



SURGICAL OUTCOME OF PENETRATING KERATOPLASTY IN ADULTS AT RURAL HOSPITAL.

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ABSTRACT

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Introduction: Full thickness corneal opacities remain a challenging situation. Unfortunately, they are more frequently seen in a rural area. PKP is indicated as gold standard surgery in full-thickness corneal involvement as: nonhealing corneal ulcers, penetrating corneal trauma, dystrophies, degenerations and failed lamellar keratoplasties. This procedure is a well-established, effective and gives faster visual rehabilitation. Still, it has many postoperative complications like graft failure, graft rejection, cataract formation, glaucoma, and corneal vascularization.

Purpose: To evaluate surgical outcome of penetrating keratoplasty done in adults having full thickness corneal lesions at a rural hospital in relation to 1) Clinical graft clarity 2) Best corrected visual acuity and 3) Occurrence of postoperative complications and indication for PKPs.

Methods: In this hospital-based, a prospective study we studied all cases that underwent PKP in adults at PRH Loni, by trained surgeons during a total 10 years period i.e. from January 2008 to December 2017.

Results: We studied 114 PKPs. There were 68 (59.64%) males. Clear graft in 59 (51.75%) in all PKPs and in optical PKPs graft clarity was 61.84%. Postoperative complications in 55 (48.24%). Best corrected V/A > 6/18 in 24 cases (21.05 %) more than 6/60 in 64 cases (56.14%) and >CF 3 Meter in 93 patients (81.58 %).

Conclusions: Post PKP graft clarity and BCVA depends on indication for PKP. Graft failure and rejection are the major postoperative complications and PKP gives good best-corrected vision and faster rehabilitation in optical PKP.

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INTRODUCTION

Penetrating Keratoplasty (PKP) also known as Corneal Transplantation which is a full thickness corneal transplant procedure, where diseased full thickness corneal button is removed from Patient's / Recipient's eye and it is replaced with Cadaveric, clear, full thickness

donor corneal button with the help of fine radial sutures either intermittent or continuous. PKP is an established technique, effective and safe¹.

Surgically, PKP is a simple technique to learn which gives immediate visual rehabilitation to a corneal blind person in an

expert's hands. PKP is indicated as gold standard surgery in full-thickness corneal diseases as nonhealing corneal ulcers, penetrating corneal trauma, dystrophies, degenerations and failed lamellar keratoplasties. As per indications, PKP has various types as: optical, therapeutic, tectonic and cosmetic. The success of PKP depends on various factors. Most important are: quality of donor tissue, indications Of PKP and associated ocular Problems like corneal vascularization, glaucoma, cataract, and posterior segment involvement. Though PKP is a well-established, effective and gives faster visual rehabilitation, it has many postoperative complications like graft failure and rejection, astigmatism, cataract formation or its fast progression, uveitis, secondary glaucoma, and corneal vascularization. Early detection of these problems and their medical or surgical timely treatment in time gives good prognosis.² In Rural area, agricultural corneal full thickness injuries, delayed and inadequate treatment and treatment by quacks for the same, ultimately leads to the full thickness involvement of cornea and subsequent corneal blindness. So in our rural setup, we studied the surgical outcome of PKP, done in adult patients for various indications.

AIM AND OBJECTIVES:

To study the surgical outcome of PKP in relation to 1) corneal graft clarity on slit lamp examination (SLE), 2) postoperative best corrected visual acuity (BCVA) 3) postoperative complications and 4) indication of PKP at rural setup.

MATERIAL AND METHODS:

Study design: Descriptive longitudinal, hospital-based observational study.

Ethical approval: The present study was approved by the Institutional Ethical committee and written informed consent was obtained prior to the study from all patients.

Inclusion criteria: Patients at or above 30 years who underwent PKP for all indications i.e. optical, therapeutic and tectonic at PRH Loni by an experienced surgeon.

Exclusion criteria: Patients with previous ocular surgery except for PKP and

patients who underwent triple surgery were excluded.

Sample size: 114 cases of PKP performed at PRH Loni.

Duration: 10 years (from January 2008 -December 17, and followed for a minimum 1 year to 10 years)

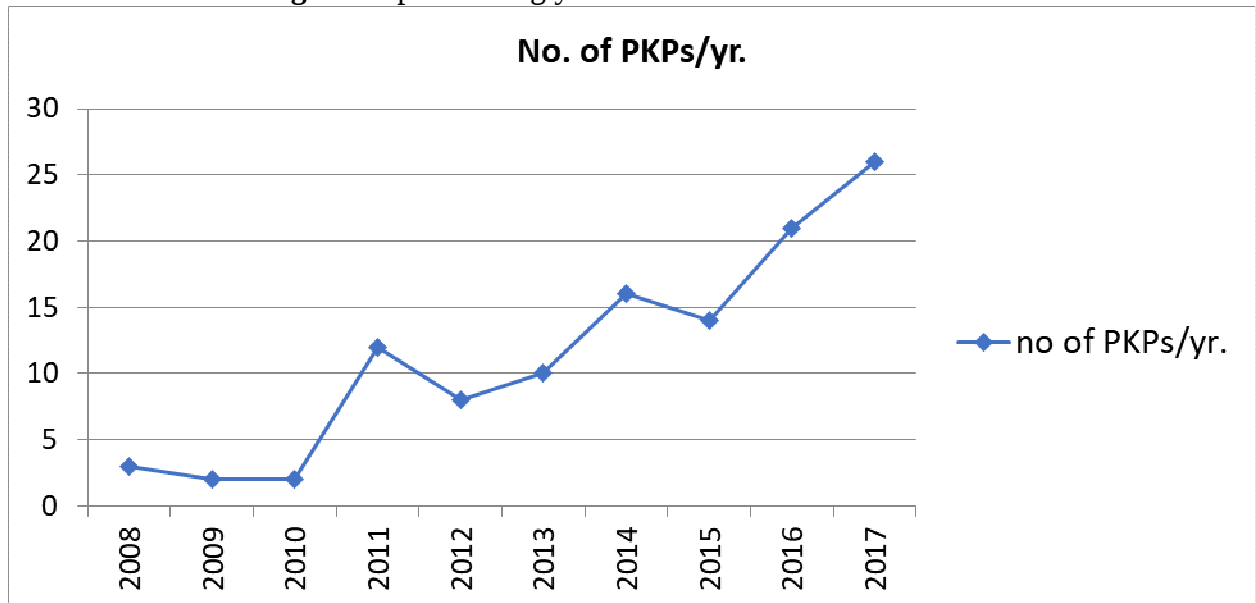
METHODOLOGY:

Operation procedure: All PKPs were performed by experienced surgeons under local anesthesia. The uniformity of the surgical procedure was maintained as follows:

Preparation of donor corneal button, removal of corneal opacity in the recipient with trephine, release of iris adhesions at angle and posterior synechiae if any , peripheral buttonhole 2 iridectomies (PBI)s, intermittent 16 equidistant, radial 10-0 nylon sutures, or continuous suture, anterior chamber (AC) reformation with air and saline, application of bandage contact lens (BCL), subconjunctival (S/C) injection of antibiotic-steroid and postoperative eye patch and bandage was given to all patients for 18-24 hours. Topical antibiotic steroid drops and lubricating drops were prescribed postoperatively. Systemic antibiotics, anti-inflammatory, analgesics, IOP lowering agents, and steroids were used as per need. Postoperative slit lamp examination findings were recorded on 1st POD and discharge day in indoor rural patients. Follow up examination findings were recorded at 1st, 3rd, 6th and 12th months (minimum F.U 1 yr.).

Parameters studied: We recorded 1) preoperative demographic data as age, gender, preoperative V/A and indication for PKP 2) intraoperative data as graft size and suturing technique and 3) postoperative data as anterior segment findings with slit lamp examination (SLE), fundus evaluation with direct ophthalmoscope, best corrected visual acuity (BCVA) with Snellen's visual acuity chart and intraocular pressure (IOP) with non contact tonometer (NCT)

Epithelial and endothelial graft rejections were treated medically as far as possible. Further interventions like repeat PKP or cataract extraction with PCIOL implantation was carried out in needy and willing patients.

4 OBSERVATIONS / RESULTS:**Fig 1:** Graph showing year wise distribution of 114 PKPs**Table 1:** Showing year wise distribution of 114 PKPs

YEAR	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	TOTAL
OPTICAL	2	2	2	10	2	6	14	8	14	16	76
THERAPEUTIC	1	-	-	2	6	2	2	5	5	6	29
TECTONIC	-	-	-	-	-	2	-	1	2	4	9
TOTAL	3	2	2	12	8	10	16	14	21	26	114

Table 2: Showing Age & Gender distribution of 114 PKPs

AGE in yrs.	MALE	FEMALE	TOTAL
30-39	06	04	10
40-49	12	06	18
50-59	11	08	19
60-69	26	16	42
70-79	10	10	20
80-89	03	02	05
TOTAL	68 (59.64%)	46(40.35%)	114 (100%)

Table 3: Showing Indication wise distribution of 114 PKPs

TYPE OF PKP	CORNEAL OPACITY /SCAR	ABK PBK	REPEAT PKP	SPHEROIDAL DEGENERATION	DYSTROPHY	NON- HEALING CORNEAL ULCER	Corneal Perforation	TOTAL
OPTICAL	50 (43.85 %).	12	10	3	1	-	-	76 (66.66 %)
THERAPEUTIC						29		29
TECTONIC							9 (0.08%)	09
TOTAL								114 (100%)

Table 4: Showing distribution of graft size used in 114 PKPs

GRAFT SIZE IN mm	NO OF PKPS	TYPE OF PKPs
7	19	OPTICAL ,TECTONIC
7.5	52 (45.61%)	OPTICAL
8	29	OPTICAL THERAPEUTIC, TECTONIC
8.5	04	THERAPEUTIC
9	07	THERAPEUTIC
10	03	THERAPEUTIC
	114 (100%)	TOTAL

Table 5: showing distribution of suturing technique in 114 PKPs

TYPE OF SUTURE	No. of PKPs
INTERMITTENT	86 (75.44%)
CONTINUOUS	28 (24.56%)
TOTAL	114 (100%)

Table 6: Showing distribution of clear grafts, at last, follow up in 114 PKPs

TYPE OF PKP	NO. OF PKPs	NO. OF CLEAR GRAFTs	% OF CLEAR GRAFTs
OPTICAL	76	47	61.84%
THERAPEUTIC	29	09	31.03%
TECTONIC	09	03	33.33%
TOTAL	114	59	51.75%

Table 7: showing the correlation of indication of PKP, clear grafts and suturing technique in 114 PKPs

Type of Suture	Clear grafts in optical PKP	Clear grafts in therapeutic PKP	Clear grafts in tectonic PKP	Clear grafts in total PKPs
INTERMITTENT	36 / 59 (61.01%)	6 / 21 (28.57%)	3 / 6 (50.0%)	45 / 86 (52.32%)
CONTINUOUS	11 / 17 (64.70%)	3 / 8 (37.50%)	0 / 3 (0%)	14 / 28 (50.0%)
TOTAL	47 / 76 (61.84%)	9 / 29 (31.03%)	3 / 9 (33.33%)	59 / 114 (51.75%)

Table 8: showing the occurrence of postoperative complication in 114 PKPs

POST OP COMPLICATIONs	NO OF PATIENTS
Epithelial defect	29 (25.43 %)
IOP rise	12 (10.52 %)
Graft failure	55 (48.24 %)
Graft rejection epi.+endo.	31 (27.19 %)
Uveitis	12 (10.52 %)
Cataract	24 (21.05 %)
Vascularization	31 (6.14 %)

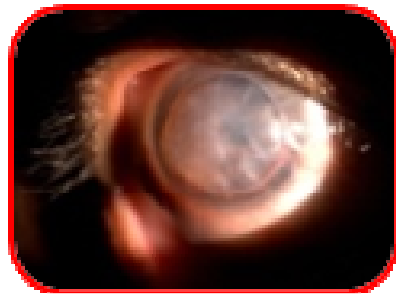
Table 9: Showing UCVA, at last, follow up in 114 PKPs

BCVA LAST F.U.	NO OF PKPs	BCVA and %of patients
6/9- 6/18	24 (21.05%)	>6/18-- in 21.05%
6/24-- 6/60	40 (35.08%) = 64 (56.14 %)	>6/60--- in 56.14%
CF 6M – 3M	29 (24.44%) = 93 (81.58 %)	>3M.-- in 81.58%
CF 2M-1M	11 (09.65%) = 104 (91.23%)	>1M.--- in 91.23%
<1M- HM	10 (08.77%) = 114 (100%)	>HM.--- in 100%

Fig 2: Pre Operative Photos**A.** Leucomatous Corneal opacities**B.** Corneal perforations

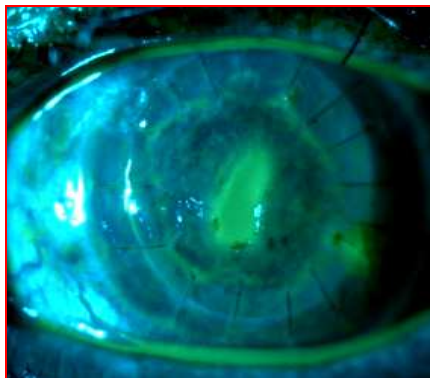


C. Bullous keratopathy

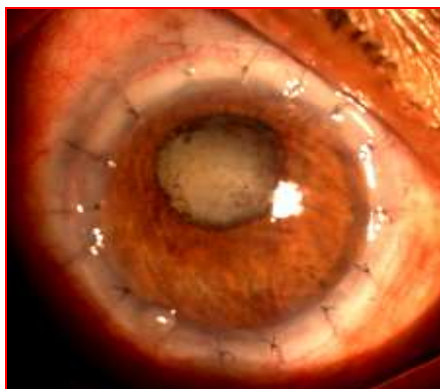


D. Failed PKP

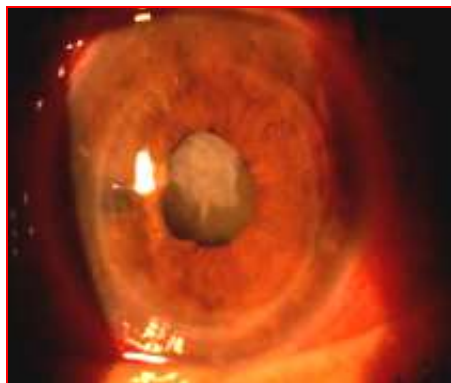
Fig 3: Post Operative Complication Photos:



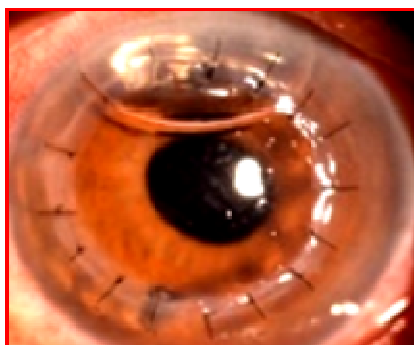
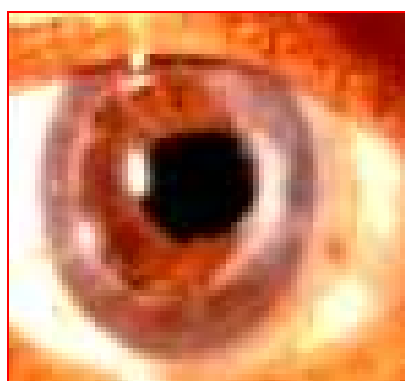
A. Post PKP Epithelial Defect stained with Fluorescein



B. Post PKP anterior uveitis and cataract



C. Partial suture removal is done prior to cataract surgery in Post PKP controlled anterior uveitis associated with cataract.

Fig 3: Post operative Photos**A. PKP did for Bullous keratopathy- 1st POD****B. PKP in bullous keratopathy.****C. Post PKP cataract extraction with PCIOL by MSICS**

DISCUSSION

First successful penetrating keratoplasty (PKP) in a human was performed by Eduard Zirm in 1905. He became the first person to perform a solid organ transplant. He performed the surgery for one of the most challenging indications - bilateral alkali burns. Thereafter, many ophthalmologists have contributed to the development and refinement of this surgery which was aided by the development of the operating microscope, refined suture materials, the eye banks and the use of steroids in postoperative care. At present the PKP has become a well-established and

effective surgical treatment for patients with thick leucomatous corneal opacities.^{1, 2} It is indicated in various situations as central corneal thick scars, corneal dystrophies, and degeneration, non healing corneal ulcers, perforated corneal ulcers, keratoconus with hydrops, postoperative bullous keratopathy, failed penetrating keratoplasty, mechanical and chemical corneal injuries and failed lamellar keratoplasty^{3, 4, 5}

PKP gives faster visual rehabilitation and is more preferred even in hands of a general ophthalmologist as its learning curve is relatively easy than lamellar keratoplasty.

Good donor graft collection with the aseptic method, use of dilute betadine drops is very important and the surgeon should respect the open-sky surgery under strict aseptic precautions to prevent postoperative endophthalmitis.⁶

Here we studied the surgical outcome of 114 PKPs. Our data showed rising no. of PKPs from 2008 to 2017. (Table no.1) This could be because of counseling and more awareness about the PKP as a good solution for the corneal blindness in rural population. Out of 114 PKP cases, there were 68 (59.64 %) males (Table no. 2) and most were farmers who suffered from trauma and corneal ulcers and postoperative bullous keratopathy. Maximum patients were in the 7th decade. Mean age was 57yrs (range 30- 82yrs).

In our study PKP was done for an optical, therapeutic and tectonic purpose. (Table no.3) Optical PKP was most common and performed in 76 eyes, (66.66 %) where the corneal scar was the commonest indication in 50 cases, (43.85 %). Aphakic or pseudophakic bullous keratopathy, repeat PKP, spheroidal degeneration, and dystrophy were the other indications for optical PKP. There were 29 therapeutic PKPs for non-healing corneal ulcers and only 9 tectonic PKPs (0.08%) done for penetrating injuries with tissue loss and perforated corneal ulcers.

The success of PKP depends upon various factors. Repeat PKP and therapeutic PKPs carry poor prognoses. In viral keratitis, one has to consider the prophylactic antiviral treatment pre and post PKP to gain good surgical results. Surgical factors like use of dilute betadine for cul de sac wash, use of optimum sized graft i.e. 6.5mm-7.5mm. and use of intermittent sutures is advocated in the literature.^{7,8} Large grafts more than 8mm have more foreign body load and so gives more problems of graft rejection, require a number of sutures to get good opposition of graft-host junction and may lead to peripheral anterior synechiae, while small grafts may give central haze due to suture marks and hyperopic shift. In our study, the most common graft size used was 7.5 mm. (in 52 PKPs). (Table no.4) Larger grafts of 8.5 or more were used for therapeutic

PKPs, while smaller grafts were used for optical and tectonic PKPs. In therapeutic PKPs, one has to remove all the diseased corneal tissue so it requires larger grafts than optical PKPs.^{8,9}

Type of suturing is very important in PKPs. The selective suture or sutures removal is possible in postoperative local problem like suture abscess, high astigmatism in tight suture meridian if we use the intermittent suturing technique. Continuous suturing requires less surgical time as compared to intermittent but it cannot be adjusted for a local problem. In this study, intermittent sutures were used in 86 PKPs (75.44%). (Table no. 5)

In case of optical PKP eye is quiet and without any inflammation e.g. corneal scar or degeneration or dystrophy or bullous keratopathy or hydrops in keratoconus. Many studies of optical PKPs showed better results of graft clarity from 60% to 95%.¹⁰ In our study the optical PKPs showed the graft clarity in 61.84% while therapeutic and tectonic PKPs showed the graft clarity in only 31.03% and 33.33% respectively. (Table no. 6) The overall graft clarity was seen only in 51.75% PKPs. This could be due to the fact that we included all PKPs i.e. therapeutic and tectonic having other anterior segment problems and subsequent postoperative inflammation, corneal haze, graft failure and rejection.^{10, 11}

Our study also showed no significant difference in graft clarity in Optical PKPs with both type of suturing technique and out of 76 Optical PKPs (100%), the graft clarity was 61.01% with intermittent sutures and 64.70% with continuous sutures (Table no.7). Al-Yousuf N et al and P Beckingsale et al states that rather than the type of suturing the indications for PKP have a significant effect on graft clarity and survival.^{12,13}

PKP is an established technique and most successful form of solid organ transplantation due to the avascular, immune privileged nature of cornea. Due to full thickness donor button or more foreign body load i.e. epithelium, stroma, and endothelium, PKP has more problems of graft rejection than lamellar keratoplasty where only the affected layer of the cornea is

removed and replaced by good respective donor tissue. Established, safe and effective PKP procedure still has many postoperative complications like graft failure and rejection, astigmatism, cataract formation or its fast progression, uveitis, secondary glaucoma, and corneal vascularization.¹³ In our study too there were many postoperative complications like epithelial defects, graft failure, graft rejection, uveitis, glaucoma, suture vascularization. There were 55 PKPs (48.24%) with postoperative complications. These results were comparable with other studies. These studies included quiet eyes and they considered only optical PKPs and not included therapeutic or tectonic PKPs. In the present study, most of the complications were treated successfully medically with steroids and immunosuppressive agents as per need.^{14,15,16}

In this study, 48.24% of patients had graft failure and 25.43% patients had epithelial defects, 10.52% of patients had secondary glaucoma and uveitis while 21.05 % of patients had a cataract and 27.19% had corneal vascularization. (Table no.8) These results were similar to Sihota *et al.*¹⁷

Cadaveric donor tissue is a foreign body which may excite the immune reaction in the patient's eye, leading to graft failure related to immunological reason i.e. graft rejection after a month or more, in spite of the initial success of the surgery. In this study, graft rejection was seen in 31eyes (27.19 %) (Table no. 8).

In 59 eyes with clear grafts, cataract formation and or fast progression was seen in 20 (17.54%) eyes those underwent cataract extraction with PCIOL implantation and gained good vision. However, 2 patients had late graft rejection after 2 years and treated medically successfully.

In our study, the best-corrected V/A more than 6/18 was seen in 24 cases (21.05%), more than 6/60 was seen in 56.14% (64 cases), more than CF 3 meter in 93 cases (81.58%) and more than CF1 meter in 104 patients (91.23%). (Table no.9) Many studies have shown postoperative BCVA > 6/9 ranging from 38% to 64% of eyes.^{17, 18} In our study we have included all type of PKPs i.e.

optical, therapeutic and tectonic, which might have affected the visual outcome due to more postoperative inflammation and graft failure in therapeutic and tectonic PKPs and also the irregular follow-ups of rural patients and lack of timely postoperative intervention to prevent or treat early graft failure, might be the other contributory factor.

Thus to summarise, successive 114 cases of PKP at last follow up showed: 1) Graft clarity- in 51.75% (59 eyes), 2) BCVA - 6/18 or better only in 21.05% (24 eyes) and more than 6/60 in 56.14% (64 eyes) & 3) Major postoperative complication- was Graft failure and seen in 48.24 % (55eyes) and rejection in 27.19 % (31eyes).

CONCLUSION:

Post PKP graft clarity and BCVA depends on indication for PKP. Graft failure and rejection are the major postoperative complications of PKP. PKP gives good BCVA and faster rehabilitation in optical PKP.

Limitations of the study:

More than one surgeon and irregular follow-ups by rural patients.

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