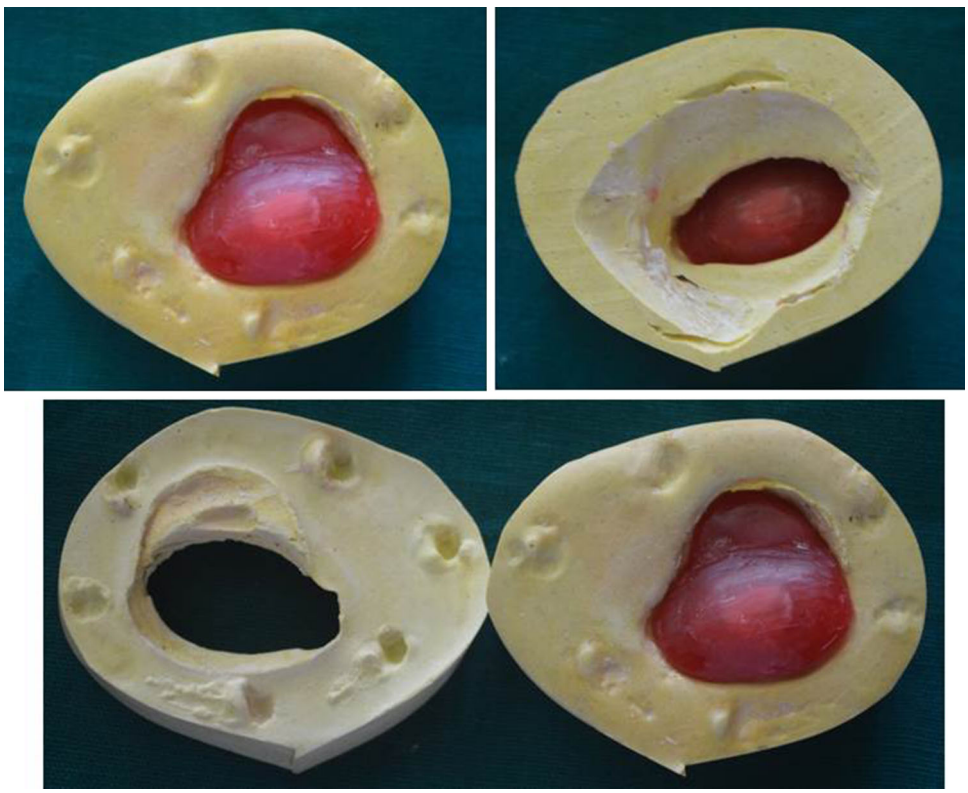

Fig. 4 Wax conformer fabricated by pouring molten modeling wax into the cast

this case. Different combination of brightness and contrast were used to produce a *variety of images* so as to match the patient's eye perfectly at the time of try-in (Fig. 7).

The modified image was printed on *self-adhesive glossy vinyl paper sticker* (Grafitek design and print solutions, Bangalore, India) using a color laser printer.

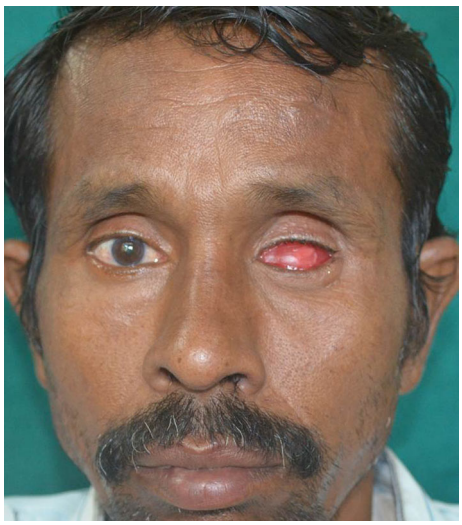

Fig. 5 Wax conformer tried in patient's enucleated socket for the fit, comfort and contour

Fig. 6 Image of the patient's natural contralateral eye obtained by a DSLR camera

Meanwhile, a scleral blank was produced using the mixture of clear heat cure acrylic resin (Dental products of India Ltd, New Delhi, India) and zinc oxide powder (Dental products of India Ltd, New Delhi, India) after investing and dewaxing the wax conformer (Fig. 8). After a satisfactory try-in of the scleral blank (Fig. 9), it was reduced by 1 mm on the frontal surface in the palpebral fissure area which would be later replaced by clear heat cure acrylic resin [7].

Using a graph grid, center of the pupil corresponding to that of the natural eye was transferred on to the scleral blank and a circle of the 11 mm diameter was drawn using the center to facilitate positioning of the sticker [8] (Fig. 10).

All the images printed on the paper sticker were matched against the natural eye of the patient and the one matching perfectly was selected. A piece of *cellphone screen guard* was pasted onto this sticker to preserve the print ink. The assembly was then cut in a more precise shape (corresponding to visible palpebral fissure area) (Fig. 11) and pasted on the scleral blank to confirm the position and appearance in the patient (Fig. 12).

Cyanoacrylate adhesive liquid was used to accurately adapt the sticker assembly over the contours of the scleral blank. The entire sticker was covered with 1 mm thickness of modeling wax. A small amount of wax was also extended beyond the periphery of sticker on the scleral blank so that the clear heat cure acrylic resin which would eventually replace the one mm thickness wax on the frontal surface would hold the scleral blank and the sticker assembly firmly together.

Investing was done in a conventional manner. After 1 hour, the flask was opened and all the wax was removed with a carver taking care not to disrupt the sticker from its position. Packing and curing with clear heat cure acrylic resin (Dental products of India Ltd, New Delhi, India) was carried out in the conventional manner. Finishing and polishing of the ocular prosthesis were carried out taking care of the convexity and contour. The ocular prosthesis was delivered after educating the patient about the care and maintenance of the prosthesis (Fig. 13).

Discussion

The ocular prosthesis is an artificial replacement for the bulb of the eye. After the surgeon enucleates the eye, the maxillofacial prosthodontist provides the patient with an artificial eye to overcome the agony of losing the eye and helps him psychologically and socially [9]. The general consensus among authors is that close matching with the natural eye is the key to mask the loss and achieve an esthetic outcome for patients with an ocular defect [10].

Various techniques have been described in literature for the fabrication of ocular prosthesis. Most of them aim to facilitate the process of making an impression of the enucleated socket [5, 11–16]. Authors have also suggested modifying existing stock or custom ocular prosthesis by use of a relining material to gain acceptable fit [17–21]. Benson has suggested a classic technique which is a

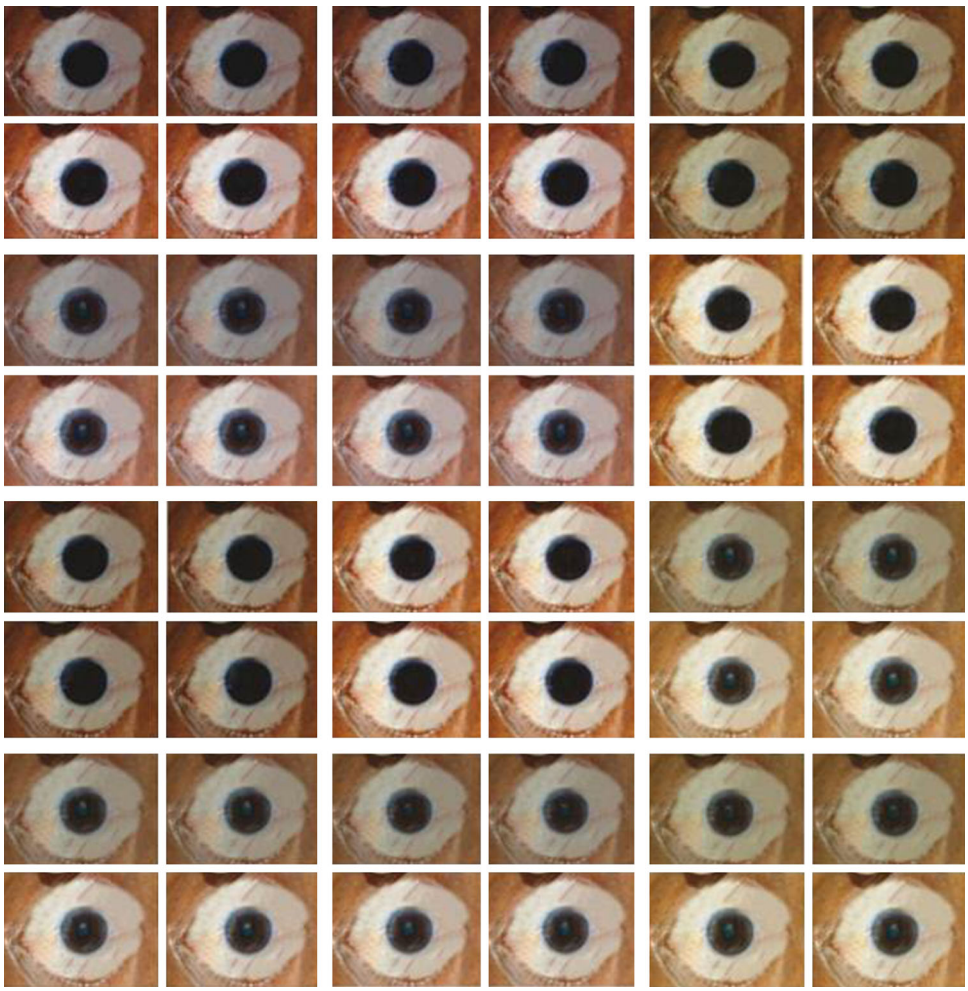

Fig. 7 Self-adhesive glossy paper sticker with modified images printed on it

Fig. 8 Wax pattern invested and processed with the mixture of clear heat cure acrylic resin and zinc oxide powder

starting point in several techniques wherein a wax scleral blank is created and after the addition of an iris button to it, the pattern is invested and processed [7]. All of these techniques use either a stock eye or manual coloring technique to match the patient's natural contralateral iris, sclera or both which requires artistic skills and experience.

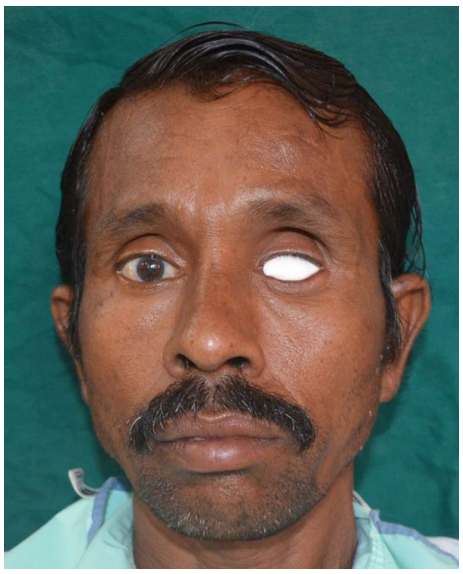

Fig. 9 Scleral blank tried in patient and adjusted

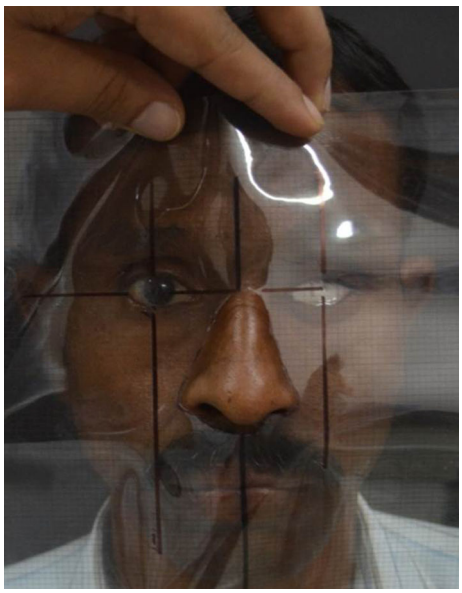

Fig. 10 Center of the iris transferred onto the scleral blank using a graph grid

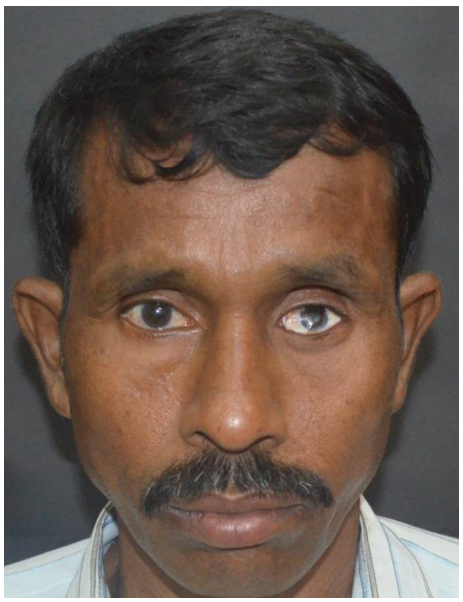

Fig. 12 Sticker assembly pasted on the scleral blank and tried in patient for the adjustments needed (if any)

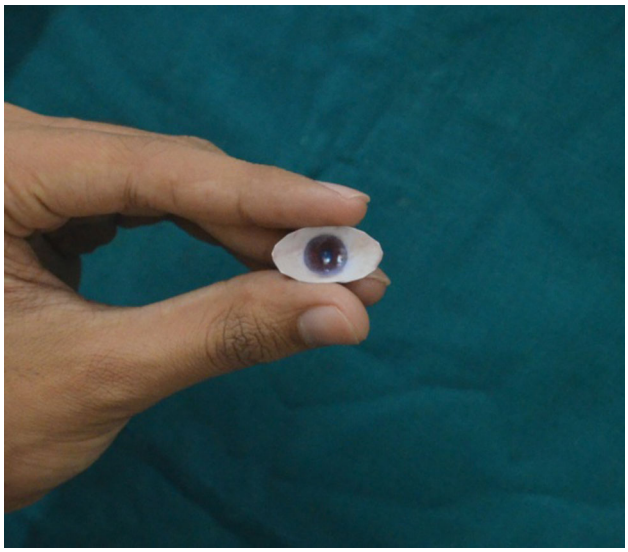

Fig. 11 Sticker assembly cut in a precise shape (of visible palpebral fissure area)

Fig. 13 Custom made ocular prosthesis using digital photography in situ at the time of delivery. Written consent obtained from the patient for publishing the photographs in compliance with the publication policy

Recent literature also mentions technique to fabricate custom ocular prosthesis using digital photography to replicate the iris [22, 23]. Kale et al. [24] have suggested a technique of fabricating both, the sclera as well as the iris with digital photography and vacuum pressing of a clear co-polyester sheet onto the photo paper. The technique is complicated and time consuming to be practiced although it replicates the patient's natural eye very well.

The technique described above is relatively simple, cost effective and easy to master. Furthermore, it saves chair side time since it uses a *customized, self-adhesive sticker having multiple images* with varying brightness and contrast. Moreover, it allows the clinician to have a *predictable outcome* due to the exact replication of patient's contralateral natural eye including both iris and sclera without any hassles of manual coloring [22–25]. Unlike the technique described by Kale et al., this technique also allows

trial of the final pattern and the changes (if any) before it is processed. However, the presented technique needs the clinician to have a basic knowledge of the appropriate image editing software for image manipulation which according to the authors can be acquired quickly and with ease.

Conclusion

Numerous impression materials and techniques for fabricating ocular prosthesis have been described in the literature. The selection and application of the technique entirely depends upon the case, operator's experience, and the availability of materials and the equipment. A *simple, time saving,* novel technique of custom ocular prosthesis fabrication using digital photography has been described here which aids the clinician in achieving a *predictable* and an *esthetic* end result.

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