International Medicine
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Research Article

Section: Ophthatmology

# Evaluation of Surgical Outcome in Penetrating Keratoplasty in Adherent Leucoma and Leucoma Grade Corneal Opacity

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ARTICLE INFO

*Article History:*

Received: 29-06-2025

Accepted: 30-07-2025

**Keywords**:

Penetrating keratoplasty

Corneal opacity

Adherent leucoma

Visual outcome

Graft complications

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ABSTRACT

**Introduction:** Penetrating keratoplasty (PK) is a full-thickness corneal transplant where a diseased cornea is replaced with a donor graft. The outcome is influenced by multiple factors including donor-host compatibility, surgical precision, and follow-up care. In India, low literacy and socioeconomic barriers often hinder consistent postoperative monitoring. **Materials and Methods:** This prospective observational study was conducted over 18 months at a tertiary care center. Thirty patients with unilateral corneal opacity were enrolled-15 with adherent leucoma and 15 with leucomatous corneal opacity. Both genders were included. Detailed clinical histories were taken, and comprehensive ocular evaluations, including visual acuity testing with Snellen's chart, slit-lamp biomicroscopy, and ophthalmoscopy, were conducted. Additional imaging, such as orbital X-rays and B-scan ultrasound, was used when needed. Patients were followed up regularly to assess visual improvement and monitor for complications. **Results:** Of the 30 patients, 12 (40%) were male and 18 (60%) female, with mean ages of 52.8 years for leucomatous opacity and 55 years for adherent leucoma. Postoperative complications included corneal edema in 24 (80%) patients, epithelial defects in 4 (13.3%), anterior chamber reaction in 10 (33.3%), hyphema in 2 (6.6%), glaucoma in 3 (10%), loose sutures in 1 (3.3%), corneal vascularization in 3 (10%), and graft failure in 3 (10%). **Conclusion:** Penetrating keratoplasty is an effective treatment for restoring vision and anatomical integrity in corneal blindness, particularly in post-traumatic and post-ulcerative cases, thereby significantly contributing to visual rehabilitation.

## INTRODUCTION

The World Health Organization (WHO) estimates that approximately 6.8 million individuals globally are affected by corneal blindness, with visual acuity reduced to below 6/60 in at least one eye. Out of these, around 1 million people suffer from bilateral corneal blindness. If current trends persist, the number of individuals in India with corneal blindness is projected to rise to 10.6 million in the future [1].

Leucoma refers to a dense white opacity of the cornea that significantly impairs vision by obstructing the passage of light through the corneal surface. It commonly results from severe corneal infections, trauma, chemical injuries, or complications following ocular surgeries. In clinical practice, leucoma is classified based on the depth and density of the corneal scar, and when it involves complete scarring that extends into the deeper stromal layers, it is often termed as leucoma-grade corneal opacity. These opacities can be cosmetically disfiguring and functionally blinding, depending on their size and location, particularly if they involve the visual axis. Leucoma-grade corneal opacities pose a significant challenge to visual rehabilitation, especially when they are associated with additional anterior segment complications like synechiae or irregular astigmatism [2].

Adherent leucoma is a more complex form of leucoma in which the corneal opacity is accompanied by anterior synechiae-where the iris adheres to the back surface of the cornea-often following a perforated corneal ulcer or penetrating ocular trauma. This condition not only affects corneal clarity but also distorts the anterior chamber

anatomy, making surgical intervention more challenging. Penetrating keratoplasty in cases of adherent leucoma requires careful preoperative evaluation and precise intraoperative technique to restore the corneal structure and improve vision. Due to the altered ocular anatomy and frequent association with vascularization or inflammation, these eyes carry a higher risk of postoperative complications such as graft failure, glaucoma, or persistent epithelial defects. Therefore, both leucoma-grade opacities and adherent leucoma represent significant indications for corneal transplantation aimed at visual rehabilitation and anatomical restoration [3,4].

In India, corneal blindness currently affects around 1.2 million people, representing 0.36% of all blindness cases. Annually, an additional 25,000 to 30,000 individuals develop corneal blindness. A study from Andhra Pradesh revealed that 0.1% of the population suffers from corneal blindness, with an overall prevalence rate of 3.9%. Among these cases, 2.9% involve blindness in one eye only [5].

A recent Rapid Assessment of Avoidable Blindness (RAAB) survey (2015-2019) conducted by the National Program for Control of Blindness and Visual Impairment (NPCBVI), Government of India, found that corneal blindness is the second most common cause of blindness, accounting for 8.2% in individuals aged 50 years or older. Additionally, corneal blindness is the leading cause of blindness in those aged between 0 and 49 years, representing 37.5% of cases [6].

Penetrating keratoplasty is a surgical technique that involves the complete removal of a diseased or damaged cornea and its replacement with a full-thickness donor corneal graft [7]. This procedure is distinctive among transplants because the cornea lacks blood vessels, receiving minimal vascular supply only at the limbus. This avascularity renders the cornea immunologically privileged, reducing the risk of graft rejection compared to other organ transplants, and thereby enhancing the likelihood of graft survival and visual rehabilitation in eligible patients [8-10].

Full-thickness penetrating keratoplasty is a corneal transplant procedure where a trephine is used to remove the full thickness of the patient's cornea, which is then replaced with a full-thickness donor corneal graft. Several factors influence corneal transparency after the procedure, including the type of donor material, the condition of the recipient's eye, the surgical technique, and post-operative care [11].

Corneal blindness presents with varying prevalence and etiologies across different regions of the world, influenced by factors such as local healthcare infrastructure, socioeconomic conditions, and endemic diseases. The success of penetrating keratoplasty, particularly in terms of graft survival and the incidence of postoperative complications, is closely linked to several key variables. These include the primary indication for transplantation, the recipient's ocular and systemic health status, the quality and handling of donor corneal tissue, surgical expertise, and the adequacy of postoperative follow-up, all of which vary regionally [12].

A major obstacle to the success of penetrating keratoplasty in India is the socioeconomic and educational status of many patients, who often belong to underprivileged communities and lack literacy. These factors hinder their ability to understand and adhere to essential postoperative care and follow-up schedules, which are critical for graft survival and optimal visual outcomes. In light of these challenges, this study aims to assess the visual outcomes in patients undergoing penetrating keratoplasty under such real-world conditions [13-17].

The aim of the present study was to evaluate the surgical outcomes of penetrating keratoplasty in patients with adherent leucoma and leucoma-grade corneal opacity. The objective was to assess improvements in visual acuity following surgery and to analyze the incidence and types of postoperative complications. The study also aimed to compare outcomes between the two groups to understand the influence of preoperative factors on graft survival and overall visual rehabilitation.

## MATERIALS AND METHODS

This prospective observational study was conducted at the Department of Ophthalmology, at a tertiary care centre from May 2022 to 31st October 2023 for 18 months. Ethical approval has been obtained from the Ethical Approval Committee at a tertiary care centre.

### Study Population

The study population included 30 patients with unilateral corneal opacity, comprising 15 cases of adherent leucoma and 15 of leucoma-grade corneal opacity, of either gender. Inclusion criteria were: patients attending the ophthalmology OPD of a tertiary care centre, aged between 18 and 60 years, with adherent leucoma or leucoma-grade corneal opacity, normal posterior segment, and willingness to give consent. Exclusion criteria included absence of light perception, abnormal intraocular pressure, diabetes, chronic dacryocystitis, or refusal to consent.

### Data Analysis

All data were collected from primary sources through individual interviews, observations, and complete ophthalmic examinations using a structured proforma, with detailed documentation of complications and their management. Continuous variables were summarized using mean and standard deviation, while categorical variables were presented as frequencies and percentages. Fisher's exact test or chi-square test assessed differences in categorical variables, and Student's t-test or Mann-Whitney U test evaluated differences in continuous variables. A p-value $<0.05$ was considered statistically significant. Statistical analysis was performed using STATA 11.0.

## RESULTS

This were a prospective observational study of surgical outcome in patients with leucomatous opacity and

adherent leucoma treated with penetrating keratoplasty. Total 30 cases were included in the study. out of 30 cases,15 (50.0%) cases of leucomatous opacity and 15 cases of adherent leucoma were studied.

**Table 1: Demographic Profile of Study Participants**

| Age in years | Gender | | TOTAL |
|---|---|---|---|
| | **Male (%)** | **Female (%)** | |
| **20 – 40** | 4(57.14) | 3(42.86) | 7(23.33) |
| **41-60** | 2(18.18) | 9(81.82) | 11(36.67) |
| **>60** | 6(50.0) | 6(50.0) | 12(40.0) |
| Total | **12(40.0)** | **18(60.0)** | **30** |

In our study, out of 30 patients who underwent penetrating keratoplasty, 12(40.0%) were males and 18 (60.0%) were females. Age of the participants ranges from 20 years to 75 years. Mean age was 53.9 years with standard deviation of 15.75 years. Median was 59 years, Mode was 65 years. Skewness of -0.7012 and skew p is -0.6843. Majority were in the age group of more than 60 years (40.0%) followed by 36.67% in the age group of 41-60 year

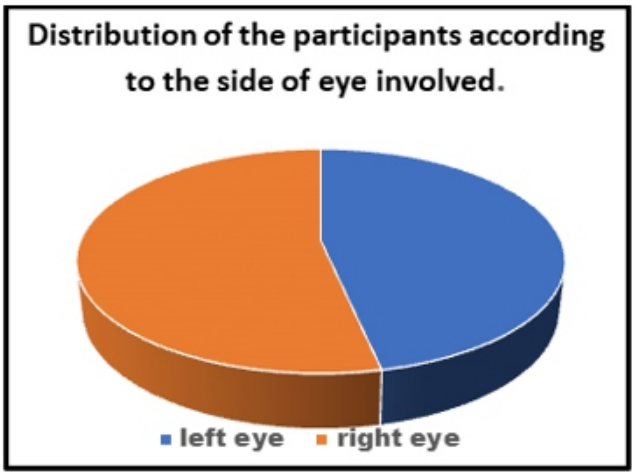


**Figure 1: Distribution of the Study Participants According to the Side of Eye Involved**

Out of 30 study participants, 14(46.6%) had their ri-ght eye involved while in 16(53.33%) cases left eye was affected.

**Table 2: Distribution of Study Participants According to Age and the Indication for Penetrating Keratoplasty**

| **Age** | **Leucomatous opacity** | **Adherent leucoma** | **Total** | |
|---|---|---|---|---|
| **20-40** | 3(20.0) | 4(16.67) | 7(23.33) | **P=0.5235** |
| **41-60** | 7(46.67) | 4(16.67) | 11(36.67) | |
| **>60** | 5(33.33) | 7(46.67) | 12(40.0) | |
| **Total** | 15(100.0) | 15(100.0) | 30(100.0) | |

In our study, out of 30 cases, 15 (50.0%) were of leucomatous opacity and 15 (50.0%) were of adherent leucoma. Among the 15 cases of leucomatous opacity, majority (7: 46.67%) were in the age group of 41-60 years followed by 5(33.33%) were in the age group of more than 60 years and 3(20.0%) were in the age group of 20-40years. Among the 15 cases of Adherent leucoma, majority 7(46.67%) were in the age group of more than 60 years followed by 4(16.67%) in each group of 20-40years and 41-60 years. mean age of all those with leucomatous opacity was 52.8years (SD 15.14) while mean age of all those with adherent leucoma was 55 years (SD17.29). Two groups did not differ with respect to age. This difference is not significant statistically.

**Table 3: Distribution of Study Participants According to Gender and the Indication for Penetrating Keratoplasty**

| Gender | Leucomatous opacity (%) | Adherent leucoma (%) | Total (%) | |
|---|---|---|---|---|
| **Male** | 7(46.67) | 5(33.33) | 12 (40.0) | P= **0.4561** |
| **Female** | 8(53.33) | 10 (66.67) | 18 (60.0) | |
| **Total** | 15(100.0) | 15 (100.0) | 30 (100.0) | |

In this study, out of 30 cases 12(40.0%) were males while 18(60%) were females. Among the cases of leucomatous opacity, 46.67% were males while 53.33% were females. and in cases with adherent leucoma cases, 40% were male and 60% were females. This difference was not significant statistically. Hence our groups were comparable with respect to age and gender.

**Table 4: Distribution of the Study Participants According to the Preoperative Visual Acuity**

| Visual acuity | Leucomatous opacity (%) | Adherent leucoma (%) | Total (%) |
|---|---|---|---|
| **PL/PR** | 6(40.0) | 12(80.0) | 18(60.0) |
| **HM+ PL+PR** | 0 | 2(13.33) | 2(6.67) |
| **FCCF** | 5(33.33) | 1(6.67) | 6(20.0) |
| **1/60** | 3(20.0) | 0 | 3(10.0) |
| **2/60** | 1(6.67) | 0 | 1(3.33) |
| **Total** | 15(100.0) | 15(100.0) | 30(100.0) |

In our study, 40% cases of leucomatous opacity had preoperative visual acuity only for hand movements and below i.e. perception of light. while 93.33% cases of adherent leucoma had preoperative visual acuity of hand movements and below i.e. perception of light. This difference was found to be statistically significant.

**Table 5: Showing Surgery Performed**

| Type of surgery | Leucomatous opacity | Adherent Leucoma | Total |
|---|---|---|---|
| **PK only** | 8 | 3 | 11 |
| **PK+PCIOL** | 2 | 15 | 17 |
| **PK+Aphakia** | 0 | 2 | 2 |
| **Total** | 10 | 20 | 30 |

In our study, Penetrating keratoplasty performed in 11 cases, PK+ PCIOL procedure performed in 17 cases and 2 patients PK performed but kept aphakic.

**Table 6: Shows Post-Operative Complications**

| Post-operative complications | No. of cases (30) | Percentage |
|---|---|---|
| **Corneal oedema** | 24 | 80% |
| **Epithelial defect** | 4 | 13.33% |
| **Ac reaction** | 10 | 33.33% |
| **Hyphaema** | 2 | 6.66% |
| **Glaucoma** | 3 | 10% |
| **Loose suture** | 1 | 3.33% |
| **Corneal vascularization** | 3 | 10% |
| **Graft failure** | 3 | 10% |

In this study shows postoperative complications, corneal oedema occurs 24 (80%) patients, Epithelial defect in 4 (13.33%) patients, AC reaction in10(33.33%), Hyphema in 2(6.66%), Glaucoma in 3(10%), Loose suture in 1(3.33%), Corneal Vascularization in 3(10%), Graft failure in 3(10 %) patients.

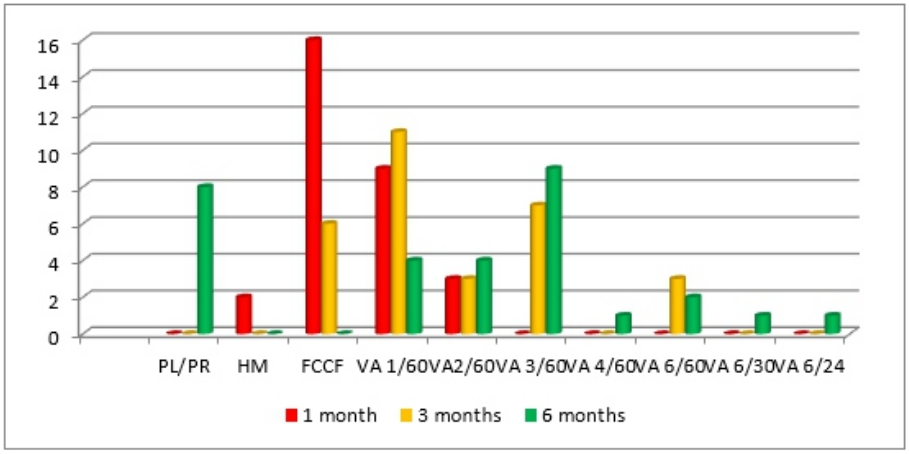


**Figure 2: Distribution of the Cases According to the Post-Operative Visual Acuity at 1 Month, 3 Months and 6 Months**

Figure shows that visual acuity is improving at subsequent follow up visits except in 4 cases where graft was failed.

**Table No. 7: Distribution of the Cases According to the Outcome of the Graft.**

| Graft outcome | Leucomatous opacity (%) | Adherent leucoma (%) | Total (%) | |
|---|---|---|---|---|
| **Graft Failed** | 1(6.67) | 3(20.0) | 4(13.33) | **P=0.2827** |
| **Graft successful** | 14(93.33) | 12(80.0) | 26(86.67) | |
| **Total** | 15(100.0) | 15(100.0) | 30(100.0) | |

This study shows that, out of 30, 4 grafts failed and 26 were successful. out of 4 failed grafts, 3 had adherent leucoma while only one had leucomatous opacity. However, this difference was not significant statistically.

## DISCUSSION

This study was a prospective observational analysis of the surgical outcomes in patients with leucomatous opacity and adherent leucoma who were treated with penetrating keratoplasty.A total of 30 cases were included in the study, with 15 cases (50%) of leucomatous opacity and 15 cases of adherent leucoma being examined.

In the study by Poorva Shrivastava et al, the youngest patient was an 18-year-old male, while the oldest was a 72-year-old male. Most patients (63.3%) were in the 40-60 years age group. The mean age of presentation in their study was 51.1 years, with a higher prevalence in males. out of 30 cases, preoperative visual acuity was notably low, with 86.7% (26 patients) having hand movements (HM), perception of light (PL+), or perception of light with projection (PR+), while 13.3% (4 patients) had relatively better preoperative visual acuity of counting fingers (CF) at 1-3 feet. The majority presented with very low visual acuity initially: 11 cases had a visual acuity of projection of light, 5 cases had hand movements, 10 cases had vision close to face, and 4 cases had counting fingers at 1-2 feet. At the final follow-up, 17 cases (56.66%) achieved a visual acuity of better than 6/60, while 6 cases (20%) had a final visual acuity of less than 6/60. Additionally, 5 cases (16.66%) had a visual acuity of counting fingers at 1-3 feet at the 6-month follow-up, and 2 cases (6.66%) had a visual acuity of hand movements at the final follow-up [18].

Regarding host risk factors and graft clarity, 8 patients with vascularization showed varied outcomes at the 6-month follow-up: 3 had clear grafts, 4 had hazy grafts, and 1 had an opaque graft. Among 2 patients with preoperative bullous cornea, 1 had a clear graft and 1 had a hazy graft. Similarly, among 2 patients with preoperative infiltration, 1 had a clear graft and 1 had a hazy graft. Postoperative complications included vascularization in 50% of the patients, secondary glaucoma or raised intraocular pressure (IOP) in 3%, suture-related complications (loose sutures) in 6.7%, and graft failure in 6.7%. Visual improvement was observed in 7 of 9 cases of pseudophakic bullous keratopathy, with 6/60 or better on the Snellen chart, while 1 case had visual acuity <6/60 and another had CF at 1-3 feet. For adherent leucoma, 5 of 8 cases showed visual improvement to 6/60 or better, and 2 cases had visual acuity of CF at 1-3 feet at the 6-month follow-up [18].

Studied, most of the patients who underwent PK are between 40 and 60 years. The mean age of the patients was 51.84 ± 13.74. The male: female ratio in the present study is close to 2:1. Among 71 patients, about 48% had a preoperative best-corrected visual acuity (BCVA) of perception of light or worse. Postoperatively, approximately 66% achieved a BCVA of 6/36 or better. Eighteen patients underwent penetrating keratoplasty combined with posterior chamber intraocular lens implantation, and two had PK combined with aphakia and anterior vitrectomy. the most common immediate postoperative complication was graft oedema, occurring in 28% (n=20) of patients. This was followed by fibrin reaction in the anterior chamber in 10% (n=7) of cases. Other complications included epithelial detachment that did not resolve with maximum topical lubrication and required a bandage contact lens (8.5%, n=6), shallow anterior chamber (8.5%, n=6), Descemet's membrane detachment (6%, n=4), and raised intraocular pressure, primarily due to retained viscoelastic substance in the anterior chamber (4%, n=3). Additionally, hyphema was observed in 4% (n=3) of cases, loose sutures requiring resuturing in 3% (n=2), and choroidal detachment in 1% (n=1). Persistent epithelial defect (PED) was defined as an epithelial defect that persisted for more than a week despite maximum topical lubrication. the survival rates for first-time corneal grafts were 79.6% at one year, 68.7% at two years, and 46.5% at five years. In this study, 65% of patients achieved a final best-corrected visual acuity (BCVA) of 6/36 or better [19].

In the study by the mean age of recipients was 39.88 years with a standard deviation of ±2.9 years [20].

Studied, the majority of patients experienced an improvement in visual acuity. Preoperatively, 12 cases (30%) had a visual acuity of perception of light (PL+), which decreased to 9 cases (22.5%) postoperatively with the same acuity. Postoperative visual acuity improved to up to 3 feet in 13 cases (32%), up to 6/36 in 5 cases (12.5%), and up to 6/18 in 3 cases (7.5%). Out of 40 cases, 32 cases of penetrating keratoplasty (PKP) showed complications. The most common issue was graft oedema, observed in 10 cases, followed by epithelial defects, suture infiltration, and stromal haze, which were present in 6, 3, and 3 cases, respectively. Graft rejection was noted in 4 cases. Visual acuity improved in most patients. Preoperatively, 12 cases (30%) had a visual acuity of perception of light (PL+), while postoperatively, only 9 cases (22.5%) retained similar visual acuity. Postoperative visual acuity of up to 3 feet was observed in 13 cases (32%), up to 6/36 in 5 cases (12.5%), and up to 6/18 in 3 cases (7.5%).out of 4 cases of graft rejection, 1 was attributed to secondary endophthalmitis, 2 to secondary infection of the graft, and 1 to secondary glaucoma. The preoperative risk factors for graft rejection identified in this study included incomplete or partially treated ulcers in 3 cases and repaired corneal tears with adherent leucoma [21].

## CONCLUSION

The study aimed to evaluate visual outcomes in patients undergoing penetrating keratoplasty by assessing visual acuity at 6 months post-surgery. The results showed that penetrating keratoplasty for optical indications generally led to favourable visual improvements. The study also explored the correlation between preoperative host factors and the final graft outcome, noting that superficial and deep vascularization, anterior synechiae, and corneal

hypoesthesia were strongly associated with poorer graft outcomes. Thorough evaluation of recipients regarding both local and systemic risk factors is crucial for optimizing graft survival. However, the study had some limitations, including a small sample size that restricted statistical analysis.

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**How to cite:** Arati Shankar Mule, Akshay Padgilwar, Tejaswini Gondane. Evaluation of Surgical Outcome in Penetrating Keratoplasty in Adherent Leucoma and Leucoma Grade Corneal Opacity. *International Medicine. 2025;11(1):1-7.*