Custom ocular prosthesis with modification in impression and iris button for rehabilitation of post-enucleation eye defect: a case report

[1]Kriswandy Putra, [2]Putri Welda Utami Ritonga, [3]Haslinda Z. Tamin
[1]Postgraduate Program in Prosthodontics
[2]Departement Prosthodontics,
Faculty of Dentistry, Universitas Sumatera Utara
Medan, Indonesia
Corresponding author: **Kriswandy Putra**, e-mail: **drg.kriswandy@yahoo.com**

ABSTRACT
Loss of eye have physiologic and social impact on patients, especially in pediatric patients. To overcome this problem ocular prosthesis can be made similar with the color, shape, size and movement of the patient's eye, so the ocular prosthesis can look like natural eye. The various methods, techniques and concepts documented in this case report with modifications to the physiologic impression and making of iris buttons aim to get the better movement of the prosthesis and 3D profile of the iris. A 6-years-old female patient came to the USU Dental Hospital to fabricate a new eye prosthesis. The patient had a medical history of retinoblastoma at the age of 2 years and had enucleation surgery. The eye is rehabilitated with fabrication of a custom ocular prosthesis with modifications on physiologic impression and iris button making. Modifications to physiologic impression and modifications to the fabrication of iris buttons will provide movement, shape and 3D effects of iris that are better than stock eye prosthesis. It is concluded that custom ocular prosthesis with modification on physiologic impression provide a better and more natural movement. While modification on making iris button using customized iris button cuvette will facilitate the process of making iris button.
Keywords: custom ocular prosthesis, physiologic impression, iris button

This title has been presented in The 12th Biennial Congress of Asian Academy of Prosthodontics, 21 August 2021

INTRODUCTION

Eyes are one of the important organs in the human body. Other than its primary function on vision, a complete eye contributes to aesthetic face and facial expression. Loss of eye will impact patient physiologic and social life, especially in pediatric patients.

Eye loss can be caused by congenital anomalies, trauma, or tumors.[1] There are 3 types of surgery on eye ball consisting of evisceration is the removal of the contents of the eyeball by leaving the sclera, Tenon's capsule, conjunctiva, extraocular muscles, while the cornea is sometimes maintained with the condition of the nerve fibers intact; enucleation is a surgical process in which the entire eyeball is removed after severing the muscles and the optic nerve, while exenteration is the removal of the contents of the orbit, including the eyelids and surrounding tissue.[1-3]

In the case of eye defects, the rehabilitations can be divided into 2 types, orbital implants and ocular prostheses.[4] Ocular prostheses can be divided into 2 types, stock eyes and custom ocular prosthesis.[5] Stock eye is a popular rehabilitation method in the past and are still used up to now,[6] because the minimal manufacturing time until it does not require any manufacturing steps in the laboraratory and consists of various types of iris sizes and colors. The disadvantages are discomfort and infection due to the difference in size between the eye socket and the stock eye, causing water pockets to become a breeding ground for bacteria, unmatched iris color also causes aesthetic problems in stock eyes. Stock eyes have a thin shape and are made of acrylic material, indicated for the rehabilitation of post-evisceration eye defects.[6]

Custom ocular prosthesis can be indicated to rehabilitate eye socket after evisceration and enucleation, whereas custom ocular prosthesis is contraindicated in patients who are allergic to acrylic materials and in eye sockets that lack retention. Custom ocular prosthesis has various advantages such as the color of the ocular prosthesis iris and sclera can be adjusted to the color of the eye that is still present. The prosthesis can be adjusted to the condition of the patient's eye socket and the movement of the custom prosthesis will be better than the stock eyes. Meanwhile, the disadvantage of a custom ocular prosthesis is that it takes a long time for the manufacturing process in the laboratory.[6]

The manufacture of custom ocular prosthesis has evolved in manufacturing techniques and materials from time to time. Ocular prosthesis can use materials made of glass or poly methyl methacrylate (PMMA) acrylic resin. At this time glass material is not an option for making eye prostheses because these materials break easily and their surface changes due to contact with orbital fluid and can only survive 18-24 months.[4] Based on previous experience the use of glass material also cannot cor-

DOI: 10.46934/ijp.v3i2.144

rect the loss of orbital volume or the atrophic condition that occurs, has a rather sharp edge and is less comfortable to use.[6] The first custom made ocular prosthesis made of acrylic material was made in 1943 by the dentists of the United States Army. This material has advantages such as not easy to break and easy to produce. Although the intaglio surface of this prosthesis fits into the eye socket, not the entire surface of the prosthesis is polished, so it can cause irritation to the socket if it is loose.[4]

This paper is aimed to explain the process of making a custom ocular prosthesis with modifications in physiologic impression and the manufacture of the iris button.

CASE

A 6-years-old female patient, came to the Universitas Sumatera Utara Dental Hospital with a chief complaint of loose and deformed old artificial eye that she wanted to make a new and better artificial eye. The patient had a medical history of retinoblastoma at the age of 2 years and had undergone enucleation surgery at that time. The patient has also worn stock eyes after 2 months post-surgery to date (Fig.1A,B,C).

On clinical examination of the intraocular tissue (Fig.1D), the eye sockets were in good condition and the depth of the eye sockets was shallow in the inferior palpebral area but quite deep in the superior palpebral area.

MANAGEMENT

Anatomical impressions were performed using an impression tray made of visible light cure (VLC) which was connected to the syringe (Fig.2A) by first testing the tray into the eye socket to see excessive

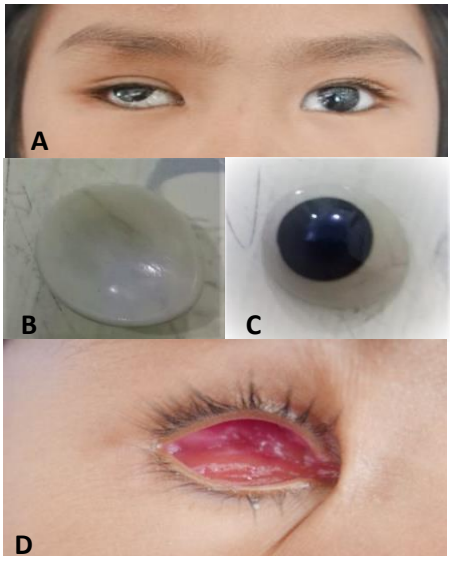

Figure 1A The patient uses old stock eyes, **B** old stock eyes intaglio surface, **C** old stock eyes facial surface, **D** intra-ocular examination of the right eye.

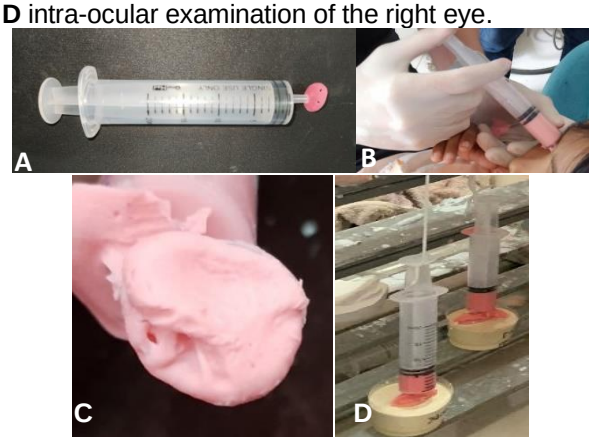

Figure 2A VLC impression tray connected to a disposable syringe, **B** anatomical impression with irreversible hydrocolloid impression material, **C** intaglio surface of anatomical Impression, **D** anatomical impression

Figure 3A Anatomical wax pattern making, **B** try in anatomical sclera wax pattern into the patient's eye socket

expansion. Anatomical impressions of eye sockets were performed using irreversible hydrocolloid (alginate) material with normal setting time. First, stir the alginate in a rubber bowl with the ratio of powder and water according to the manufacturer's directions, after stirring insert the alginate into a syringe with a VLC impression tray attached to the syringe. Then the tray is placed into the socket and the alginate is injected into the eye socket. The position of the patient sitting in an upright position, the patient was instructed to move the eyeball to the right, left, up and down without moving the head to record the proper depth and width of the socket (Fig.2B). After the material hardens, the tray is removed and the remaining print material is cleaned from the socket.

The anatomical imprinted intaglio surface (Fig. 2C) was implanted in a small plastic cup containing half of the dental stone to anterior posterior border of the impression and allowed to harden (Fig.2D).

Making anatomical slera wax patterns; first the surface of the mold is coated with petroleum jelly then liquid wax is poured into the mold, let the wax harden after that the wax pattern is adjusted to the shape of the patient's natural eye convexity with the highest part of the convexity located in the pupillary area. Trial the anatomical sclera wax pattern on the patient's eye socket until the eyeball shape is most suitable for the natural eye. After everything

DOI: 10.46934/ijp.v3i2.144

is matched, surface of the wax pattern is smoothed (Fig.3A). After that, try in the patient's eye socket to see if it matches the real eye (Fig.3B).

Making physiologic impression tray mold using polyvinyl siloxane (putty and light body). First, the anatomical sclera wax pattern was implanted from the intaglio to the periphery on the base of the cuvette using putty material and then allow it to harden, then apply vaseline to the putty surface to prevent the putty and the antagonist light body merging. Cover the surface of the cuvette with plastic separator then place the antagonist cuvette. The antagonist cuvette is then filled with putty material then closed and pressed, after the putty material hardens open the cuvette, remove the plastic separator and inject the light body on the antagonist surface then the cuvette is closed and pressed again to get details of the wax pattern. After the printed material hardens, open the cuvette and remove the wax pattern (Fig.4A).

After obtaining a mold from putty material, it will be continued with the manufacture of physiologic impression tray using a self-polymerized acrylic resin with a ratio of powder and liquid according to the manufacturer's instructions, the acrylic is stirred in a rubber bowl and allowed to reach the dough stage then the acrylic is inserted into the mold and pressed on cuvette to remove excess acrylic. After the acrylic material hardens, open the cuvette and trim the physiologic tray (Fig.4B).

Physiologic impression was carried out using polyvinyl siloxane (light body) material. First, adhesive tray material was applied to the intaglio and peripheral surfaces of the physiologic impression tray, then the light body impression material was injected into the eye socket using a mixing tip and a dispensing gun. Insert the physiologic tray into the eye socket then the patient was instructed to

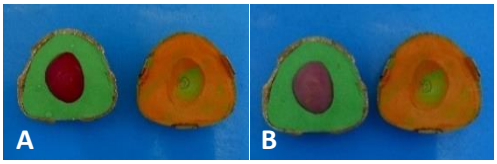

Figure 4A Immersion of anatomical sclera wax pattern in cuvette, **B** physiologic tray from self-polymerized acrylic

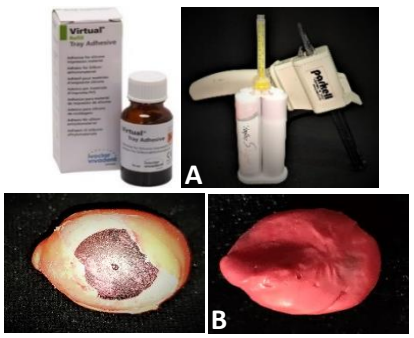

Figure 5A Tray adhesive material, PVS light body and, **B** the result of physiologic impression.

close his eyes and move his eyes up, down, left and right, this aims to record all movements that may occur when the prosthesis is used. After the impression material hardens remove the physiologic tray from the socket. Smooth out the impression result by removing excess material (Fig.5).

In making mold for physiologic sclera, embedded physiologic impression tray intaglio surface into the base of cuvette using a type IV dental stone; where the embedded portion of the tray is the intaglio portion of the impression tray. After the dental stone has hardened, apply vaseline to the entire surface of the dental stone and physiologic tray then unite the antagonist cuvette and fill it with the type IV dental stone, then close the cuvette and the dental stone will harden. After hardening, open the cuvette and remove the physiologic impression tray to obtain a mold from the physiologic sclera (Fig.6A).

Physiologic sclera is made by using wax with pouring liquid wax into the mold. First heat the wax until it melts then pour the molten wax on the facial mold and let it harden. After hardening, proceed with pouring the molten wax on the intaglio mold where after the molten wax is poured, immediately close the cuvette and press the cuvette until the wax hardens. Open the cuvette and remove the physiologic sclera wax pattern and trim away excess wax.

Try in physiologic sclera wax, determine the location, size and color of the iris. Try-in physiologic sclera wax pattern is performed on the patient's eye socket to see if the sclera convexity is in similar with contralateral eye, then check the movement of the physiologic sclera wax pattern (Fig.6B). Determination the location and size of the iris is using the interpupillary distance (IPD) ruler (Fig.6C).

Determine the size of the iris, in this patient the iris size is 11 mm, so an iris disc made of plastic material with a diameter of 10.5 mm was used to compensate for the enlargement effect due to the convexity of the sclera and iris button. Then the pupil disc was placed with previously determined

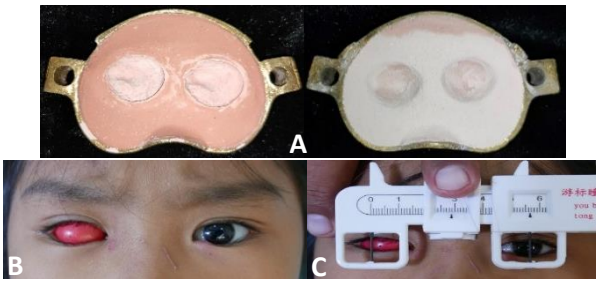

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Figure 7A Iris and pupil disc that have been fused, **B** making iris pattern with light cure resin composite, **C** the coloring process and the finished iris.

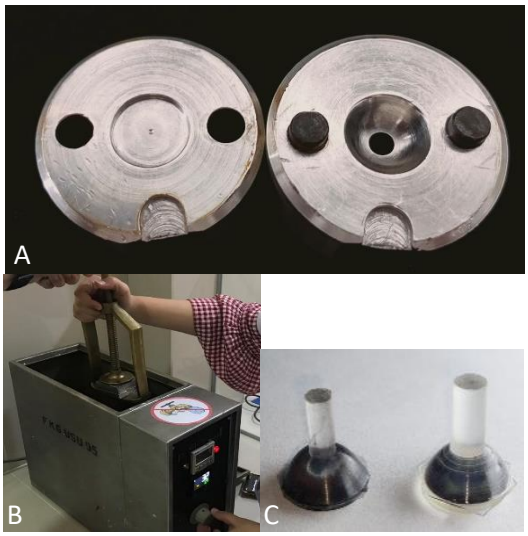

Figure 8A Customized iris button cuvette, **B** waterbath, **C** finished iris button

midpoint in the iris disc (Fig.7A). Making iris pattern is done by using light cure resin composite to get a better 3-D effect. After the iris pattern is finished, it is followed by coloring the iris using acrylic paint with the color that matched with patient contralateral eye. Where in this case acrylic paint is used with a mixture of burnt umber and black colors in a ratio (1:1/2) (Fig.7B); when finished, the paint is allowed to dry for 24 hours (Fig.7C).

After the paint is dry, it was continued with making the iris button using a customized iris button mold cuvette (Fig.8A). Iris buttons will be made using heat cured acrylic resin with clear color and processed using a water bath (Fig.8B). After the boiling process is completed, the iris button was ready (Fig.8C).

Insertion of the iris button on the physiologic sclera. After the iris button has been produced, it will be continued by making a hole for the iris button in the physiologic sclera wax pattern. Where the position and diameter of the hole has been determined at the time of try-in physiologic sclera wax pattern. After the hole is made, the iris button can be incorporated into a physiologic sclera wax pattern. After the iris button is installed, the sclera wax

Figure 6A Physiologic sclera mold, **B** try in physiologic sclera wax pattern, **C** using the IPD ruler to determine the location and size of the iris

pattern will be tried in again to the patient to see if the iris button position is correct or if it needs to be readjusted.

Definitive sclera preparation was performed by immersing the physiologic sclera wax pattern into a cuvette with the iris button attached to the sclera wax pattern. Immersion in the cuvette was carried out using type IV dental stone. After hardening the cuvette was opened and dewaxed the cuvette. The cuvette is allowed to dry and then apply cold mold seal (CMS) on both surfaces of the dental stone except for the iris button do not apply CMS. Stir the heat cured PMMA with the ratio of powder and liquid according to the manufacturer's recommendations and the pre-determined color. Mixing is done using a rubber bowl; after that, allow the acrylic to reach the dough stage, then put the resin into the cuvette and press to remove excess acrylic resin. Boiling is done using a water bath at 80^{o}C and a time of 1 hour 30 minutes. After the boiling process is complete, let the cuvette cool then open the cuvette and remove the eye prosthesis, grind the prosthesis from the remaining acrylic and polish the facial to the peripheral edges.

Definitive sclera try-in to see if the convexity is appropriate and make adjustments until the sclera is similar to the original eye. If there is an adjustment to the sclera convexity, the antagonist cuvette must be replanted to correct the changes that have been made. Reduction of the facial surface to the periphery of about 1.5-2 mm to obtain space for the clear acrylic resin (Fig.9).

Coating of clear acrylic on the facial surface. Place the reduced facial sclera back into the cuvette, then stir in the heat cured PMMA with powder-to-liquid ratio as recommended by the manufacturer. Mixing is done using a rubber bowl, after stirring, allow the acrylic to reach the dough stage, then put the resin into the cuvette and press to remove excess acrylic resin.

Boiling was carried out using a water bath at a temperature of 80^{o}C and a time of 1 hour 30 minutes. After the boiling process is complete, let the cuvette cool then open the cuvette and remove the eye prosthesis, grind the prosthesis from the remaining acrylic and polish the facial to the peripheral edges (Fig.10A).

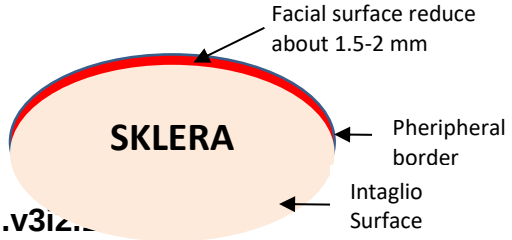

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Figure 9 Overview of reduced facial portion of the sclera

Figure 10A Completed eye prostheses, **B** patient wearing right ocular prosthesis

The finished prosthesis is inserted with attention to esthetic appearance, comfort and function (Fig.10B). The patient is given instructions on how to put on and remove the prosthesis, as well as how to treat it at home. The prosthesis should be inserted with clean hands, removed at wax and immersed in an antibacterial solution. Controls were carried out on days 1, 3, 7 post-inserting.

DISCUSSION

Eye loss can be caused by congenital anomalies, trauma, or tumors. There are 3 types of surgery on eye ball consisting of evisceration, enucleation and exenteration.[1,4] Ocular prostheses aims to restore the patient's facial appearance to look normal, so it can give patient more self confidence in social life.

Ocular prostheses are recommended to be made 6-8 weeks after evisceration or enucleation and after healing of the socket.[4] Ocular prostheses are divided into stock eye prostheses, custom ocular prostheses and ocular implants.[1] Stock eye prostheses come in standard size, contour, shape and colour.

Custom ocular prosthesis can produce movement, orientation, color, iris and sclera contour, pupil and iris size, a more real and symmetrical appearance on the patient's face.[7]

By making a custom ocular prosthesis with modifications to physiologic impression using anatomical sclera made of PMMA acrylic material as an impression tray, with light body Impression materials and Impression techniques with eyes closed and eye socket muscle activation, it is hoped that it will give better results in custom movements.

Meanwhile, modifications to the iris button making by sculpting the iris pattern are expected to give iris a more lively and real impression on the iris from the custom ocular prosthesis produced.

The use of the customized iris button mold itself can simplify the process of making the iris button that will be used.

Process of making a custom ocular prosthesis is very sensitive technique but can produce a better ocular prosthesis compared to the use of stock eyes. With the advantages obtained in this custom ocular prosthesis, it is hoped that it can improve the quality of life of these patients, especially in terms of psychological and social aspects of the patient.

However, this custom ocular prosthesis also requires treatment if it has been used for a long time. the surface becomes rough which can lead to accumulation of debris. Efforts to overcome this can be done by cleaning the ocular prosthesis regularly and if scratches and deposits form, polishing is done again. This is done every 6 months at a time to evaluate and readjust the patient's ophthalmic prosthesis.

It is concluded that custom ocular prosthesis fabrication with modifications to physiologic impressions and iris button fabrication can be an option to rehabilitate post-enucleated eye defects. This physiologic impression modification can record the details of the eye socket intaglio so that the eye prosthesis can have better and natural movement.

While modifications to the iris button manufacturing technique are expected to provide a better 3-D effect on the resulting iris, and using a customized iris button cuvette can simplify the process of making iris buttons so that maximum results are obtained. This method produces a more natural ocular prostheses compared to stock eye and patient feels more satisfied, improving the patient's confidence.

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