



A Comparative Study of Postoperative Astigmatism and Visual Outcome in Patients Operated for Penetrating Keratoplasty and Deep Lamellar Keratoplasty

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Abstract

Purpose: To compare postoperative astigmatism and visual outcome in patients operated for penetrating keratoplasty and deep lamellar keratoplasty.

Method: his study was conducted at Ophthalmology Department of our hospital during July 2011-November 2013. Patients who clinically presented with a corneal opacity, Corneal stromal dystrophies, Corneal stromal degenerations, Deep corneal scarring (post traumatic, post infection, & other stromal scar.) who had a best corrected visual acuity BCVA of less than 6/60(=1.0 in log MAR) and not improving beyond it during July 2011- November 2013 in our institute were chosen. DALK was done in 17 eyes and sixth month post operatively for 1. Uncorrected visual acuity. 2. Best corrected visual acuity 3. Slit lamp examination. 4. Tonometry. 5. Corneal topography.

Result: The difference between BCVA at 6 month between two groups DALK and PKP. After applying independent t-test there is t-value of 0.776 with 'p' value of 0.452, which is >0.05. so there is no significant difference between BCVA at 6 month between DALK and PKP group.

Conclusion: After Both procedures there is significant improvement in post-operative visual acuity (measured in logarithm of Minimum Angle of Resolution) at each follow up when compared with pre-operative visual acuity. Both procedures having problem of post-operative Astigmatism.

Introduction

Corneal transplantation is a widely practiced surgical solution for blinding corneal opacity, Keratoplasty has evolved by leaps and bounds since its inception. During 1970s and early 1980s, Penetrating Keratoplasty was usually performed for various corneal disorders. Penetrating Keratoplasty is associated with a list of complications like graft rejection, irregular astigmatism and corneal opacification resulting in visual impairment as also intra operative

complications associated with open sky surgery. To overcome such problems concept of Lamellar Keratoplasty has evolved⁽¹⁾. The basic principle of Lamellar Keratoplasty is to replace only that part of cornea that is diseased and leave recipient's normal anatomic layers intact. It is most useful for the treatment of corneal disease in the setting of a normally functioning endothelium thus eliminating the possible complication of endothelial graft rejection and also reduces chances of the other complications associated with Penetrating

Keratoplasty and open sky surgery. Despite these benefits, surgeons commonly perform a Penetrating Keratoplasty for anterior corneal disorders, because the latter technique is easier to perform and lamellar transplants often shows decreased best corrected visual acuity due to irregular astigmatism and/or scarring at the donor to recipient interface⁽²⁾. Anterior Lamellar Keratoplasty is a surgical procedure in which a maximum of diseased cornea is replaced by donor tissue. Commonly the anterior stroma is incised with a trephine that can be set to a depth not exceeding the corneal thickness and several stromal layers may be dissected until the desired depth of recipient bed is obtained. Lamellar dissection, for example in Lamellar Keratoplasty, are generally made by removing stromal tissue 'layer by layer', while the depth of the dissection is judged by the changing tissue structure with deeper stromal beds. However as mentioned above there is always a risk of interface haze and scarring with lamellar dissection. Less scarring may occur by performing lamellar dissection at a deeper level i.e. by performing Deep Anterior Lamellar Keratoplasty. However to perform a lamellar dissection at a deeper level is difficult as the stromal dissection depth relative the corneal thickness cannot be optically visualized. The posterior corneal surface is 'invisible' through an operating microscope, due to small difference in refractive index between corneal tissues and aqueous. Lamellar dissection technique therefore bears the risk of inadvertent perforation, when deeper dissections are intended. If perforation occurs completion of stromal dissection can be difficult, so that donor button may have to be sutured into an imperfectly prepared recipient bed. When conversion of the procedure into a penetrating keratoplasty is required, donor tissue with good quality endothelium may not be available. Anterior Lamellar Keratoplasty may become a more feasible and less complicated surgical procedure, if a stromal dissection could be made at a visually controlled depth during surgery, which is possible if Deep Anterior Lamellar

Keratoplasty is performed using various techniques such as Melles technique, Big bubble technique, Double bubble technique. With these advances in surgical technique and reduced complications of interface haze associated with Lamellar Keratoplasty DALK is fast gaining popularity as one of the first line procedures for stromal corneal disorders⁽³⁾.

In this study, we reviewed patients on whom PKP and DALK was performed for various Corneal pathologies and assessed their post operative outcome on serial follow up. There is currently a trend among corneal surgeons toward replacing penetrating keratoplasty (PK) with various types of lamellar techniques that aim to remove only damaged tissue. Deep anterior lamellar keratoplasty (DALK) is currently considered to be the first-choice operative procedure in patients with corneal diseases not involving the endothelial layer, including keratoconus, stromal scars, and lattice dystrophy.⁽⁴⁻⁸⁾ Patients suffering from these corneal diseases may require transplantation. A long graft survival is then expected in these young patients. Removal of the damaged corneal stroma may be achieved by manual dissection with a surgical blade and scissors, microkeratome-assisted lamellar cut, or femtosecond laser-assisted cut. Descemet's membrane detachment from the corneal stroma can be achieved using air injection (the "big-bubble" technique), hydrodelamination through a sclerocorneal flap, or sodium hyaluronate injection.⁽⁴⁻¹³⁾ Whereas a successful big-bubble procedure allows removal of all the recipient stroma, a layer of the recipient posterior stroma usually remains with the other techniques. The objective of the present study was to compare the long-term results of deep lamellar anterior keratoplasty with those of Penetrating Keratoplasty in eyes with the same preoperative corneal conditions.

Method

This prospective analytic study was conducted at Ophthalmology Department of our hospital during July 2011- November 2013. Patients who clinically

presented with a corneal opacity, Corneal stromal dystrophies, Corneal stromal degenerations, Deep corneal scarring (post traumatic, post infection, & other stromal scar.) who had a best corrected visual acuity BCVA of less than 6/60(=1.0 in log MAR) and not improving beyond it were chosen. DALK was done in 17 eyes and PKP was done in 13 eyes of different patients selected as per inclusion criteria. A detailed history was taken and complete examination of eye was done. Thereafter the patients went through a series of investigations. Accordingly patients underwent surgery either DALK or PKP (with common baseline criterias) and followed for post-operative outcome for six months.

Surgical procedure: Donor material: Donor eyes were obtained from the Eye Bank of our Hospital. The donor eyes were stored in moist chamber at 4 °C and where the surgery was delayed for more than 24 hours after procurement it was stored in M-K medium and stored at 4 °C and used within 72 hours.

Preoperative preparation: The patients were started on oral antibiotics from the day of surgery. 500 mg of Tab. Acetazolamide was given. 150 ml of Inj. Mannitol intravenous was given 1 hour before surgery. Locally Antibiotics eye drops every 15 minutes. 2% pilocarpine eye drops were instilled in all cases once every 15 min, 1 hour before surgery in order to maintain intraoperative miosis. All patients underwent either PKP or DALK between July 2011 to November 2013 were entered into a longitudinal study. DALK was done in 13 eyes and PKP was done in 18 eyes of different patients selected as per inclusion criteria. All PKPs and DALKs were performed under local anesthesia except in children where general anesthesia was used.

Surgical procedure: Keratoplasty were performed following the ethical guide lines for biomedical research on human subjects issued by the Indian council of medical research in 2000. The institutional ethical committee had approved the project.

Post-operative protocol: Post operatively eyes were kept patched for one day. Once the epithelial defect was healed topical antibiotic (Moxifloxacin 0.5%) and steroids (Prednisolone Acetate 1%) were started. Steroids were gradually tapered after one month and low dose steroids were continued for a long time. Antibiotic was discontinued after two months. Anti-glaucoma medication (Timolol 0.5%) and cycloplegic (Atropine sulphate 1%) was also given for about a month.

Follow up: The patients were evaluated on first day, first week and then on first and sixth month post operatively. Following clinical examinations were done on each follow up. 1. Uncorrected visual acuity. 2. Best corrected visual acuity (Refraction and subjective correction) These were recorded using Log MAR distance visual acuity chart and Snellen's near vision chart. 3. Slit lamp examination: Careful slit lamp examination was done to evaluate tear film status, graft clarity, interphase (in DALK), condition of sutures, residual graft edema (if present), anterior chamber reactions or iritis. Any complications like double anterior chamber, inter phase haze, graft haze, graft rejections if present were managed accordingly. 4. Tonometry non-contact tonometer. 5. Corneal topography was done on last follow up.

Result

In present study, out of 30 eyes 13 eyes underwent PKP and 17 eyes was operated for DALK. The data is expressed as Mean±SD. The statistical analysis is performed using independent t-test. The patient's age ranges from 10 years to 60 years. Maximum number of cases in DALK group were from 31-40 years group (16.17%) and in PKP group from 51-60yrs (16.67%). Mean (±2SD) age of patient was 37.12 ± 12.56. Most common indication of keratoplasty in our study was corneal opacity which contributes for 11cases (36.67%) of DALK and 8 cases (26.67%) of PKP followed by corneal degeneration which contributes for 1 case (3.33%) of DALK and 5 cases (16.67) of PKP. In addition, present study contains 5 cases of corneal dystrophy (16.67%) who were operated for DALK.

Table: 1 A Distribution of BCVA during Each Follow up (DALK)

Visual Acuity (log MAR)	Pre-operative (no. of patients)	Post-operative (no. of patients)			
		1 week	1 month	3 months	6 months
2.01-3.00	3	0	0	0	0
1.01-2.00	13	8	3	2	1
0.60-1.00	1	9	12	12	8
0.40-0.59	0	0	2	3	3
0.20-0.39	0	0	0	0	4

Table: 2 Distribution of BCVA during Each Follow up (PKP)

Visual Acuity (log MAR)	Pre-operative (no. of patients)	Post-operative (no. of patients)			
		Pre – op.	1 week	1 month	3 months
2.01-3.00	3	0	0	0	0
1.01-2.00	9	8	3	2	1
0.60-1.00	1	5	9	5	4
0.40-0.59	0	0	1	6	5
0.20-0.39	0	0	0	0	1

Table 1 and 2 represents distribution of BCVA at each follow up after DALK and PKP procedure respectively. It states that majority of patients had their preoperative visual acuity within range of 1.01-2.00 which contributes for 13cases in DALK and 9 in PKP group. 2 patients had their pre operative visual acuity within range of 0.60-1.00, one in each group. 3 patients in each group had their pre-operative visual acuity within range 2.01-3.00. The mean (\pm 2SD) pre-operative visual acuity (Log MAR) in our study is 1.976 ± 1.112 in DALK and 2.076 ± 1.164 . Post operatively at the end of 1 week, majority of the patients had their visual acuity within range of 1.01-2.00 in PKP group and within range of 0.6-1.0 in DALK group which contributes for 8 and 9 cases respectively. None of the patients had their vision better than 0.40 at the

end of 1 week. The mean (\pm 2SD) post-operative visual acuity (Log MAR) at 1 week is 1.117 ± 0.948 for DALK and for PKP 1.369 ± 0.6 .

Post operatively at the end of 1 month majority of the patients had their visual acuity within range of 0.60-1.00 which contributes for 12 cases of DALK and 9 cases of PKP. Visual acuity within range of 1.01-2.00 3 cases of each group and within range of 0.40-0.59 was 2 cases of DALK and 1 case of PKP. no patient had vision within range of 0.20-0.39. The mean (\pm 2SD) post-operative visual acuity (Log MAR) at 1 month is 0.882 ± 0.558 for DALK and $0.984 \pm (0.962)$.

Post operatively at the end of 6 months visual acuity within range of 0.6-1.0, there were 8 cases of DALK and 4 of PKP. visual acuity within range of 0.40-0.59, there were 3 cases of DALK and 5 of

PKP. visual acuity within range of 0.20-0.39, there were 4 cases of DALK and 1 of PKP. While visual acuity within range of 1.01-2.0, there were 2 case of

DALK and 1 of PKP. The mean (\pm 2SD) post-operative visual acuity (Log MAR) at 6 month is 0.668 ± 0.608 for DALK and 0.569 ± 0.730 for PKP.

Table 3- Statistics of BCVA at 6 Months

	type of surgery	N	Mean	Std. Deviation	Std. Error Mean
BCVA (logMAR)	DALK	17	0.669	0.3049	0.0762
	PKP	13	0.569	0.3794	0.1052

Table 4- Statistics of BCVA at 6 Months

t-test for Equality of Means						
T	Df	p	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
0.766	22.860	0.452	0.0995	0.1299	0.1694	0.3684

Table 3 and 4 represents difference between BCVA at 6 month between two groups DALK and PKP. After applying independent t-test there is t –value of 0.776 with ‘p’ value of 0.452, which

is >0.05 . so there is no significant difference between BCVA at 6 month between DALK and PKP group.

Table 5- Mean BCVA

DURATION	BCVA(log MAR) (MEAN \pm SD)	
	DALK	PKP
Before	1.98 \pm (0.56)	2.077 \pm (0.59)
1 week	1.12 \pm (0.35)	1.37 \pm (0.46)
1 month	0.88 \pm (0.28)	0.98 \pm (0.50)
3 months	0.76 \pm (0.26)	0.83 \pm (0.55)
6months	0.63 \pm (0.34)	0.67 \pm (0.31)

Table 5 represents average (Mean \pm SD) BCVA pre operatively, at 1 week, 1 month, 3 month and 6 months. Average BCVA pre operatively was $1.98 \pm (0.56)$ in DALK and $2.077 \pm (0.59)$ in PKP. Average BCVA at 1 week, 1 month, 3 month and 6 months was $1.12 \pm (0.35)$ and $1.37 \pm (0.46)$; $0.88 \pm (0.28)$ and $0.98 \pm (0.50)$; $0.76 \pm (0.26)$ and $0.83 \pm (0.55)$; $0.63 \pm (0.34)$ and $0.67 \pm (0.31)$ respectively.

The statistical analysis of above observation with independent t- test shows that difference in preoperative visual acuity and post-operative visual acuity at 1 week is statistically significant with ‘p’ value of <0.001 . Difference in post-operative visual acuity at 1 week and 1 month is also statistically significant with ‘p’ value of <0.05 . Difference in post-operative visual acuity at 1 month and 6 month is statistically significant

with 'p' value of <0.05. Difference in pre-operative visual acuity and post-operative visual acuity at 6 month is statistically significant with

'p' value of <0.001. This indicates that there is significant improvement in the BCVA at each follow up after DALK and PKP procedure.

Table: 6 Spherical Refractive out Come at 6 Month

DURATION	SPHERICAL ERROR(D)(Mean±SD)	
	DALK	PKP
6 MONTH	+1.35± (1.55)	+2±(1.34)

Table 6 represents spherical refractive outcome at 6 month after DALK and PKP. Post operatively in DALK group, average (Mean±SD) spherical

refractive error at 6 month was +1.35±(1.55) D and in PKP it was +2±(1.34) D.

Table: 7 Cylindrical Refractive Outcomes at 6 Month

Duration	Cylindrical Error (D) (Mean±2SD)	
	DALK	PKP
6 Month	-2.47± (1.14)	-2.96±(1.47)

Table 7 represents cylindrical refractive outcome at 6 month after DALK and PKP. Post operatively in DALK group, average (Mean±SD) cylindrical

refractive error at 6 month was -2.47±(1.14) D and in PKP it was -2.96±(1.47) D.

Table 8 C-Statistics of Spherical Refractive Outcome

	type of surgery	N	Mean	Std. Deviation	Std. Error Mean
Sph	DALK	17	1.25	1.573	0.393
	PKP	11	2.36	1.221	0.368

Table 9 Statistics of Spherical Refractive Outcome

t-test for Equality of Means						
t	Df	p	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
-2.067	24.538	0.049	-1.114	0.539	-2.224	-0.003

Table 10 Statistics of Cylindrical Refractive Outcome

	type of surgery	N	Mean	Std. Deviation	Std. Error Mean
Cyl	DALK	17	-2.63	0.796	0.199
	PKP	11	-3.50	1.124	0.339

Table 11 Statistics of Cylindrical Refractive Outcome

t	Df	p	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
2.227	16.758	0.040	0.875	0.393	0.045	1.705

Table 8, 9 and 10,11 represents statistical difference between spherical and cylindrical refractive error according to t-test between DALK and PKP group respectively.

Statistical analysis according to TABLE 11C and 11D shows that there is t value of - 2.067 with p 0.049 (<0.05) which indicates that there is

significant difference between spherical refractive outcome of DALK and PKP, more spherical error in PKP group. According to Table 11E and 11F there is t value of 2.227 with p 0.040 (<0.05) which indicates that there is significant difference between cylindrical refractive outcome of DALK and PKP, more spherical error in PKP group.

Table: 12 Complications

POST OP COMPLICATIONS	NO. OF PATIENTS		PERCENTAGE	
	DALK	PKP	DALK	PKP
DM Tear	2	0	11.76	00
GRAFT HAZE	3	1	17.64	7.69
GRAFT REJECTION	1	3	5.88	23.07
GRAFT INFECTION	0	1	00	7.69

Table 12 represents distribution of various post operative complications after DALK and PKP in our study. It states that there is 11.76% cases of DALK having DM tear and 17.64% cases having Graft haze which was 0% and 7.69% in PKP respectively. in DALK there is 5.88% cases of graft rejection which was 23.07% in PKP and only 1 case of PKP get graft infection which was not in DALK. so we can say from above data that in DALK group there is more DM tear and Graft

haze complications than PKP group. While there is more graft rejection in in PKP.

Conclusion

The following important conclusions can be derived from the study:

- 1) After Both procedure there is significant improvement in post-operative visual acuity (measured in logarithm of Minimum Angle of Resolution) at each

follow up when compared with pre-operative visual acuity.

- 2) Both procedure having problem of post-operative Astigmatism.
- 3) In DALK the major limiting factors affecting visual outcome are (1) graft host interface haze and (2) Irregular astigmatism.
- 4) DALK procedure is associated with less incidence of immunological graft rejection compared to penetrating keratoplasty as recipient's endothelium is not sacrificed in this procedure.

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