ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 09 | September - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A STUDY ON CLINICAL PROFILE AND VISUAL OUTCOME OF PATIENTS UNDERGOING PENETRATING KERATOPLASTY

Ophthalomology

Dr Sumeet Deshpande DO, DNB, Professor, Department of Ophthalmology, Mahadevappa Rampure Medical College, Kalaburagi, Karnataka

Dr. Anusha P Kulkarni* Final Year Resident, Department of Ophthalmology, Mahadevappa Rampure Medical College, Kalaburagi, Karnataka *Corresponding Author

Dr Manjula Mangane M.S. Ophthalmology, Professor and HOD, Mahadevappa Rampure Medical College, Kalaburagi, Karnataka

Dr Kavita Salagar M.S. Ophthalmology, Professor, Mahadevappa Rampure Medical College, Kalaburagi, Karnataka

ABSTRACT

Background: Penetrating Keratoplasty is where a diseased corneal tissue is replaced by donor corneal tissue in its entirety. **Objectives:** To assess the clinical profile and visual outcome of patients undergoing penetrating keratoplasty. **Methodology:** The study was done among 60 patients attending outpatient department of Ophthalmology OPD of a Basaveshwar Teaching and General Hospital, Mahadevappa Rampure Medical College, Kalaburagi **Results:** In this prospective observational study, subjects undergoing penetrating keratoplasty were enrolled under strict inclusion criteria. 41.66% of the patients were in the age group of 40-50 years, and 50-60 years each. Majority of our subjects were from rural background, among whom manual laborer and farmers were the highest. The visual acuity was better in both the groups at 3rd month follow up. 51.6% were selected for Therapeutic Penetrating Keratoplasty procedure, while 48.4 % were selected for Optical Penetrating Keratoplasty procedure. **Conclusion:** Farmers were found be most occupation undergoing Therapeutic Penetrating Keratoplasty. Non healing corneal ulcer and Bullous keratopathy were found to be common indication in Therapeutic Penetrating Keratoplasty and Optical Penetrating Keratoplasty respectively. There was significant difference in visual outcome in both the procedures compared with their pre op vision, although OPK yielded better result.

KEYWORDS

Therapeutic Penetrating Keratoplasty, Optical Penetrating Keratoplasty

INTRODUCTION

Damage to the cornea, which can result in vision loss or blindness, may arise from a variety of causes. These include infections, poor nutrition, inflammation, inherited disorders, medical interventions (iatrogenic causes), and degenerative diseases. The types and frequency of corneal diseases vary depending on the environment. In many low- and middle-income countries, infectious keratitis remains the leading cause of corneal damage. [1]

Blindness caused by corneal disease is a major global health issue, but understanding its distribution is challenging due to the diverse range of infections and inflammatory conditions it includes. The prevalence of corneal blindness is not uniform—it differs widely across countries and even among different communities. These differences are largely shaped by factors such as the availability of eye care services and the overall quality of healthcare. [2]

While corneal blindness is the fifth most common cause of blindness worldwide—preceded by cataracts, glaucoma, refractive errors, and age-related macular degeneration—it holds greater significance in India. According to the National Blindness and Visual Impairment Survey conducted between 2015 and 2019, corneal blindness is now identified as the third leading cause of blindness in the country. [3,4]

The National Programme for Control of Blindness (NPCB) (2015–19) data were retrieved through a Rapid Assessment of Avoidable Blindness (RAAB) survey conducted randomly in 31 districts of India over a population of >50 years of age. Blindness prevalence varies across regions, with Bijnor in Uttar Pradesh recording the highest rate at 3.7%, and Thrissur in Kerala showing the lowest at 1.1%. Corneal diseases resulting from infections and trauma have been identified as the second leading cause of complete blindness. According to a global meta-analysis covering the period from 1984 to 2020, approximately 5.5 million individuals are bilaterally blind due to corneal opacities, while 6.2 million are affected by blindness in one eye. [5]

In full-thickness penetrating keratoplasty, the entire corneal layer is replaced through a surgical procedure. A trephine is used to excise the central portion of the patient's cornea, matching the size of the donor graft. A full-thickness donor cornea is then placed into the opening. To ensure stability and reduce the risk of post-operative astigmatism, sutures—either interrupted, continuous, or a combination—are applied evenly in a radial pattern with uniform tension. [6]

MATERIAL AND METHODS

A prospective study was conducted on patients presenting to the Department of Ophthalmology at Basaveshwar Teaching and General Hospital, affiliated with Mahadevappa Rampure Medical College, Kalaburagi, India. The study took place from May 1st, 2023, to October 31st, 2024, over a period of 18 months. A sample size of 60 patients was taken.

Sample Size:60

N= sample size for study group

Authors: Dr Sumeet Deshpande, Dr Anusha P Kulkarni

Ethical clearance was obtained from an ethical clearance committee prior to the commencement of study.

Patients were selected after applying the inclusion and exclusion criteria. Inclusion criteria included all the patients registered in cornea clinic and in waiting list for penetrating keratoplasty in the Department of Ophthalmology, Basaveshwar Teaching and General Hospital, Kalaburagi; age between 15-80 years; non healing corneal ulcer; best corrected visual acuity <6/36; corneal opacity in visual axis; impending perforation and perforated corneal ulcer; best corrected visual acuity <6/36. Exclusion criteria ruled out patients with posterior segment abnormality; non healing corneal ulcer with endophthalmitis; lid anomalies; raised intraocular pressure.

Each patient's information was collected using a structured proforma, and a detailed medical history was obtained, including any previous treatments.

Data was captured in the case record form [CRF], that were broadly classified into

Demographic Characteristics: Name, age, sex, address, contact details, monthly income, languages known, occupation, educational level, rural/ urban.

Patient history – Complaints with duration, history of presenting illness, past history, family history, personal history, medical history was noted

Clinical examination: General physical examination, vitals, BP, PR, RR, systemic examination, local examination, ocular examination – facial symmetry, head posture, ocular alignment, extra ocular movement, visual acuity of right and left eye, slit lamp examination of eye lids, conjunctiva, cornea, sclera, anterior chamber, iris, pupil; reaction to light, fundus examination were noted.

Investigations – Routine blood investigations and urine investigations was done
Follow ups: Follow ups on visual acuity of left and right eye was done. Patients' questionnaire with respect to cooperation was noted.

Data is analyzed using SPSS software version 21 and Excel. Categorical variables are given in the form of frequency table. Continuous variables are given in Mean ± SD/ Median (min, max) form. Normality was checked by Shapiro wilk test. If data followed normality, then parametric test like RM-ANOVA test will be conducted, otherwise Friedman's test will be used. P-value less than or equal to 0.05 indicates statistical significance.

RESULTS

Data contains measurements of 60 subjects undergoing penetrating keratoplasty.

The following tables provides the details.

Table 1: Age Distribution of Patients

Age in years	Total	OPK	TPK
20-30	4	4	0
30-40	0	0	0
40-50	25	10	15
50-60	25	12	13
60-70	6	3	3
Mean ± SD	49.35 ± 8.75	47.96 ± 11.34	50.64 ± 5.2

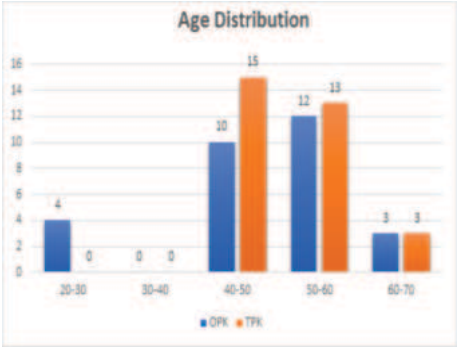

Fig 1: Age Distribution of Patients

Fig 1 shows the age distribution, we saw that majority [n=25; 41.66%] of the patients were in the age group 40-50 years and 50-60 years distributed equally. The OPK group had 10 patients in 40-50 years and 12 in 50-60 years, while the TPK group had 15 patients in 40-50 years and 13 in 50-60 years. Later followed by 6 in 60-70 years, where OPK and TPK had 3 patients each. There were only 4 patients in 20-30years group in OPK group.

Table 2: Distribution of Subjects on Socio-demographic Details Over Operative Procedure

Variable	Subcategory	Operative procedure				Total
		OPK (n=29)		TPK (n=31)		
		Count	%	Count	%	
Sex	Female	11	37.9%	10	47.6%	21 (35%)
	Male	18	62.1%	21	53.8%	39 (65%)
Place	Rural	20	69.0%	24	54.5%	44 (73.3%)
	Urban	9	31.0%	7	43.8%	16 (26.7%)
Occupation	Construction worker	2	6.9%	1	33.3%	3 (5%)
	Factory worker	3	10.3%	0	0.0%	3 (5%)
	Farmer	1	3.4%	12	92.3%	13 (21.7%)
	Fisherman	0	0.0%	2	100.0%	2 (3.3%)
	Housewife	4	13.8%	5	55.6%	9 (15%)
	Land owner	1	3.4%	0	0.0%	1 (1.7%)
	Manual labourer	6	20.7%	2	25.0%	8 (13.3%)
	Shopkeeper	3	10.3%	3	50.0%	6 (10%)
	Student	4	13.8%	0	0.0%	4 (6.7%)
	Teacher		0.0%	1	100.0%	1 (1.7%)
	Unemployed	5	17.2%	5	50.0%	10 (16.7%)

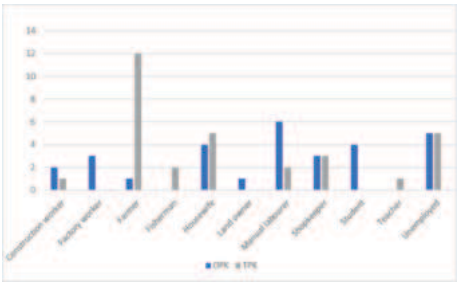

Figure 2: Distribution of Subjects Based on Occupation Over Procedure Type

Table 2 shows the sociodemographic data, we noted that male patients were predominant representing 39(65%) and 21(35%) were females. Male to female ratio was 1.8:1. Male preponderance seen in OPK and TPK category was 18 (62.1%) and 21 (53.8%) respectively.

Fig 2 shows majority of our subjects were from rural background, among whom manual laborer(20.7%) were the highest, followed by unemployed (17.2%)in OPK group, while in TPK farmers(92.3%) constituted majority.

Table No.3: Surgical Procedure Wise Distribution of Patients

Procedures	Associated procedures	Number of patients	Percentage
THERAPEUTIC PK (TPK)	----	31	51.6
OPTICAL PK (OPK)	Plain	22	36.7
	SICS with PCIOL	6	10.0
	SICS without PCIOL	1	1.7
	Total	29	48.4
Grand Total		60	100.0

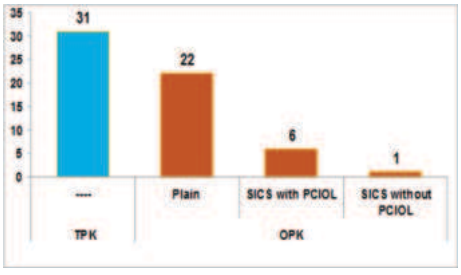

Figure 3: Distribution of Subjects Based on Surgical Procedure

Table 3, Fig 3 indicate surgical procedure; 31 (51.6%) of patient's surgical procedure was Therapeutic Penetrating Keratoplasty (TPK) and 29 (48.2%) of patient's surgical procedure was Optical Penetrating Keratoplasty (OPK), among which the associated procedures were, 22 (36.7%) of patient's surgical procedure was Plain OPK, 6 (10.0%) of patient's surgical procedure was SICS with PCIOL and 1 (1.7%) of patient's surgical procedure was SICS without PCIOL insertion.

Table No.4: Diagnosis Wise Distribution of Patients

Procedure	Diagnosis	Number of patients	Percentage
Therapeutic PK	Non healing corneal ulcer (bacterial, fungal and acanthamoeba)	14	23.2
	Non healing fungal corneal ulcer	6	9.9
	Non healing bacterial corneal ulcer	5	8.3
	Non healing acanthamoeba corneal ulcer	3	5
	Perforated corneal ulcer (bacterial, fungal and acanthamoeba)	13	21.7
	Perforated fungal corneal ulcer	9	15
	Perforated bacterial corneal ulcer	4	6.7
	Anterior staphyloma	4	6.7

Optical PK	Bullous keratopathy (Pseudophakic, Aphakic)	9	15.0
	Pseudophakic bullous keratopathy	5	8.3
	Aphakic bullous keratopathy	4	6.7
	Corneal scarring (Adherent leucoma and leucomatous corneal opacity)	7	11.7
	Graft failure	5	8.3
	Corneal degeneration (CDK)	4	6.7
	Corneal dystrophy (Macular cornel dystrophy)	3	5.0
	Keratoconus	1	1.7
Total	---	60	100.0

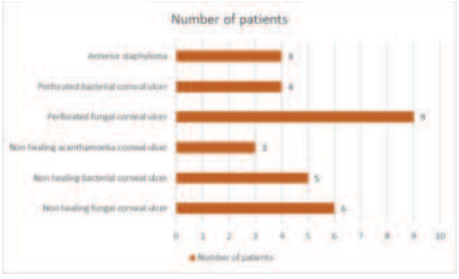

Figure 4: Distribution of Subjects Based on Different Diagnosis of TPK

Figure 5: Distribution of Subjects Based on Different Diagnosis of OPK

Table 4, Fig 4 shows; the surgical procedure of TPK; majority of patients 14 (23.2%) were diagnosed non healing corneal ulcer among which non healing fungal corneal ulcer 6 (9.9%) was most common, followed by 13 (21.7%) of patients were diagnosed perforated corneal ulcer(21.7%) among which perforated fungal corneal ulcer(15%) was more common and 4 (6.7%) of patients were diagnosed anterior staphyloma.

Furthermore Fig 5 shows that in the surgical procedure of OPK; majority of patients 9 (15.0%) were diagnosed bullous keratopathy among which pseudophakic bullous keratopathy 5 (8.3%)was more common, followed by 7 (11.7%) of patients were diagnosed corneal scarring (Adherent leucoma and leucomatous corneal opacity), 5 (8.3%) of patients were diagnosed graft failure, 4 (6.7%) of patients were diagnosed corneal degeneration (CDK), 3 (5.0%) of patients were diagnosed corneal dystrophy (macular cornel dystrophy) and 1 (1.7%) of patients was diagnosed keratoconus.

Table No.5: Complications Wise Distribution of Patients

Time period	Complications	Number of patients	Percentage
Intra OP	Nil	59	98.3
	PC Rent	1	1.7
	Total	60	100.0
Early Post-OP Day-1—1 week	Nil	46	76.7
	Mild AC reaction	6	10.0
	Epithelial defects	3	5.0
	Wound leak	3	5.0
	Hyphema	2	3.3
	Total	60	100.0
Late Post-OP 6—12 weeks	Nil	52	86.6
	Raised IOP	4	6.7
	Graft failure	2	3.3
	Epithelial down growth	1	1.7
	Suture infiltrate	1	1.7
	Total	60	100.0

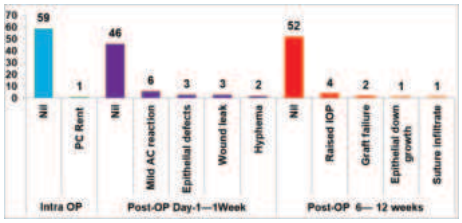

Figure 6: Distribution of Subjects Based on Complications of PK

Table 5, Fig 6 demonstrates that; intra-op complication was seen in 1 (1.7%) patient that is posterior capsule (PC) rent. Early post-op (day1 to 1 week) complications were observed in 14 (23.3%) of patients. Among them 6 (10.0%) of patients were seen the complication of mild AC reaction which was most common, 3 patients each were seen having epithelial defects and wound leak respectively. Late post-op (6—12 weeks) complications were seen in 8 (13.4%) of patients, among them 4 (6.7%) of patient's complication was seen raised IOP, 2 (3.3%) of patients were seen graft failure and each 1 patient were observed epithelial down growth and suture infiltrate.

Table No.6: Comparison of Vision in Optical PK

Vision	Pre-Operative		Final follow-up at 3 months	
	No.	%	No.	%
PL+, PR+	4	13.8	0	0.0
HMCF – CF2m	22	75.9	4	13.8
CF3m – 6/60	3	10.3	4	13.8
6/36 – 6/18	0	0.0	15	51.7
>6/18.	0	0.0	6	20.7
Total	29	100.0	29	100.0
X2 test, P-value	X2= 37.604, P = 0.000, HS			

NS= not significant, S=significant, HS=highly significant

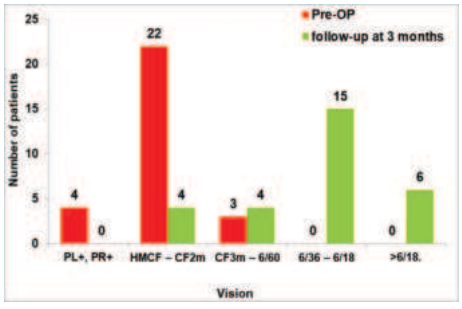

Figure 7: Comparison of Vision in Optical PK

Study reveals that; there was statistically highly significant difference of visual acuity at presentation (pre-operative) comparison with final follow-up at 3 months in OPK (P<0.001)

Table 6, Fig 7 shows that in OPK category all cases had pre op visual acuity <6/60, most of them (n=22,75.9%) having HMCF-CF2m, while the post op vision at 3rd month had maximum number of cases (n=15,51.7%) with vision 6/36-6/18 and only (n=4,13.8%) with vision HMCF-CF2m.

Number of patients who achieved vision >6/18 is n=6, 20.7% at post op 3rd month while there were no cases >6/18 vison pre operatively.

Table No.7: Comparison of Vision in Therapeutic PK

Vision	Pre-Operative		Final follow-up at 3 months	
	No.	%	No.	%
PL+, PR+	5	16.2	0	0.0
HMCF – CF2m	25	80.6	17	54.8
CF3m – 6/60	1	3.2	5	16.2
6/36 – 6/18	0	0.0	8	25.8
>6/18.	0	0.0	1	3.2
Total	31	100.0	31	100.0
X2 test, P-value	X2= 18.190, P = 0.001, HS			

NS= not significant, S=significant, HS=highly significant

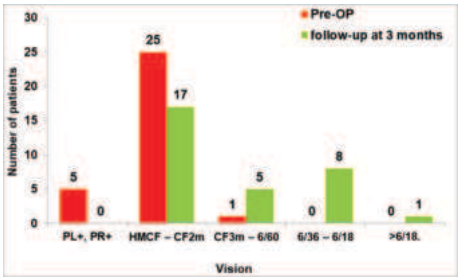

Figure 8 : Comparison of Vision in Therapeutic PK

Study reveals that; there was statistically highly significant difference of visual acuity at presentation (pre-operative) comparison with final follow-up at 3 months in therapeutic PK (P<0.001)

Table 7, Fig 8 shows that in the TPK category also all the patients had pre op visual acuity <6/60, most of them (n=52,80.6%) having vision HMCF-CF2m, while in the post 3rd month still had most patients in the range of HMCF-CF2m but the number was reduced(n=17,54.8%). This was followed by patients having visual acuity 6/36-6/18 (n=8,25.8%). Only 1 patient achieved vision >6/18.

DISCUSSION

1. Age and Sex

Our study data contains measurements of 60 subjects undergoing penetrating keratoplasty. With respect to the age distribution, we saw that majority [n=25; 41.66%] of the patients were in the age group of 40-50 years, and 50-60 years each. The OPK group had 10 patients in 40-50 years and 12 in 50-60 years, while the TPK group had 15 patients in 40-50 years and 13 in 50-60 years. Majority of the patients were male in both the groups, 62.1% and 53.8% in OPK and TPK groups respectively, overall, the mean age was 49.35±8.75. A study done by Keshav BR et al [7] have similar results. Among the 188 patients studied, males comprised 121 individuals (64.36%), while females accounted for 67 individuals (35.73%). Regarding age, 24 patients(12.76%) were younger than 30 years, 43 patients(22.87%) were between 30 and 60 years, and the majority, 121 patients(64.36%), were over 60 years old. These findings suggest that corneal ulcers are more common in males and in people over 60. In another study by Singh G et al., which examined patients aged 41 to 70 years, 26(86.67%) out of 30 cases were male, compared to 4 cases(13.33%) who were female.

2. Sociodemographics

With respect to sociodemographic data, we noted that majority of our subjects were from rural background, among whom manual laborer were the highest (20.7%), followed by unemployed (17.2%) in OPK group, while in TPK farmers constituted majority (92.3%). In a comparable study by Amar SP et al[9]., n = 29 (61.7%) of the participants were from a lower socioeconomic status. The study population included 21 unemployed individuals, 13 farmers, 7 manual laborers, 3 students, and 3 teachers. According to Manu et al[10]., 54% of the study subjects were employed in active work including agriculture, construction, and industrial jobs. Many women who managed household responsibilities also worked part-time in beedi making. Most patients who underwent penetrating keratoplasty (83%) came from rural regions.

3. Visual Acuity

The visual acuity in our study was noted preoperatively and post operatively after 3 months of surgery in both OPK and TPK group.

In OPK category all cases had pre op visual acuity <6/60, most of them (n=22,75.9%) having HMCF-CF2m, while the post op vision at 3rd month had maximum number of cases (n=15,51.7%) with vision 6/36-6/18 and only (n=4,13.8%) with vision HMCF-CF2m. 6 patients (20.7%) achieved vision >6/18.

In the TPK category also all the patients had pre op visual acuity <6/60, most of them (n=52,80.6%) having vision HMCF-CF2m, while post 3rd month still had most patients in the range of HMCF-CF2m but the number was reduced(n=17,54.8%). This was followed by patients having visual acuity 6/36-6/18 (n=8,25.8%). Only 1 patient (3.2%) achieved vision >6/18. According to Singh G et al[8]., after six months, 10 cases (33.33%) had a final pinhole visual acuity exceeding 6/60. Additionally, 5 cases (16.67%) achieved vision between 4/60 and 6/60. In the study by Gangandeep et al[12]., preoperative vision in the affected eye was recorded as perception of light with projection (PL+PR+) in 2 cases (10%). Hand movement vision was observed in 8 cases (40%), and finger counting at 1 meter was noted in 10 cases (50%). Among the fellow eyes, 4 cases (20%) had cataracts, 5 cases (25%) showed no perception of light (PL-), 5 cases (25%) had similar pathological findings, and 4 cases (20%) had normal vision. At the six-month postoperative assessment, visual acuity outcomes varied: 1 case achieved 6/36, 1 case 6/60, 1 case 5/60, 5 cases 4/60, 3 cases 3/60, 1 case 2/60, 3 cases could count fingers at 1 meter, 3 cases perceived hand movements, 2 cases had PL+PR+, and no cases had no light perception. In a study by Doren GS et al[13]., 41 patients received penetrating keratoplasty for corneal opacity resulting from trauma. Of the 39 patients who completed one-year follow-up, 20 (51%) attained visual acuity of at least 6/60.

In a separate study, Rao SK et al.[14] reported that half of the patients attained visual acuity greater than 6/60. Our study's final visual outcomes align closely with the findings of these previous investigations.

5. Diagnosis

In the present study, distribution of the subjects according to diagnosis was done over OPK and TPK. In OPK group, we noticed that majority of patients had bullous keratopathy (15%) among which pseudophakic bullous keratopathy was more common; followed by corneal scarring (11.7%). While in TPK, non-healing corneal ulcer (23.2%) was more common among which non healing fungal corneal ulcer was found to be more common; this was followed by perforated corneal ulcer (21.7%) among which perforated fungal corneal ulcer was more common. In a review of 145 penetrating keratoplasty cases, Raj A et al.[15] identified the primary indications as corneal scarring (33.10%), bullous keratopathy in both aphakic and pseudophakic eyes (26.89%), and active infective keratitis (20.68%). Other reasons included graft failure (11.72%), anterior staphyloma (2.75%), corneal dystrophy (2.75%), keratoconus (0.68%), and miscellaneous causes (1.37%). These findings align well with those reported in similar studies. Singh G et al.[8] reported that traumatic corneal opacity was the most frequent indication for penetrating keratoplasty, comprising 30% of the cases. Healed corneal ulcers accounted for 26.67%, while graft failure represented 20% of the patients. According to Sony P et al[16]., healed infectious keratitis accounted for 19.83% of penetrating keratoplasty cases, while traumatic corneal scars made up 16.71%. These conditions were identified as common indications for the procedure.

6. Complications

We in our study analyzed the complications as early and late. We saw that among early complications mild AC reaction (10%) was the most common followed by epithelial defect (5%) and wound leak (5%), while in late complications most common complication was increased IOP (6.7%), followed by graft failure (3.3%). Vaishali et al.'s[11] study yielded results similar to ours, highlighting that persistent epithelial defects and postoperative uveitis were the most common complications shortly after surgery. In the later postoperative period, secondary glaucoma and graft rejection were the primary concerns. Managing post-keratoplasty glaucoma is particularly challenging because it plays a crucial role in graft survival and is more difficult to diagnose and treat than typical glaucoma. In their research, post-keratoplasty glaucoma was defined as an increase in intraocular pressure lasting beyond one month after penetrating keratoplasty, along with glaucomatous optic disc damage.

In their study, Kamal Dodia et al.[17] observed that persistent epithelial defects, late graft rejection mainly involving the endothelium, and secondary glaucoma were the most prevalent complications, similar to our findings. Tanuj Dada et al.[18] highlighted that glaucoma after penetrating keratoplasty is a major cause of irreversible vision loss and ranks second only to graft rejection as a cause of graft failure. The complications we encountered in our study correspond well with those described in these previous reports.

CONCLUSION

Our study's aim was to evaluate sociodemographic profile, indications and type of PK performed and its visual outcome, to patients presenting to tertiary care center. Visual outcome was assessed at the end of 3 month after the surgery, there was significant difference in the visual outcome in their respective post op period compared to their pre op of both the procedures, however PK done for optical indications

yielded better results. In our study patients underwent TPK and OPK in almost similar number. Most of the patients who underwent TPK were farmers. Non healing corneal ulcer was most common cause in TPK among which non healing fungal corneal ulcer was more common. Bullous keratopathy was most common cause in OPK among which Pseudophakic bullous keratopathy was more common.

Most common early post op complication was mild AC reaction and raised IOP was the most common late complication noted in our study.

One of the limitations of this study is the small sample size, which limited the applicability of statistical testing. A longer follow up period would have given a clearer understanding of all parameters we are to study. Specular microscopy of donor eye couldn't be done due to its non-availability.

Acknowledgements: The authors would like to acknowledge the support provided by the staff and faculty of Department of Ophthalmology in conducting this research.
Sources of Funding: None
Conflicts of Interest: None

REFERENCES

1. Burton M. J. (2009). Prevention, treatment and rehabilitation. Community eye health, 22(71), 33–35..
2. Smith GTH, Taylor HR. Epidemiology of corneal blindness in developing countries. Refractive and Corneal Surgery, 1991;7: 436-9.
3. Oliva MS, Schottman T, Gulati M. Turning the tide of corneal blindness. Indian J Ophthalmol 2012;60:423–7.
4. National Blindness and Visual Impairment Survey 2015-2019 Available from:https://indiavisionatlasnpcb.aiims.edu/national-blindness-and-visual-impairment-survey-2015-2019/.
5. Wang EY, Kong X, Wolle M, et al. Global Trends in Blindness and Vision Impairment Resulting from Corneal Opacity 1984-2020: A Meta-analysis. Ophthalmology. 2023;130(8):863-871.
6. Shrivastava P, Saxena N. Clinical evaluation of penetrating keratoplasty and its visual outcome. Indian J Clin Exp Ophthalmol 2021;7(3):528-531.
7. Keshav BR, Zacheria G, Ideculla T, Bhat V, Joseph M. Epidemiological Characteristics of Corneal ulcers in South Sharqiya Region. Oman Med J 2008;(1):23
8. Singh G, Monga S, Bhandari H, Aggarwal V, Dhingra R, Jain A. Visual outcome in patients undergoing penetrating keratoplasty. Int J Res Med Sci 2015;3:244-9
9. Amar SP, Sinha R, Kalra N, Agarwal T, Sharma N, Titiyal JS. Demographic and clinical profile, surgical outcome, and quality of life in patients who underwent bilateral lamellar corneal grafts. Indian J Ophthalmol. 2021 Jul;69(7):1747-1752.
10. Dr. Manu Thoma,, Dr. Hrishikesh Amin,, Dr.Vijay Pai, Dr. Jayaram Shetty. A Clinical Study on Visual Outcome and Complications of Penetrating Keratoplasty. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS).2015;14(6):49-60.
11. Vaishali, Kumar K, Sharma B. Study of visual outcome in patients undergoing penetrating keratoplasty. Indian J Clin Exp Ophthalmol 2019;5(3):352-7.
12. Dr. Gagandeep Kaur, Dr. Charu Chadha, Dr. Meena Chadha, Dr. Barkha Jain, Dr. Manpreet Kaur Bajaj. A study to assess the outcome of optical penetrating keratoplasty in a tertiary health care centre in north India. Int J Med Ophthalmol 2022;4(1):81-88
13. Doren GS, Cohen EJ, Brady SE, Arentsen JJ, Laibson PR. Penetrating keratoplasty after ocular trauma. Am J Ophthalmol. 1990;110:408-11.
14. Rao SK, Sudhir RR, Fogla R, Rajagopal R, Sitalakshmi G, Padmanabhan P. Bilateral penetrating keratoplasty: indications, results and review of literature. Int Ophthalmol. 1999;23:161-6
15. Raj A, Dhasmana R, Bahadur H. Factors associated with surface epithelial keratopathy after optical penetrating keratoplasty. J Curr Ophthalmol. 2017;29:108-15
16. Sony P, Sharma N, Sen S, Vajpayee RB. Indications of penetrating keratoplasty in northern India. Cornea. 2005;24:989-91
17. Dodia Kamal R, Shah Nirzari M, Chudasama Rajesh K. Incidence of increased intraocular pressure and factors associated with it after optical penetrating keratoplasty at secondary care centre, India. 2014;6(1):14-8.
18. Dada T, Aggarwal A, Minudath K B, Vanathi M, Choudhary S, Gupta V, Sihota R, Panda A. Post-penetrating keratoplasty glaucoma. Indian J Ophthalmol. 2008;56:269-77.