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Visual Recovery Following Primary Corneal Tear Repair in Penetrating Ocular Trauma: A Prospective Observational Study

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ABSTRACT

Penetrating ocular trauma frequently results in corneal tears requiring urgent globe repair to preserve anatomical integrity and visual function. This study investigates the visual outcomes following corneal tear repair in patients presenting with penetrating eye trauma. The primary objective was to evaluate the frequency and degree of visual acuity improvement postoperatively in patients undergoing primary corneal repair. A prospective, descriptive case series was conducted involving 150 patients who presented to the Department of Ophthalmology, Jinnah Hospital Lahore, with penetrating corneal injuries. All patients underwent primary corneal tear repair, and visual acuity was reassessed eight weeks post-surgery. Visual outcomes were stratified by age and gender, and data were analyzed using the chi-square test with a significance threshold of $p \leq 0.05$. The mean age was 34.02 ± 12.83 years, with the majority (66.67%) aged 31–60. Males comprised 60% of the cohort. Among all cases, 26% demonstrated significant improvement in visual acuity post-repair, suggesting successful anatomical and partial functional restoration.

Statistically significant improvement in visual acuity was noted in younger patients ($p = 0.021$). This study identifies corneal tear repair as an effective primary intervention in restoring visual function in a substantial number of trauma patients, especially when conducted promptly.

Keywords: globe repair, visual acuity, penetrating trauma

INTRODUCTION

Ocular trauma remains one of the primary causes of monocular blindness worldwide, especially in low- and middle-income countries. Among the diverse spectrum of ocular injuries, penetrating trauma to the anterior segment is particularly detrimental due to its immediate disruption of the eye's structural integrity and potential for severe visual impairment. Corneal tears resulting from such injuries often necessitate urgent surgical repair, with the goal of restoring anatomical continuity and minimizing long-term visual disability. Advances in microsurgical techniques and refined suture materials have enhanced outcomes over the past decade; however, variability in visual prognosis remains due to the heterogeneity in injury types, associated complications, and timing of intervention 1-3.

The global burden of ocular trauma is considerable, with recent epidemiological data showing a prevalence of 3.5 to 4.7 per 1,000 population per year 4. In Pakistan, ocular trauma is significantly underreported, with occupational hazards, road traffic accidents, and interpersonal violence cited as leading contributors.5 Penetrating injuries, particularly those involving the cornea, often present as full-thickness lacerations requiring immediate repair to prevent endophthalmitis, secondary glaucoma, or sympathetic ophthalmia 6. Despite the urgency of surgical repair, the predictability of visual recovery remains challenging, given the variability in pre-operative visual acuity, depth of penetration, and intraocular involvement 7.

Primary corneal tear repair is traditionally performed using interrupted or running 10-0 nylon sutures under operating microscopy. The timing of the procedure is critical, ideally within hours of trauma, as delayed intervention significantly increases the risk of infection and irreversible retinal damage 8. Postoperative visual rehabilitation, including management of induced astigmatism, secondary cataract formation, and corneal scarring, further complicates the long-term recovery 9. Several recent studies have demonstrated that, in properly selected cases, significant visual improvement is achievable following primary repair, with outcomes varying based on age, gender, wound size, and initial presenting acuity 10-12.

However, much of the current literature lacks stratification of visual outcomes based on injury characteristics and demographic factors in South Asian populations. This gap is especially relevant in public sector hospitals where limited access to advanced ophthalmic care and poor follow-up compliance pose significant challenges to data acquisition 13. In contrast to developed settings, where ocular trauma registries allow long-term surveillance, short-term visual outcomes in developing countries remain sparsely documented. This study addresses that gap by prospectively evaluating postoperative visual improvement in patients undergoing corneal tear repair due to penetrating trauma at a tertiary care center in Pakistan 14.

A notable aspect of this study is its emphasis on statistical validation of outcomes using stratified chi-square analysis, highlighting specific subgroups where intervention was most effective. By limiting follow-up to an eight-week postoperative window, the study minimizes confounding variables such as secondary surgical interventions or visual rehabilitation therapies, thereby isolating the primary impact of surgical repair on visual acuity 15. This approach not only aligns with practical constraints in resource-limited settings but also reflects the immediate benefits of emergency globe repair, an often-underestimated endpoint in trauma studies.

METHODOLOGY

ssThis prospective, descriptive case series was conducted at the Department of Ophthalmology, Jinnah Hospital Lahore, from January 2023 to December 2023. The study aimed to assess visual improvement following surgical repair of corneal tears due to penetrating ocular trauma. The sample size was calculated using Epi Info version 7.2 based on an anticipated frequency of visual improvement of 25%, with a 95% confidence interval, 5% margin of error, and design effect of 1, yielding a required sample size of 150. Non-probability consecutive sampling was used to recruit eligible participants.

Patients aged between 5 and 60 years who presented with full-thickness corneal lacerations due to penetrating trauma and underwent primary surgical repair within 24 hours of injury were included. Exclusion criteria encompassed patients with pre-existing ocular pathology (such as corneal dystrophies or glaucoma), prior ocular surgeries, retinal detachment at presentation, intraocular foreign bodies, or follow-up loss within 8 weeks postoperatively. All patients or their guardians,

where applicable, were verbally counseled regarding the study and their condition, and informed verbal consent was obtained prior to enrollment.

Standardized surgical protocols were followed for all participants, involving meticulous wound toilet, anterior chamber reformation, and repair with 10-0 nylon under an operating microscope. Postoperative care included topical antibiotics, corticosteroids, cycloplegics, and oral analgesics. Visual acuity was assessed preoperatively and then at 8 weeks post-surgery using Snellen's chart under uniform lighting conditions. Best corrected visual acuity (BCVA) was recorded by a senior ophthalmic resident unaware of the study hypothesis to minimize bias.

Demographic data, injury mechanism, and time to surgery were recorded. Patients were stratified into age groups (≤30 and >30 years), gender, and laterality of injury. Statistical analysis was conducted using SPSS version 26. Categorical variables such as gender and improvement in visual acuity were expressed as frequencies and percentages. Continuous variables such as age were reported as mean ± standard deviation. Chi-square tests were applied to compare visual outcomes across strata, and a p-value of ≤0.05 was considered statistically significant.

Results

Table 1. Demographic Characteristics of Study Participants (n = 150)

Variable	**Frequency (n)**	**Percentage (%)**	**Mean ± SD**
Age (years)	-	-	34.02 ± 12.83
Age group			
≤30 years	50	33.3%	
>30 years	100	66.7%	
Gender			
Male	90	60.0%	
Female	60	40.0%	
Variable	**Frequency (n)**	**Percentage (%)**	**Mean ± SD**

Eye involved			
Right	84	56.0%	
Left	66	44.0%	
Time to surgery	<12 hours	102	68.0%
	≥12 hours	48	32.0%

Explanation: Most patients were above 30 years old, with males comprising the majority. The right eye was more frequently involved, and over two-thirds received surgical repair within 12 hours of trauma.

Table 2. Pre- and Postoperative Visual Acuity

Visual Acuity	**Preoperative (n, %)**	**Postoperative (n, %)**
≥6/18	15 (10.0%)	36 (24.0%)
6/60 to <6/18	24 (16.0%)	33 (22.0%)
<6/60 – PL positive	111 (74.0%)	81 (54.0%)
No Perception of Light	0 (0.0%)	0 (0.0%)

Explanation: There was a notable shift toward improved visual acuity post-surgery, with patients gaining functional vision (≥6/18) increasing from 10% to 24% after 8 weeks.

Table 3. Visual Improvement by Age and Gender

Variable	**Improved (n = 39)**	**Not Improved (n = 111)**	**p-value**
Age group			
≤30 years	19 (38.0%)	31 (62.0%)	0.021*
>30 years	20 (20.0%)	80 (80.0%)	
Gender			
Variable	**Improved (n = 39)**	**Not Improved (n = 111)**	**p-value**

Male	24 (26.7%)	66 (73.3%)	0.891
Female	15 (25.0%)	45 (75.0%)	

*Statistically significant at $p \leq 0.05$

Explanation: Visual improvement was significantly higher in younger patients (≤30 years), while no significant difference was found between genders.

DISCUSSION

This prospective series involving 150 patients with penetrating corneal lacerations confirms that primary repair restores functional vision in a meaningful proportion, with 26% achieving BCVA ≥6/18 by eight weeks. The demographic profile—mean age 34 years, predominately male—aligns with regional and international trauma patterns, as documented in similar settings 16-17. The preponderance of injuries occurring in working-age adults reflects occupational and traffic-related risks, underscoring the importance of timely intervention.

Visual gain postoperatively was most prominent among patients aged ≤30 years (38%, p=0.021), a finding consistent with regenerative advantages observed in younger corneas. Visual restoration appears to be age-sensitive, likely due to fewer comorbid ocular conditions and prompt wound healing in this subgroup. Comparable rates of visual recovery between genders further support that biological rather than social factors influence visual rehabilitation post-repair 18-20.

Our data demonstrate that surgical repair within 12 hours in over two-thirds of cases likely contributed significantly to improved outcomes. Existing literature underscores the protective effect of early wound closure in preventing endophthalmitis, proteolysis, and secondary retinal damage: Ballouz et al and Qureshi et al reported up to 35% worse outcomes with delayed management. This emphasizes the need for heightened triage and referral protocols in emergency eye care 21-23.

The shift from 10% achieving ≥6/18 preoperatively to 24% at follow-up confirms that globe repair can yield functional improvement even when preoperative acuity is poor—a critical reassurance for patients and primary surgeons. These findings echo reports from El-Kashlan et al. and Jarrah

et al who achieved ≥20/40 vision in similar cohorts using standardized microsurgical techniques and early postoperative rehabilitation, reinforcing current repair protocols 24-25.

A key limitation is the absence of corneal topography and refractive data, which could elucidate astigmatic sequelae—recognized to affect visual quality significantly. Future studies aiming to integrate visual quality metrics, contrast sensitivity, and patient-reported outcomes will provide a more comprehensive picture. Nevertheless, the current dataset offers robust insight into straightforward anatomical repair outcomes.

In summary, this study contributes high-level evidence supporting early surgical repair of penetrating corneal tears, particularly in younger patients, within the South Asian context. It emphasizes rapid surgical intervention and demographic stratification, addressing underreported short-term visual outcomes in developing settings. These findings warrant integration into trauma protocols and reinforce the importance of ophthalmic emergency readiness.

CONCLUSION

Primary corneal tear repair within 24 hours results in meaningful visual acuity improvement in 26% of patients after eight weeks, with significantly better outcomes in individuals aged ≤30 years. This study fills the knowledge gap on short-term visual recovery from ocular trauma in a resourceconstrained setting and advocates for prompt surgical intervention and structured follow-up. Future research should explore refractive outcomes, patient-reported visual quality, and long-term recovery beyond the early postoperative period.

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