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Rehabilitation of an Enucleated Eye Socket Using a Custom-Made Ocular Prosthesis Combining Conventional Impression Technique and Digital Zirconia Milling: A Case Report

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Abstract
Background: *Loss of an eye due to trauma, infection, or neoplastic disease produces a disfiguring facial defect with significant psychological and social consequences for the patient. Prosthetic rehabilitation with a custom-made ocular prosthesis restores facial symmetry, aesthetics, and patient confidence more predictably than a stock prosthesis.*
Case Presentation: *A 54-year-old female presented with an enucleated right eye socket following post-traumatic infection, one year after a road-traffic accident that had originally preserved useful vision for approximately eight years. Clinical examination revealed a healed, mobile socket with adequate fornix depth suitable for prosthetic rehabilitation. A custom ocular prosthesis was fabricated using a hybrid workflow: conventional impression procedures (irreversible hydrocolloid primary impression and light-body addition silicone final impression), a wax try-in and acrylic conformer stage, followed by digital scanning of the conformer and computer-aided milling of a definitive zirconia prosthesis. Iris positioning was verified using an electronic vernier caliper referenced to the contralateral eye, and the sclera was extrinsically characterized to match natural coloration.*
Conclusion: *Combining a conventional impression-based clinical workflow with digital scanning and zirconia milling produced a well-adapted, esthetically acceptable ocular prosthesis and improved the patient's facial appearance and confidence, illustrating a practical hybrid analog-digital pathway for ocular rehabilitation.*
Keywords: *ocular prosthesis; custom eye prosthesis; enucleation; digital workflow; zirconia; iris positioning; case report*

I. Introduction

The loss of an eye impairs visual function and produces a conspicuous facial deformity that affects a patient's psychological well-being, self-esteem, and social participation. Orbital causes leading to loss of the globe include congenital anophthalmia or microphthalmia, ocular tumors, and acquired traumatic or infective lesions.1 Depending on the extent of tissue loss, surgical management may take the form of evisceration (removal of the intraocular contents with the scleral shell left intact), enucleation (removal of the entire globe), or exenteration (removal of the entire orbital contents, including the globe and periocular soft tissue).1

Prosthetic rehabilitation of the resulting defect is considerably enhanced when an orbital implant has been placed at the time of the primary surgery, although this is not always feasible.2 Depending on the surgical technique and the residual anatomy, an ocular or orbital defect may be rehabilitated with a stock (ready-made) eye prosthesis, a custom-fabricated prosthesis, or, in select situations, a prosthesis retained by osseointegrated micro-implants.2,3

Stock acrylic resin eyes were originally developed to meet the high clinical demand for rapid rehabilitation; fitting is quick, but the fixed range of sizes, shapes, and iris positions frequently produces an unsatisfactory cosmetic and functional result.3,4 A custom prosthesis, in contrast, allows both the scleral shape and the iris–pupil complex to be individualized to the fellow eye, producing a more natural and lifelike appearance

and a more even distribution of pressure within the socket.4,5 For these reasons, a customized acrylic or ceramic ocular prosthesis remains the most esthetically satisfactory rehabilitative option currently available.3

Advances in intraoral and facial scanning, together with the increasing availability of subtractive computer-aided design/computer-aided manufacturing (CAD/CAM) milling, have created an opportunity to combine conventional clinical impression techniques with digital fabrication of the definitive prosthesis, including the use of milled zirconia as a scleral substrate. This case report describes the rehabilitation of an enucleated right eye in a 54-year-old female using a custom-made ocular prosthesis fabricated through a combination of conventional impression procedures and a digital workflow involving scanning and milling of zirconia, with iris positioning verified using an electronic vernier caliper.

II. Case Report

2.1 Patient Information

A 54-year-old female patient presented to the Department of Prosthodontics, SMBT Dental College and Hospital, Maharashtra, India, with the chief complaint of poor facial appearance due to the absence of her right eye.

On eliciting the case history, the patient reported a road-traffic accident with trauma to the right eye. Clear vision was maintained for approximately eight years following the trauma, after which she noted a progressive decline in vision and consulted an ophthalmologist. An infection developed in the right eye approximately one year prior to presentation, following which enucleation of the right eye was performed.

2.2 Clinical Examination

Extraoral and orbital examination revealed an enucleated right eye with a completely healed socket and no signs of inflammation (Figure 1). The palpebral fissure was assessed in the open and closed positions and found to be normal, and mobility of the posterior wall of the defect was preserved. The intraocular tissue bed appeared healthy, and adequate depth was present between the upper and lower fornices, providing favorable anatomical support and retention for an ocular prosthesis. On the basis of this examination, the patient was considered a suitable candidate for prosthetic rehabilitation with a custom ocular prosthesis rather than a stock prosthesis.

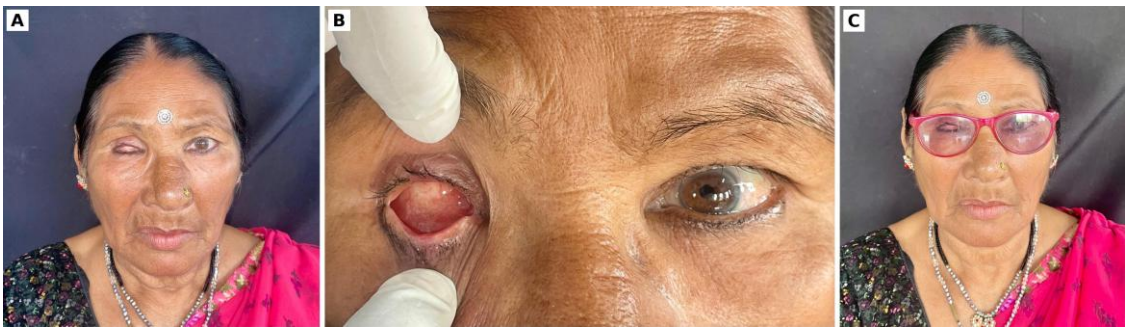

Figure 1. Pre-operative extraoral views of the enucleated right ocular defect: (A, C) frontal views; (B) close-up of the healed socket.

2.3 Treatment Procedure

Fabrication of the custom-made ocular prosthesis was carried out in the sequential stages described below.

2.3.1 Primary Impression

An external-tray impression technique was used to record the ocular defect.6 A primary impression of the right ocular socket was made using irreversible hydrocolloid impression material, which reproduced the general anatomy of the defect and permitted fabrication of a custom impression tray (Figure 2). The patient was seated upright and instructed to look straight ahead during impression-making, and to perform a range of eye movements so that the functional anatomy of the socket could be recorded. Two percent lignocaine topical gel was applied to the ocular tissue bed to minimize irritation during the procedure, and the primary impression was poured to obtain a primary cast on which the custom tray was subsequently fabricated.

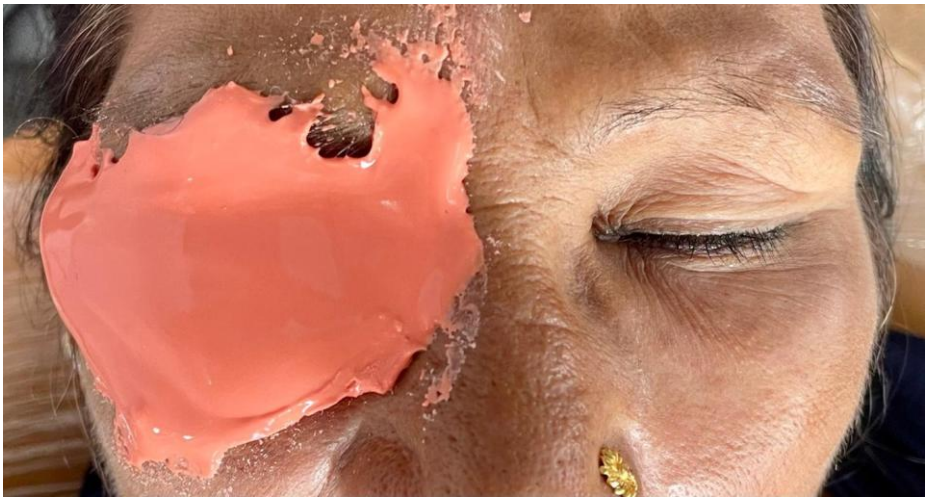

Figure 2. Primary impression of the ocular socket recorded using irreversible hydrocolloid impression material.

2.3.2 Custom Tray Fabrication and Final Impression

A custom tray was fabricated for the patient's ocular socket using cold-cure acrylic resin and was attached to a dispensing syringe to allow controlled delivery of the impression material (Figure 3). Five vent holes were placed at the periphery of the tray to permit escape of excess material, and a larger central hole served as the inlet for the impression material.

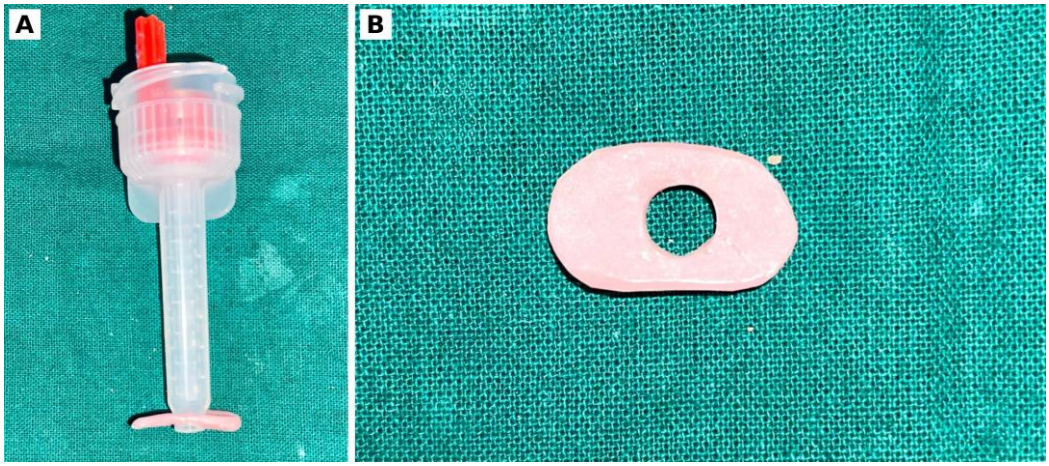

Figure 3. (A) Custom impression tray fabricated for the ocular socket; (B) tray attached to a dispensing syringe for controlled delivery of the final impression material.

A final impression of the ocular socket was recorded using a low-viscosity addition silicone material, which permitted detailed reproduction of the socket anatomy (Figure 4).7 As with the primary impression, the patient was asked to sit upright, look straight ahead, and perform a range of eye movements so that the functional limits of the socket could be captured. The final impression was poured to obtain the definitive cast (Figure 5).

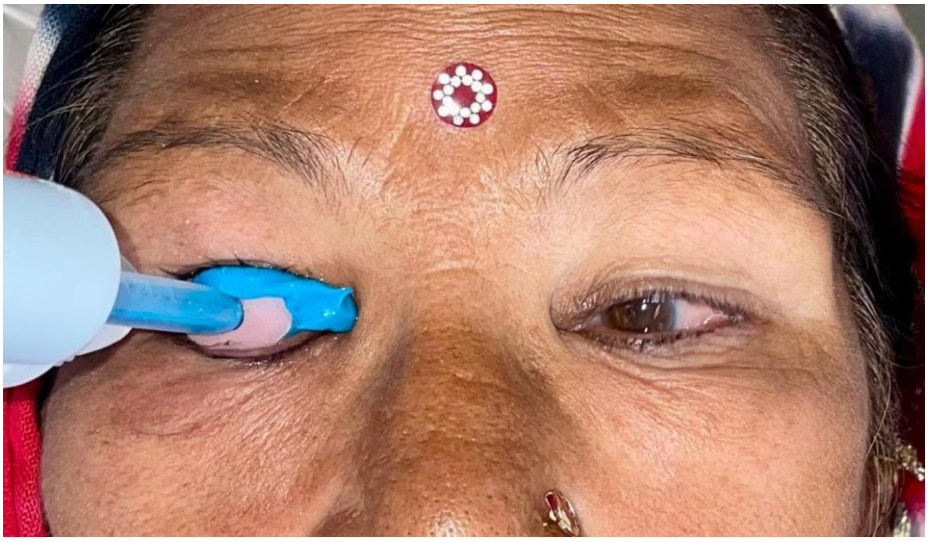

Figure 4. Final impression of the ocular socket recorded using low-viscosity addition silicone.

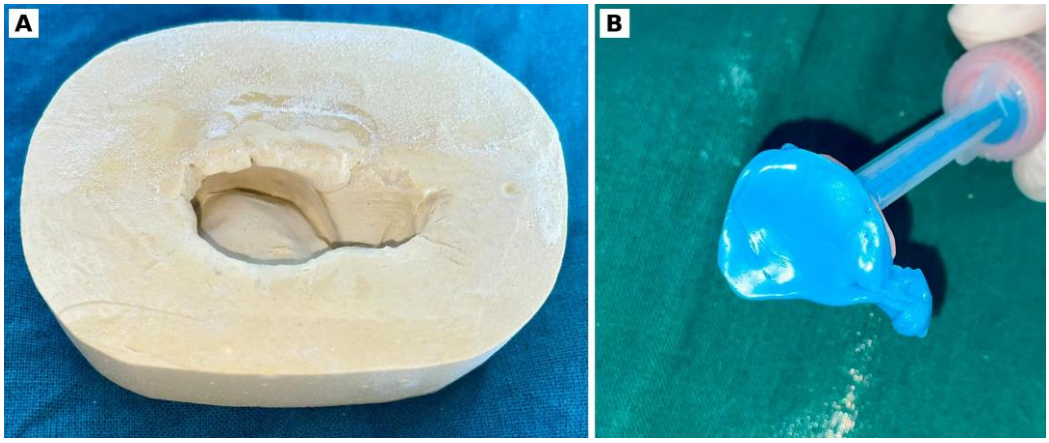

Figure 5. (A) Final impression retrieved from the socket; (B) definitive cast obtained by pouring the final impression.

2.3.3 Wax Pattern Try-In and Conformer Fabrication

A wax pattern was fabricated on the definitive cast and subjected to an intraocular try-in, during which adaptation, contour, and functional movement within the socket were evaluated (Figure 6).8 Following satisfactory evaluation, the wax pattern was flasked and dewaxed in the conventional manner (Figure 7), and a clear acrylic ocular conformer was fabricated and tried in the patient's socket. The conformer was worn for approximately six weeks to allow the socket to adapt and to establish an appropriate prosthetic contour before definitive fabrication (Figure 8).9

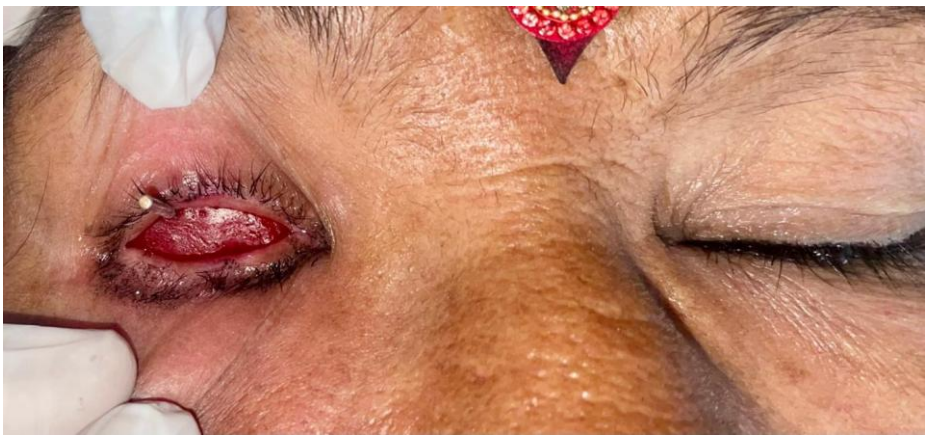

Figure 6. Wax pattern try-in evaluated for adaptation, contour, and movement within the ocular socket.

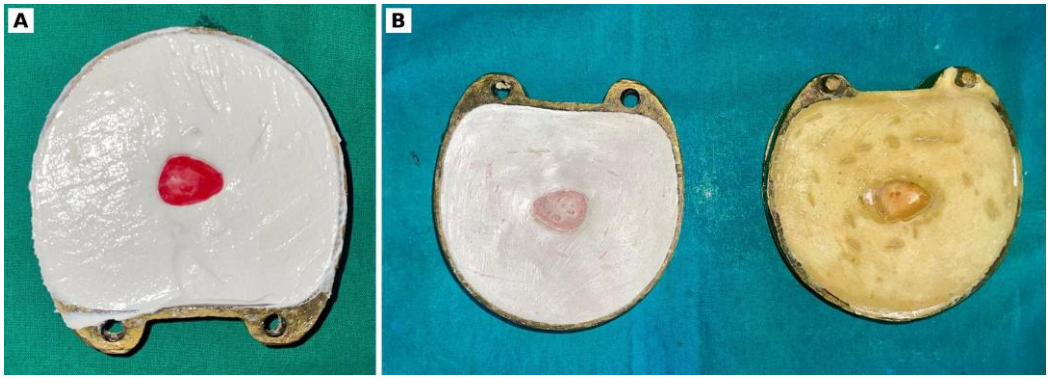

Figure 7. (A) Flasking of the wax pattern; (B) dewaxing prior to fabrication of the clear acrylic conformer.

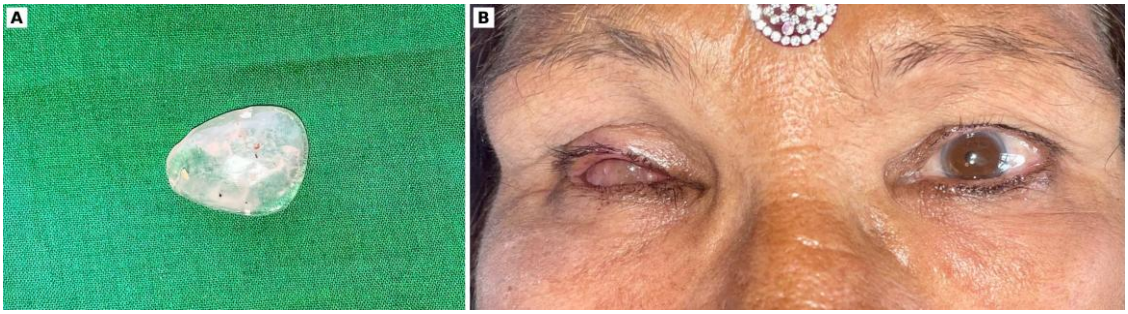

Figure 8. Clinical trial of the clear acrylic conformer, used for approximately six weeks to establish socket adaptation and prosthetic contour.

2.3.4 Digital Scanning and Fabrication of the Zirconia Prosthesis

After approximately six weeks of conformer use, the conformer was digitally scanned and the resulting standard tessellation language (STL) data were used as the basis for fabrication of the definitive prosthesis.10 This approach allowed the external contours established clinically with the conformer to be transferred directly into the computer-aided manufacturing workflow. A customized zirconia prosthesis was subsequently fabricated by a milling procedure and subjected to the manufacturer's recommended sintering protocol to achieve final strength and translucency (Figure 9).

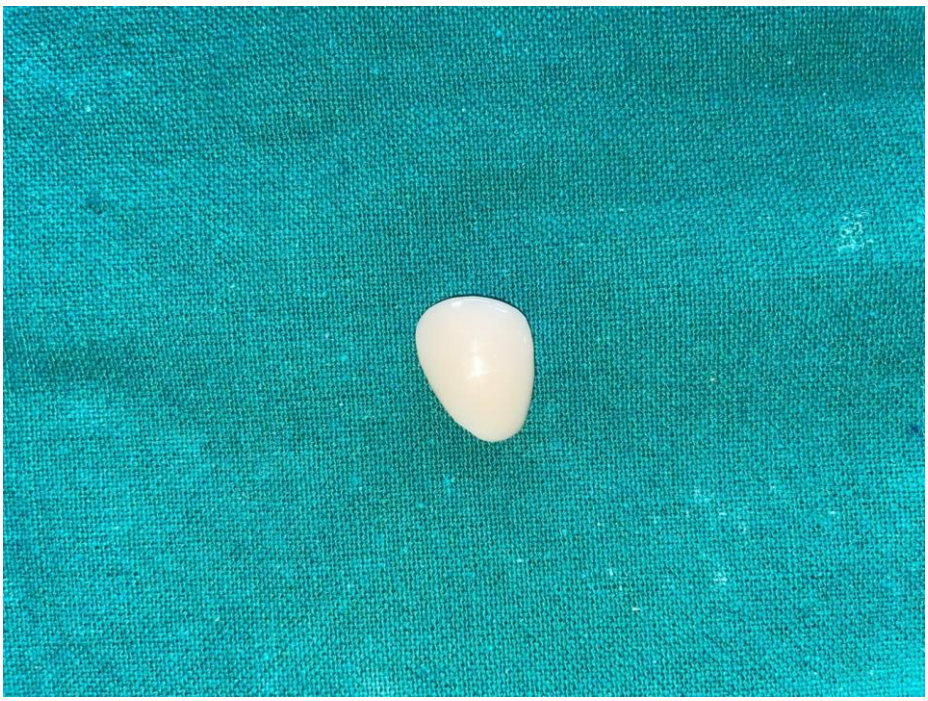

Figure 9. Definitive ocular prosthesis milled in zirconia from the digitally scanned conformer data, prior to sintering and characterization.

2.3.5 Iris Positioning

Accurate iris positioning is a critical determinant of symmetry between the prosthetic and natural eyes, and a variety of clinical methods for recording and reproducing iris position have been described in the literature, ranging from simple facial measurements and graph-grid templates to pupillometers and digital photographic techniques.11 In the present case, iris centering was performed with reference to the position and dimensions of the patient's contralateral (left) eye (Figure 10).

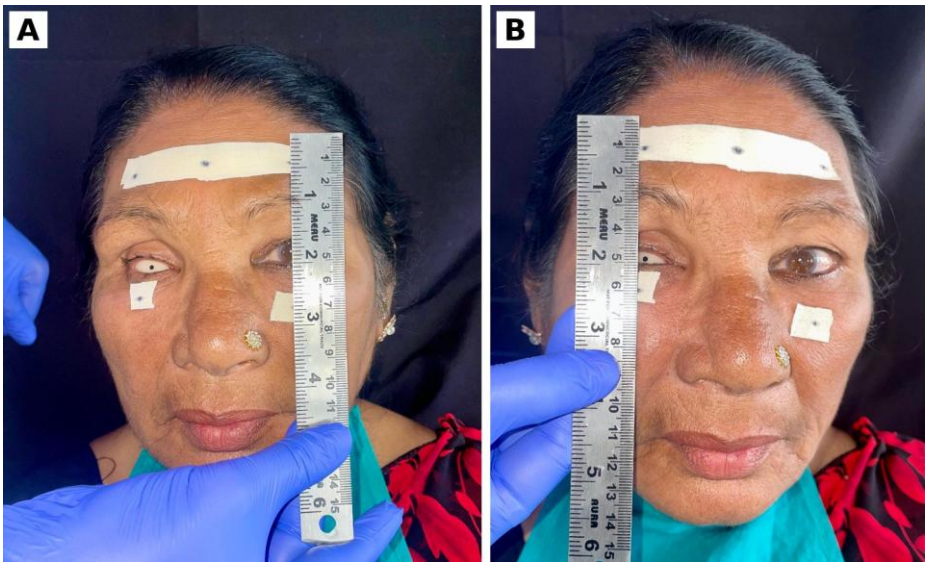

Figure 10. (A, B) Clinical centering of the prosthetic eye position with reference to the contralateral natural eye.

An electronic vernier caliper was used to assist in determining and reproducing the horizontal and vertical iris coordinates relative to fixed anatomical reference points on the forehead and adjacent skin (Figure 11).10,12 The iris was centered accordingly before final characterization of the prosthesis.

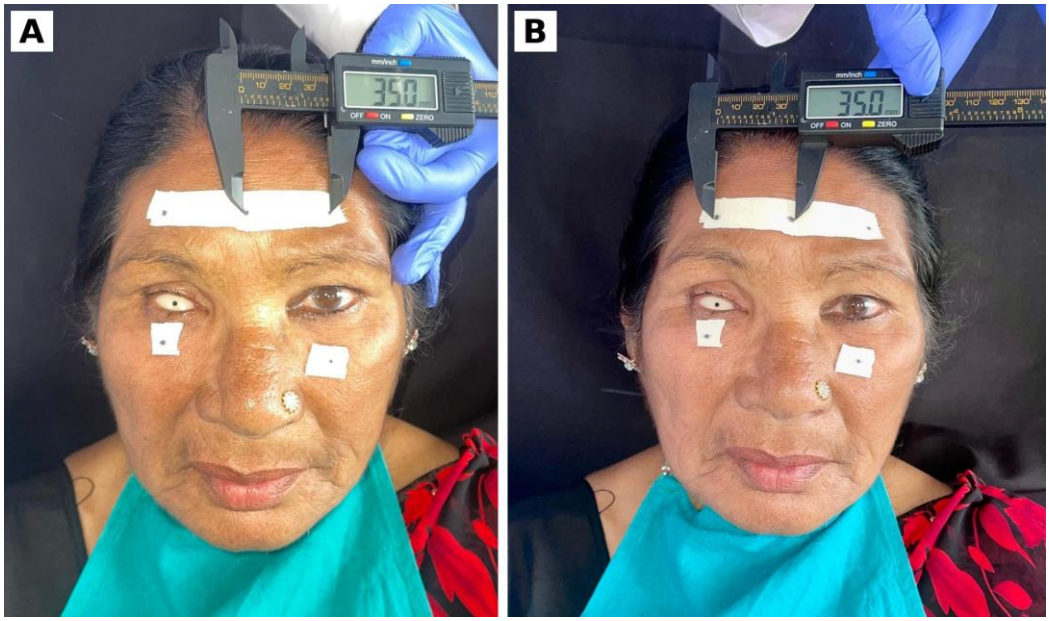

Figure 11. (A, B) Iris positioning verified using an electronic vernier caliper referenced to fixed anatomical landmarks.

2.3.6 Scleral Characterization

The scleral portion of the prosthesis was characterized to reproduce the appearance of the natural eye. Extrinsic staining was carried out to create an individualized scleral vascular pattern and coloration, improving esthetic integration of the prosthesis with the surrounding tissues (Figure 12).13

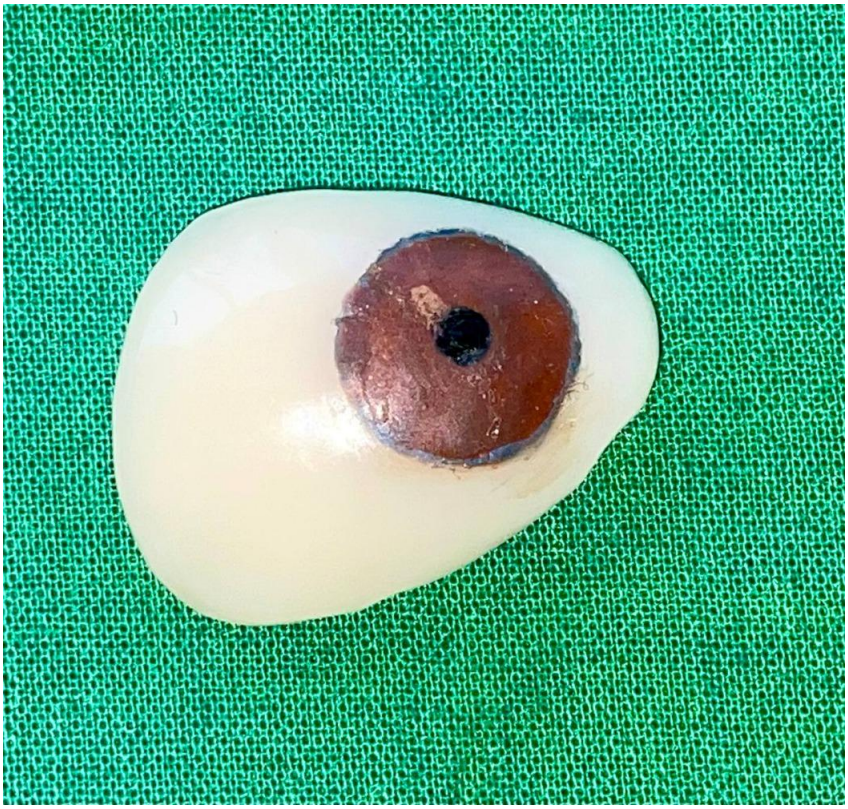

Figure 12. Extrinsic scleral characterization of the ocular prosthesis to reproduce natural coloration and vascularity.

2.3.7 Finishing, Polishing, and Try-In

Following characterization, the prosthesis was finished and polished, and a final clinical try-in was performed to evaluate adaptation, position, and esthetic appearance before delivery to the patient (Figure 13).

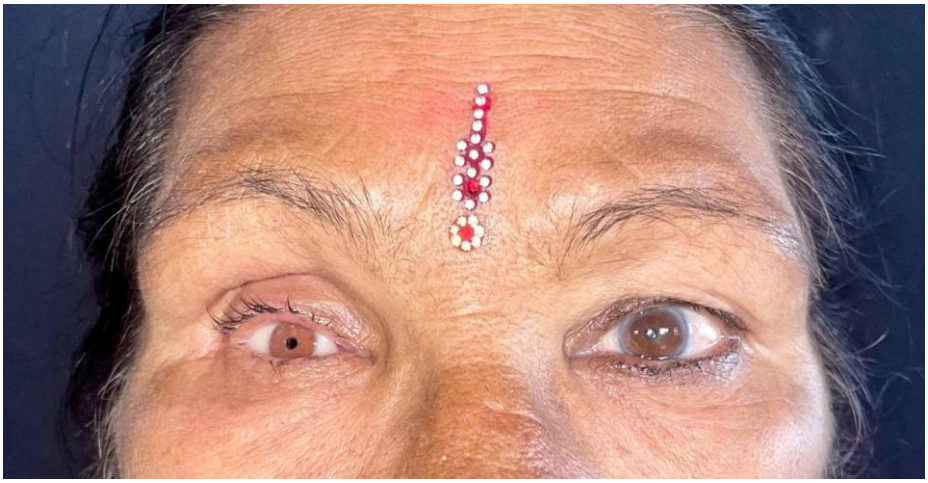

Figure 13. Final clinical try-in of the finished, polished ocular prosthesis.

2.4 Final Outcome

The definitive prosthesis demonstrated satisfactory rehabilitation of the right ocular defect, with good adaptation to the socket, appropriate symmetry of iris position, and an acceptable scleral color match to the natural eye. Comparison of the pre-treatment and post-treatment extraoral views showed a marked improvement in facial appearance following insertion of the custom zirconia ocular prosthesis (Figure 14).

Figure 14. Comparison of extraoral appearance before and after rehabilitation with the custom-made zirconia ocular prosthesis.

III. Discussion

Rehabilitation of an anophthalmic or enucleated socket aims to restore facial symmetry, protect the residual tissues, and support the patient's psychological recovery from a disfiguring loss.1,2 Although stock prostheses remain a fast and economical option, their fixed inventory of shapes, sizes, and iris positions cannot fully reproduce the individual anatomy of the fellow eye, which is why a custom-fabricated prosthesis is generally preferred whenever the clinical situation and resources permit.3,4,14

The conventional impression-based workflow used in this case, employing an external custom tray, irreversible hydrocolloid for the primary impression, and light-body addition silicone for the definitive impression, follows well-established principles for accurately recording the anophthalmic socket described since the earliest reports on ocular prosthesis fabrication.6,7,8,15 More recent reports have highlighted the value of incorporating digital photography and CAD/CAM-based workflows at the iris-fabrication and prosthesis-milling stages, citing improved reproducibility, reduced chair-time, and easier archiving of patient-specific data compared with fully manual iris painting.10,13,16,17 The present case builds on this trend by scanning the clinically verified conformer and milling the definitive scleral shell in zirconia, a material more commonly associated with fixed dental restorations but which offers high mechanical strength, biocompatibility, and stain resistance that are equally desirable properties in an ocular prosthesis.

Accurate iris positioning remains one of the most technique-sensitive steps in ocular prosthesis fabrication, and numerous instruments and methods, including pupillometers, graph grids, Boley's gauges, and, more recently, electronic and optical vernier calipers, have been proposed to standardize this step and reduce operator variability.11,12,18 The use of an electronic vernier caliper in the present case allowed iris coordinates to be recorded and reproduced with a level of numerical precision that is difficult to achieve with purely visual estimation, consistent with the increasing adoption of instrument-assisted iris positioning techniques reported in the recent prosthodontic literature.11,18

Extrinsic scleral characterization, as performed in this case, remains an important determinant of the final esthetic outcome, since even a well-fitting and correctly positioned prosthesis will appear unnatural if the scleral color and vascular pattern do not match the contralateral eye.16,19 The use of a conformer stage before definitive fabrication, as originally described for ocular defect management, also allowed the socket to mature and adapt to a stable contour before the final zirconia prosthesis was milled, reducing the likelihood of later adjustment.20

The broader clinical value of combining a conventional, patient-verified analog stage with digital scanning and CAD/CAM manufacturing is increasingly recognized across restorative and rehabilitative dentistry, where hybrid digital workflows are being applied to a wide range of prosthodontic and regenerative treatment goals.21 Continued documentation of such hybrid protocols, supported by longer-term follow-up of prosthesis fit, color stability, and patient-reported satisfaction, will help clarify the comparative advantages of digitally milled zirconia over conventional heat-cured acrylic ocular prostheses.

IV. Conclusion

A hybrid workflow combining conventional impression-making, a clinically verified conformer stage, and digital scanning and milling of a zirconia prosthesis provided a well-fitting, esthetically satisfactory rehabilitation of an enucleated eye socket. Instrument-assisted iris positioning using an electronic vernier caliper

contributed to accurate symmetry with the contralateral eye. This combined analog–digital approach offers a practical and reproducible pathway for custom ocular prosthesis fabrication and merits further clinical documentation.

Patient Consent Statement

Written informed consent was obtained from the patient for the publication of this case report and the accompanying clinical photographs. A copy of the consent form is available for review by the Editor-in-Chief of this journal upon request.

Conflict of Interest

The authors declare that they have no conflict of interest.

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References

[1]. Perman KI, Baylis HI. Evisceration, enucleation, and exenteration. Otolaryngol Clin North Am. 1988;21(1):171-182.
[2]. Goiato MC, Bannwart LC, Haddad MF, dos Santos DM, Pesqueira AA, Miyahara GI. Fabrication techniques for ocular prostheses: an overview. Orbit. 2014;33(3):229-233.
[3]. Murphey PJ, Pitton RD, Schlossberg L, Harris LW. The development of acrylic eye prostheses at the National Naval Medical Center. J Am Dent Assoc. 1945;32:1227-1244.
[4]. Mathews MF, Smith RM, Sutton AJ, Hudson R. The ocular impression: a review of the literature and presentation of an alternate technique. J Prosthodont. 2000;9(4):210-216.
[5]. Patil SB, Meshramkar R, Naveen BH, Patil NP. Ocular prosthesis: a brief review and fabrication of an ocular prosthesis for a geriatric patient. Gerodontology. 2008;25(1):57-62.
[6]. Bartlett SO, Moore DJ. Ocular prosthesis: a physiologic system. J Prosthet Dent. 1973;29(4):450-459.
[7]. Bhatt, S., Machani, P., Kukreja, P., Singh, V., Sinha, S., Thomas, W., & Kashwani, R. (2026). Assessment of the Effect of Different Alveolar Ridge Augmentation Techniques on the Stability and Fit of Implant-supported Prostheses. Advances in Human Biology, 16(2), 445–450. https://doi.org/10.4103/aihb.aihb_242_25
[8]. Chandra N, Swati M, Chandrakar L, Katara AA, Shrivastava A, Bhansali D. Comparison of hyaluronic acid, chlorhexidine and persica during SRP. Bioinformation. 2026 Feb 28;22(2):1212.
[9]. K R, Bhat R. Institutional Cross-Sectional Study on Student Knowledge, Attitude, and Practice of Blue Light Filters and Eye Health. Oral Sphere J. Dent. Health Sci. 2025;1(3):156-165. doi: 10.63150/osjdhs.2025.13
[10]. Lanzara R, Thakur A, Viswambaran M, Khattak A. Fabrication of ocular prosthesis with a digital customization technique: a case report. J Family Med Prim Care. 2019;8(3):1239-1242.
[11]. Sathe S, Pisulkar S, Nimonkar SV, Belkhode V, Borle A. Positioning of iris in an ocular prosthesis: a systematic review. J Indian Prosthodont Soc. 2020;20(4):345-352.
[12]. McArthur DR. Aids for positioning prosthetic eyes in orbital prosthesis. J Prosthet Dent. 1977;37(3):320-326.
[13]. Artopoulou II, Montgomery PC, Wesley PJ, Lemon JC. Digital imaging in the fabrication of ocular prostheses. J Prosthet Dent. 2006;95(4):327-330.
[14]. Kohli D, Mehta S, Makwana P, Choudhary S. An ocular prosthesis: a case report. Pravara Med Rev. 2011;3(4):27-30.
[15]. Sethi T, Kheur M, Haylock C, Harianawala H. Fabrication of a custom ocular prosthesis. Middle East Afr J Ophthalmol. 2014;21(3):271-274.
[16]. Reis CR, Dias BR, Carvalho MCJ. Evaluation of iris color stability in ocular prosthesis. Braz Dent J. 2008;19(4):370-374.
[17]. Buzayan MM, Ariffin YT, Yunus N, Mahmood WA. Ocular defect rehabilitation using photography and digital imaging: a clinical report. J Prosthodont. 2015;24(6):506-510.
[18]. Guttal SS, Joshi SM, Pillai LK, Nadiger RK. Ocular prosthesis for a geriatric patient with customised iris: a report of two cases. Gerodontology. 2011;28(2):152-156.
[19]. Syke LM, Essop ARM, Veres EM. Use of custom-made conformers in the treatment of ocular defects. J Prosthet Dent. 1999;82(3):362-365.
[20]. Ikbal M, Mude AH, Machmud E, et al. Modification of techniques in the fabrication of ocular prostheses: a case report. Enferm Clin. 2020;30(Suppl 4):510-513.
[21]. Basnet BB, Singh RK. Prosthetic rehabilitation of an ocular defect by custom eye prosthesis: a clinical report. Int J Dent Sci Res. 2014;2(5):115-119.
[22]. Taylor TD. Clinical Maxillofacial Prosthetics. 1st ed. Chicago: Quintessence Publishing; 2000. p. 233-276.
[23]. Sinha ND. Fabrication of custom ocular prosthesis using a graph grid. Pravara Med Rev. 2009;4(1):21-24.
[24]. Parr GR, Goldman BM, Rahn AO. Surgical considerations in the prosthetic treatment of ocular and orbital defects. J Prosthet Dent. 1983;49(3):379-385.
[25]. Kashwani R, Kumari A, Sawhney H. Artificial Teeth and Biological Tooth Regeneration Through USAG-1 Suppression: A Narrative Review. Int Res J Med Surg. 2026;3(3):17-25. DOI: 10.47857/irjmeds.2026.v03i03.075