RESEARCH PAPER

Tectonic Triumph: Penetrating Keratoplasty for Globe Salvage in Advanced Anterior Staphyloma – A tertiary care centre experience

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ABSTRACT

Purpose: To evaluate the anatomical and functional outcomes of penetrating keratoplasty (PK) in patients with advanced anterior staphyloma at a tertiary care centre.

Methods: This retrospective, cross-sectional observational study included 28 eyes of 28 patients who underwent PK for advanced anterior staphyloma between January 2019 and January 2024. Data were collected from medical records, including demographic details, preoperative best-corrected visual acuity (BCVA), and recipient graft size. Patients were categorized based on preoperative visual acuity (Group A: hand movements to 6/60; Group B: perception of light and below) and graft size (Group C: <8 mm; Group D: >8 mm). Outcome measures included anatomical success (maintenance of globe integrity) and functional success (improvement in BCVA). Postoperative complications such as raised intraocular pressure (IOP), graft failure, and phthisis bulbi were also analyzed over a minimum follow-up of 6 months.

Results: The study population had a mean age of 64 years, with a male predominance (78.6%). Anatomical success was higher in Group A (93.3%) compared to Group B, wherein higher rates of anatomical (46%) and functional failure (65.2%) were observed. Similarly, smaller graft sizes (Group C) showed better anatomical (80%) and functional success (53%) compared to larger grafts (Group D), which had higher failure rates. Common postoperative complications included raised IOP (42.8%), graft failure (53.6%), and phthisis bulbi (25%). Complications were strongly associated with poorer anatomical and functional outcomes.

Conclusion: Penetrating keratoplasty remains a crucial globe-preserving procedure in advanced anterior staphyloma, with high anatomical success rates. However, functional visual recovery remains limited, particularly in patients with poor preoperative vision and larger graft sizes. Early surgical intervention, appropriate case selection, and meticulous postoperative management are essential to optimize outcomes.

Keywords: Anterior staphyloma, Penetrating keratoplasty, Therapeutic keratoplasty.

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Introduction

A staphyloma is defined as a localized outpouching of the ocular wall characterized by thinning and structural alteration of the sclera, leading to protrusion of the underlying uveal tissue. The majority of staphylomas involve the posterior pole and are most commonly associated with pathological or degenerative myopia.[1] Anterior staphylomas are relatively rare and typically arise following prolonged, inadequately treated ocular infections in an otherwise healthy eye, frequently in association with fungal corneal ulcers. They may also develop secondary to chronic inflammatory conditions such as necrotizing scleritis. Owing to their infrequent occurrence, the literature contains

limited reports addressing their clinical presentation and management.[2]

Advanced anterior staphyloma represents a severe end-stage corneal disorder that poses significant therapeutic challenges in ophthalmic practice. It is characterized by marked ectatic thinning of the cornea with prolapse of uveal tissue, most commonly resulting from severe infectious keratitis, ocular trauma, or postoperative complications.[3] Clinically, patients present with profound visual loss, cosmetic deformity, persistent ocular discomfort, and a compromised ocular surface.[4]

Penetrating keratoplasty (PK) remains the mainstay surgical intervention in such advanced cases, primarily aimed at restoring structural integrity of the globe, relieving symptoms, and, when feasible, achieving some degree of visual rehabilitation.[5] Nevertheless, surgical outcomes are often variable and unpredictable, owing to coexisting ocular comorbidities, suboptimal host tissue quality, and the inherently high-risk nature of the graft.[6] This study evaluates the anatomical and functional outcomes of penetrating keratoplasty in patients with advanced anterior staphyloma over a Five-year period at a tertiary eye care centre.

Methodology

This retrospective, cross-sectional, observational study was conducted at a tertiary eye care center which included 28 eyes of 28 patients. Medical records of patients who underwent PK for advanced anterior staphyloma between January 2019 and January 2024 were included .Incomplete and missing records were excluded.

Data Collection

Data were retrieved from medical records using a standardized data collection format. Baseline parameters included age, gender, size of the recipient graft and preoperative best corrected visual acuity (BCVA). The postoperative outcomes included postoperative BCVA ,intraocular pressure (IOP) and long-term complications of PK.

Outcome Measures

The outcome measures in this study were categorized into anatomical and functional parameters to comprehensively evaluate the effectiveness of the intervention. Anatomical success was defined as the preservation of globe integrity, characterized by a well-apposed and stable graft without evidence of dehiscence or structural compromise. In contrast, anatomical failure referred to the loss of structural integrity of the globe, which could manifest as graft melt, perforation, or phthisis. Functional outcomes were assessed based on visual improvement. Functional success was defined as an improvement in postoperative best-corrected visual acuity (BCVA) compared to the preoperative baseline, indicating a gain in visual function following surgery. Conversely, functional failure was defined as the absence of any improvement in postoperative BCVA relative to preoperative vision, reflecting limited or no visual benefit despite surgical intervention

Statistical Analysis

Data were analysed using descriptive statistical methods. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Quantitative data were entered in MS Excel and analysed using IBM SPSS software v20.0 .

Ethical Considerations

The study adhered to the tenets of the Declaration of Helsinki. Institutional Ethics Committee approval was obtained prior to data collection. Patient confidentiality was maintained by anonymizing all data.

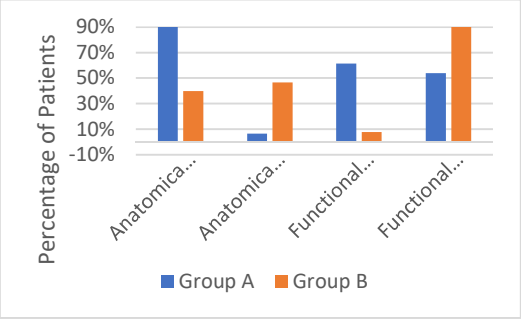
Results

A total of 28 patients who underwent penetrating keratoplasty for advanced anterior staphyloma were included in the study. Among them, 22 (78.6%) were males and 6 (21.4%) were females. The age of the patients ranged from 52 to 76 years, with a mean age of 64 years.

The variables assessed included preoperative visual acuity, recipient graft size, and postoperative complications. Based on preoperative visual acuity, patients were categorized into two groups: Group A (n = 15), comprising eyes with visual acuity ranging from hand movements to 6/60, and Group B (n = 13), including eyes with perception of light or worse. Based on recipient graft size, patients were divided into Group C (n = 5), with graft size < 8 mm, and Group D (n = 23), with graft size > 8 mm.

As illustrated in Graph 1, anatomical and functional outcomes were compared between Group A and Group B. Group A demonstrated a high rate of anatomical success (93.3%) along with a moderate functional success rate (53%). In contrast, Group B showed poorer outcomes, with anatomical failure observed in 46% of cases and functional failure in 65.2% of cases.

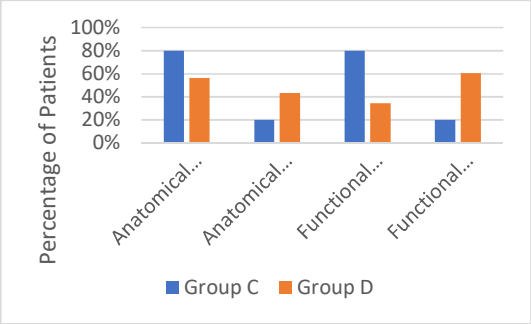
Graph 1: Comparison of anatomical and functional outcomes between Group A and Group B expressed as percentages



Similarly, Graph 2 compares outcomes based on graft size. In Group C, anatomical success was

observed in 80% of cases, while functional success was achieved in 53%. However, Group D showed comparatively poorer outcomes, with anatomical failure in 56.2% and functional failure in 60.8% of cases.

Graph 2 : Comparison of anatomical and functional outcomes between Group C and Group D expressed as percentages



Postoperative complications observed during the 6-month follow-up period included raised intraocular pressure (IOP) in 12 cases, graft failure in 15 cases, and phthisis bulbi in 7 cases. As shown in Table 1, among cases with raised IOP, 8 resulted in anatomical failure and 10 in functional failure. Of the 15 cases with graft failure, only 2 maintained anatomical integrity. Additionally, 6 cases progressed to phthisis bulbi, which was associated with both anatomical and functional failure in the majority of cases.

Table 1: Proportion of anatomical and functional integrity associated with each postoperative complication following penetrating keratoplasty

Complications	Anatomical Success	Anatomical Failure	Functional Success	Functional Failure
Raised IOP	33.3%	66.6%	16.6%	83.3%
Graft Failure	13.3%	86.6%	53.3%	46.6%
Phthisis Bulbi	14.28%	85.71%	14.28%	85.71 %

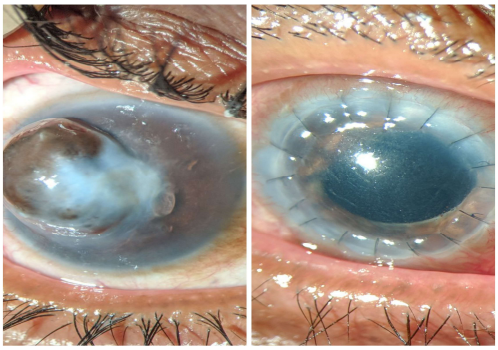


Figure 1: Demonstrates the clinical appearance of anterior staphyloma (left image) and the postoperative outcome at one-month follow-up (right image), highlighting structural restoration of the globe.

Discussion

Advanced anterior staphyloma represents one of the most severe end-stage manifestations of corneal disease, most often arising from uncontrolled infectious keratitis, ocular trauma, or chronic inflammatory conditions. In such advanced scenarios, the principal goal of management is tectonic restoration of globe integrity, with visual rehabilitation being a secondary consideration.[7]

The anatomical success rate observed in our cohort is comparable to previously reported outcomes of TPK in severe corneal pathology. Studies by Panda et al. and Sharma et al. have documented anatomical success rates ranging from 70% to 90%, influenced by factors such as severity of infection, extent of corneal involvement, and timing of surgical intervention. The favourable outcome in our study may be attributed to timely surgical management and meticulous postoperative care.[8,9]

Visual outcomes following TPK in cases of anterior staphyloma remain inherently guarded. In our study, functional success was seen in patients with better pre operative visual acuity and in graft size of < 6mm. Consistent with prior literature, only a limited proportion of patients attained meaningful visual recovery. Dandona et al. similarly reported that while anatomical success is achieved in the majority of cases, functional outcomes often remain suboptimal.[10]

Postoperative complications significantly influence both anatomical and functional outcomes. The complications encountered in our study included elevated intraocular pressure, graft failure, and phthisis bulbi. These findings are in concordance with reports by Das et al. and Saini et al., highlighting the need for vigilant long-term follow-up and, in some cases, additional medical or surgical interventions.[11-13]

Collectively, these observations reinforce the concept that TPK in advanced anterior staphyloma serves primarily as a globe-preserving procedure rather than a vision-restoring intervention. Early diagnosis, prompt surgical management, and meticulous postoperative care remain critical in optimizing anatomical success, although functional recovery continues to be limited in the majority of cases.

Clinical Implications

The findings of this study highlight several important clinical implications. Early surgical intervention plays a crucial role in preventing irreversible damage to the globe and improving the chances of anatomical preservation. Furthermore, long-term follow-up is essential to detect and manage potential postoperative complications such as glaucoma and graft failure, which can significantly affect outcomes. Lastly, a multidisciplinary approach that emphasizes effective control of infection and inflammation contributes substantially to improved surgical success and overall patient prognosis.

Limitations

The limitations of our study include Its retrospective design may introduce selection and data-related biases, while the small sample size limits the generalizability and statistical strength of the findings. In addition, the lack of long-term follow-up prevents assessment of sustained outcomes such as graft survival and late complications. Therefore, larger prospective studies with extended follow-up are needed to provide more reliable evidence.

Conclusion

Penetrating keratoplasty remains an indispensable intervention in the management of advanced anterior staphyloma. While anatomical success rates are encouraging, functional outcomes remain limited. The procedure should be regarded primarily as a globe-preserving surgery, with visual rehabilitation being a secondary goal. Early intervention, careful case selection, and vigilant postoperative care are key determinants of success.

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