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Cosmetic Reconstruction of Post-Traumatic Anterior Staphyloma by Customized Ocular Prosthesis

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ABSTRACT

Anterior staphyloma is a rare but devastating complication that can arise from untreated or poorly managed corneal trauma, particularly in pediatric patients. This condition frequently results in irreversible visual impairment, significant cosmetic disfigurement, and a compromised ocular surface. We present the compelling case of a 19-year-old female who has endured prolonged blindness in her right eye due to a traumatic corneal perforation incurred in early childhood. An extensive ophthalmological examination revealed the striking presence of anterior staphyloma accompanied by complete corneal degeneration, marking a severe degradation of her ocular health. Considering the severity of her condition, the patient underwent evisceration under general anesthesia. During this intricate procedure, a 14 mm polymethyl methacrylate (PMMA) ocular implant was carefully inserted to provide structural support. Subsequent histopathological assessment confirmed the diagnosis of anterior staphyloma, shedding light on the underlying pathology. The patient's postoperative recovery was remarkably smooth and complication-free. Following this, she was fitted with a custom-made PMMA ocular prosthesis, which significantly enhanced her facial symmetry, restored a degree of ocular motility, and vastly improved her overall appearance. This case highlights the crucial importance of timely surgical intervention and comprehensive prosthetic rehabilitation in effectively addressing the complex challenges posed by post-traumatic ocular deformities.

Keywords: Anterior Staphyloma, Pediatric Ocular Trauma, Corneal Perforation, Evisceration, PMMA Implant, Customized Ocular Prosthesis.

INTRODUCTION

Anterior staphyloma is a relatively rare condition characterized by the bulging of uveal tissue through the cornea that has become weakened or degenerated, typically because of trauma, surgery, infection, glaucoma, high myopia, malnutrition, dysplasia, and severe inflammatory disease. This condition is particularly concerning in pediatric patients, as the visual prognosis following penetrating injuries tends to be notably bleak. Factors such as delayed presentation, misdiagnosis, or inadequate initial care significantly contribute to the poor outcomes often observed in these cases [1]. Enucleation and evisceration are both effective surgical options for addressing the challenges posed by a blind, painful eye or a severely disfigured globe. However, evisceration is frequently the preferred choice, particularly when the posterior segment of the eye remains intact and there is no suspicion of intraocular malignancy. This procedure allows for the removal of the eye's contents while preserving the exterior eye structures, often leading to a more favorable cosmetic outcome and reduced postoperative discomfort [2]. The implantation of customized orbital implants, specifically using materials such as polymethyl methacrylate (PMMA) or porous polyethylene, plays a crucial role in reconstructive surgery for the eye socket. These implants provide not only essential volume replacement for the orbital cavity but also create a stable structure that supports the fitting and retention of ocular prosthetics. The choice of PMMA, known for its durability, biocompatibility, or porous materials, which promote tissue integration and vascularization, can significantly enhance the aesthetic outcomes and functional performance of the prosthetic [3]. A custom ocular prosthesis can significantly enhance a patient's appearance by providing a realistic and lifelike replacement for a missing or damaged eye. This tailored solution not only improves aesthetic symmetry but also restores confidence and dignity. Additionally, the psychological well-being of the

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patient is greatly improved, as a well-fitted ocular prosthesis can help reduce feelings of self-consciousness and social anxiety, allowing individuals to engage more fully in their personal and professional lives. The emotional benefits of feeling whole again are profound, making this medical solution not just a physical enhancement, but a crucial component of holistic recovery and self-acceptance [4].

Case Presentation

A 19-year-old female patient presented to the ophthalmology outpatient department of Dr. KNS Memorial Institute of Medical Sciences in Barabanki, reporting complete vision loss in her right eye approximately 15 years ago. This loss followed an episode of accidental penetrating ocular trauma caused by a wooden stick. After the injury, she underwent corneal tear repair and foreign body removal at another facility. Subsequently, she experienced a gradual decline in vision in her right eye and sought consultations at various hospitals. During her initial visit, she expressed significant concern about her cosmetic appearance and requested a customized ocular prosthesis for her right eye. Upon detailed examination using a slit lamp, the condition of her right eye was found to be poor (Fig.1B). The eyelids were apart, revealing significant meibomitis, total corneal opacity, and scarring, with an irregular, opaque protrusion of uveal tissue at the center of the cornea. The anterior chamber was obliterated, and there was no perception of light. B-scan ultrasonography revealed a loss of normal anatomical structure, indicating a deformed globe. The anterior chamber was collapsed, the iris and ciliary body were thickened, the lens could not be visualized, and there were floating internal echoes and membrane formation in the posterior chamber. However, the retrobulbar fat and optic nerve appeared normal. The ultrasound findings were consistent with post-traumatic staphyloma and total corneal degeneration. A clinical and radiological diagnosis of post-traumatic anterior staphyloma with total corneal degeneration of the right eye was made. The patient was admitted and planned for evisceration after providing written informed consent. The eye area was prepared and painted with 10% povidone-iodine under general anesthesia. A combination of lignocaine and bupivacaine was administered as a peribulbar block. The eyelids were held apart with a universal eye speculum. A 360-degree peri-limbal peritomy was performed using conjunctival spring scissors, followed by a stab incision in the limbal area with an 11-blade scalpel. A curved tenotomy scissor was used to remove the corneoscleral button, and hydro-dissection of the uveal tissue was performed using an evisceration scoop. Chemical cauterization of the optic nerve was done using absolute alcohol, while the inner surface of the sclera was treated with povidone-iodine. A 14 mm polymethyl methacrylate (PMMA) spherical implant was inserted into the scleral shell to maintain orbital volume, and the sclera and conjunctiva were sutured with 6-0 vicryl and 8-0 vicryl sutures, respectively. Postoperative rehabilitation follow-ups were scheduled for Postop Day 1, Day 7, 4 weeks, 6 weeks, and 12 weeks. On postop day 1, conjunctival congestion was noted (Fig.2). During these follow-ups, the socket appeared healthy, the implant was in place, and there were no signs of infection, implant migration, or extrusion. At the 12-week follow-up, a customized PMMA ocular prosthesis was fabricated and fitted. This prosthesis matched the fellow eye in terms of size, color, vascular markings, and alignment, allowing for good passive movement and significantly improving the cosmetic appearance of the patient (Fig.3A, B &C). Histopathological analysis of the eviscerated ocular tissue revealed a stratified squamous epithelial lining with dense fibro-collagenous stroma. There was moderate infiltration by lymphocytes and plasma cells indicative of chronic inflammation, along with numerous congested and dilated blood vessels interspersed with pigmented cells. These microscopic features confirmed the diagnosis of anterior staphyloma with inflammatory changes.

DISCUSSION

The management of anterior staphyloma, especially in non-seeing eyes resulting from childhood trauma, presents both cosmetic and functional challenges. While corneal transplantation may be an option in selected cases with potential for vision, evisceration is the preferred method for eyes with no light perception and significant anatomical damage. Evisceration retains the scleral shell and extraocular muscles, resulting in improved motility of the implant [5]. PMMA implants have gained widespread use owing to their favorable biocompatibility and cost-effectiveness. However, when it comes to fostering optimal fibrovascular integration, porous materials like hydroxyapatite and porous polyethylene demonstrate superior performance. These materials not only promote enhanced tissue integration but also facilitate better blood vessel formation, making them highly advantageous in various medical applications [6]. In the present case, a PMMA (polymethyl methacrylate) implant was selected due to its economic advantages and the practical

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considerations of the surgical procedure. Unlike stock prostheses, which are mass-produced, custom ocular prostheses provide a significantly improved fit tailored to the unique contours of the patient's eye socket. This personalized approach not only enhances comfort but also yields superior aesthetic outcomes, ensuring that the result aligns closely with the patient's natural appearance [7]. Prompt surgical intervention combined with effective prosthetic rehabilitation plays a crucial role in averting potential complications. These may include socket contracture, where the tissue surrounding the implant tightens, conjunctival dehiscence, which involves the separation of the conjunctival tissue, and implant exposure, where the implant becomes visible due to insufficient tissue coverage. By addressing these issues proactively, healthcare providers can greatly enhance patient outcomes and overall comfort [8]. In addition, cosmetic rehabilitation plays a vital role in enhancing a patient's self-esteem and fostering social integration, especially among adolescents. Addressing physical appearances and promoting confidence, empowers young individuals to navigate social interactions more comfortably and positively influences their overall emotional well-being [9]. Recent advancements in prosthetic design and implant technology have revolutionized the development of ocular prostheses, resulting in remarkably life-like and dynamic artificial eyes. These innovations not only enhance the aesthetic appeal of the prosthetics but also significantly boost patients' confidence, leading to improved emotional and psychological outcomes. By closely mimicking the natural movement and appearance of real eyes, these sophisticated prostheses enable individuals to engage more fully with the world around them, fostering a sense of normalcy and self-assurance in their daily lives [10]. A recent study draws an inference that the utilization of stock ocular prosthesis, which are available in various sizes and colors, plays a crucial role in delivering satisfactory visual outcomes. These stock options can yield favorable functional and aesthetic results; however, the benefits of custom-made ocular prosthesis are undeniable. Tailored specifically to the individual's anatomy, custom prosthesis ensures a precise fit, allowing for even pressure distribution across the eye socket. This precision enhances eyelid movement, contributing to a more natural appearance. Furthermore, the aesthetic appeal of custom-made prosthesis often surpasses that of stock options, providing patients with a more harmonious and lifelike look. Overall, while stock ocular prosthesis serves a vital purpose, the advantages of customization improved functionality, comfort, and visual coherence make custom options a compelling choice for those seeking optimal outcomes [11]. Another study also supports that the extra effort and time put into the fabrication of custom-made ocular prosthesis has been a boon to patients who cannot afford other alternatives, including implants, ensures a better drape of lid tissues, and provides a superior natural appearance to both the patient and the observer [12]. In a comprehensive study conducted by Cain, it was found that custom ocular prosthesis significantly outperformed stock ocular prosthesis in terms of both fit and aesthetic appeal. The research highlighted that custom prosthesis, which are tailored to the individual anatomy and preferences of the patient, not only provide a more comfortable and secure fit but also offer a more natural appearance that closely resembles the patient's existing eye. This bespoke approach minimizes complications related to mobility and irritation often associated with ill-fitting stock options, ultimately enhancing the overall quality of life for those who utilize them [13]. In a case reported by Colvenkar S et al, the use of stock ocular prosthesis, carefully selected for their appropriate size and color, plays a significant role in achieving satisfactory functional and aesthetic outcomes. These readily available options can often yield superior results compared to custom-made ocular prostheses. However, custom-made ocular prostheses offer distinct advantages that set them apart. They provide an exceptional fit tailored to the unique contour of an individual's eye socket, ensuring even pressure distribution for greater comfort. This personalized approach facilitates more natural eyelid movement, enhancing the overall functionality. Additionally, custom prostheses often boast improved aesthetics, closely mimicking the appearance of a natural eye, which can significantly boost a patient's confidence and quality of life.[14]. In a recent comprehensive retrospective study conducted by Kashani et al., the authors meticulously assessed the effectiveness of custom-made ocular prosthesis in patients diagnosed with anophthalmia. The study spanned a diverse cohort of patients, with a focus on both aesthetic appeal and functional performance of the prosthesis. The findings revealed that custom-made ocular prosthesis significantly outperformed stock ocular prosthesis in terms of not only visual symmetry and natural appearance but also comfort and ease of use. Patients reported higher satisfaction levels, noting improvements in social interactions and quality of life. This study underscores the importance of personalized solutions in ocular rehabilitation, demonstrating that tailored prosthetic options can lead to superior outcomes in individuals dealing with the challenges of anophthalmia [15].

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CONCLUSION

The present case underscores the profound effects of childhood ocular trauma, which can lead to anterior staphyloma and considerable long-term vision loss. Although the patient faced irreversible blindness, prompt surgical intervention through evisceration and the placement of a Polymethyl methacrylate (PMMA) implant, followed by a tailored ocular prosthesis, greatly enhanced both the cosmetic appearance and psychological well-being of the patient. Ophthalmologists are encouraged to prioritize early referrals, accurate diagnoses, and meticulous surgical and prosthetic planning in similar cases.

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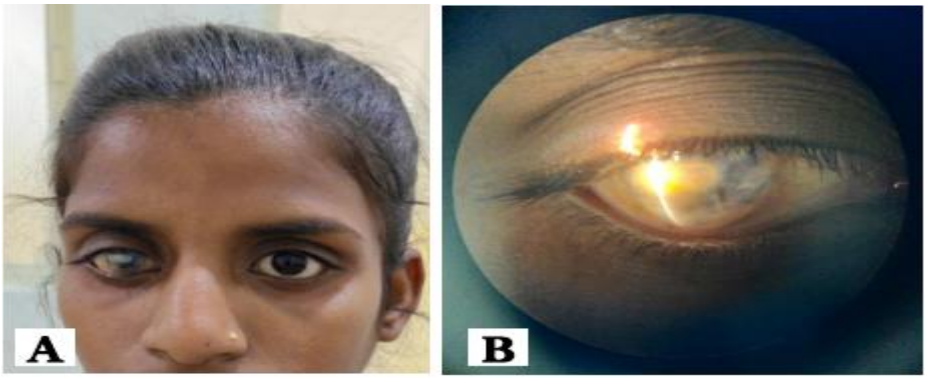

Figure 1 (A&B): Right eye shows patient facial asymmetry and on slit lamp biomicroscopy Total leucomatous corneal opacity and scarring with anterior staphyloma while left eye appears normal.

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Figure 2: Right eye on a post-operative day1, Diffuse conjunctival congestion, suture site healthy, sutures are intact and the implant is in the place

Figure 3 (A, B & C): Ocular alignment and symmetry are well achieved, Parts A, B, and C show the presentation of ocular position in primary gaze, up gaze, and down gaze. The aesthetic parameters like the scleral show, palpebral fissure height, etc are in excellent state.