Original Article

Indications and Outcomes of Penetrating Keratoplasty at a Tertiary Care Hospital in Northern Thailand

Khotcharrat R, MD[1], Sawatdiwithayayong J, MD[1], Bhoopat T, MD[1], Ngowyutagon P, MD[2]

[1] Department of Ophthalmology, Faculty of Medicine, Naresuan University, Phitsanulok, Thailand

[2] Department of Ophthalmology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Objective: To inquire into the causative diseases for corneal transplantation, treatment outcomes, and the prognostic factors influencing post-operative outcomes.

Materials and Methods: A retrospective review of the medical records of the patients that underwent penetrating keratoplasty between September 1, 2004 and December 31, 2009 was done.

Results: Corneal transplantation was done in 51 eyes of 51 patients with a mean age of 60.9±14.3 years (range from 25 to 88 years old). The most common indication was for optical purpose (82.4%) in patients diagnosed with bullous keratopathy (n=14, 25.9%), followed by corneal scar (n=10, 18.5%). The pre-operative mean visual acuity was 2.3±0.7 Log MAR, and post-operative mean visual acuity was 1.6±0.9 Log MAR. The mean of visual improvement was 0.7±0.8 Log MAR (p=0.001). The graft failure rate was 48%, caused by irreversible graft rejection, recurrent infection, corneal ulcer on graft, graft perforation, and late endothelial failure. The risk of graft failure was significantly higher in patients with pre-existing glaucoma, re-grafting for previous graft failure, and secondary post-operative glaucoma.

Conclusion: Penetrating keratoplasty remains the effective treatment in many corneal conditions. Bullous keratopathy and corneal scar are the major indications for optical purpose.

Keywords: Penatrating keratoplasty, Indication for penetrating keratoplasty, Graft failure

J Med Assoc Thai 2019;102(11):1156-9
Website: http://www.jmatonline.com
Received 9 Nov 2018 | Revised 28 Jan 2019 | Accepted 4 Feb 2019

Penetrating keratoplasty (PKP) is recommended for corneal diseases with severe visual impairment. To promote visual recovery, optical PKP is indicated for cloudy corneal diseases. Moreover, severe corneal infections need therapeutic PKP when the aggressive medication fails. In addition to restoring the corneal integrity, Tectonic PKP is performed for corneal perforation. The clinical outcomes depend on many factors such as underlying corneal pathology, pre-existing glaucoma, underwent glaucoma surgery, age, and corneal graft size[1-5]. Advances in the medical management of certain diagnoses and the adoption of a conservative approach have changed patterns in the indications of PKP. Moreover, the decline of certain disorders due to changes in surgical practice, and the emergence of new surgical techniques have largely influenced the changing trend. Al-Yousuf et al, and other investigators reported that the indications for PKP have continued to change over the past few decades[5].

Correspondence to:

Khotcharrat R.

Department of Ophthalmology, Faculty of Medicine, Naresuan University, Phitsanulok 65000, Thailand.

Phone: +66-55-965666 ext. 5056, **Fax**: +66-55-965005

Email: Rossukon_ae@hotmail.com, rossukonsr@nu.ac.th

Materials and Methods

The out-patient and in-patient medical records of patients that underwent PKP between September 1, 2004 and December 31, 2009 were retrospectively reviewed for the indications, the surgical techniques and other combined operations, and the prognostic factors to graft success or failure. The pre-operative and post-operative visual acuity were converted from Snellen equivalent to Log MAR[6]. Pearson chi-square tests at p-value of less than 0.05 was considered statistically significant.

The present study was approved by the

How to cite this article: Khotcharrat R, Sawatdiwithayayong J, Bhoopat T, Ngowyutagon P. Indications and Outcomes of Penetrating Keratoplasty at a Tertiary Care Hospital in Northern Thailand. J Med Assoc Thai 2019;102:1156-9.

Table 1. The clinical diagnosis, associated eye diseases and surgical indications

Data	n (%)
Diagnosis (some patients had 2 diagnosis)	
Corneal scar	10 (18.5)
Bullous keratopathy	14 (25.9)
Graft failure	7 (13.0)
Corneal thinning and/or perforation	7 (13.0)
Corneal dystrophy	6 (11.1)
Corneal ulcer	6 (11.1)
Lipid keratopathy	1 (1.9)
ICE syndrome	1 (1.9)
Band keratopathy	1 (1.9)
Descemet detachment	1 (1.9)
Associated eye diseases	
None	18 (35.3)
Glaucoma	14 (27.5)
Cataract	5 (9.8)
Glaucoma and Cataract	3 (5.9)
Aphakia	2 (3.9)
Neurothrophic keratitis	1 (2.0)
PCO	1 (2.0)
Lipid keratopathy	1 (2.0)
Glaucoma and Aphakia	1 (2.0)
Glaucoma and PCO	1 (2.0)
Cataract and old perforation	1 (2.0)
Glaucoma and HIV infection	1 (2.0)
Glaucoma and limbal stem cell deficiency	1 (2.0)
Glaucoma with chronic uveitis and late endopthalmitis	1 (2.0)
Indications	
Optical PKP	42 (82.4)
Tectonic PKP	5 (9.8)
Therapeutic PKP	4 (7.8)
Surgical Procedures	
Simple PKP	31 (60.8)
PKP + ECCE and IOL	8 (15.7)
PKP + Avastin injection	2 (3.9)
PKP + synechiolysis + iridectomy	2 (3.9)
PKP + SF IOL	1 (2.0)
PKP + pterygium excision	1 (2.0)
PKP + synechiolysis	1 (2.0)
PKP + iridectomy	1 (2.0)
PKP + CLAU	1 (2.0)
PKP + AC IOL removal + SF IOL	1 (2.0)
PKP + iridectomy + vitrectomy	1 (2.0)
PKP + amniotic membrane patch + tarsorrhaphy + punctal occlusion + Avastin injection	1 (2.0)

ICE=iridocorneal endothelial; PCO=posterior capsular opacity; PKP=penetrating keratoplasty; ECCE=extracapsular cataract extraction; IOL=intraocular lens; SF=scleral fixed; CLAU=conjunctival limbal autograft; AC=anterior chamber

Institutional Review Board of Naresuan University (No.916/59, November 2016).

Results

The present study evaluated 51 eyes from 51 patients. There were 21 men (41.2%) and 30 women (58.8%). The mean recipient's age was 60.9±14.3 years (range from 25 to 88 years old). The mean followed up time was 35.8±20 months. The most common indication was for optical reason (82.4%) in patients diagnosed with bullous keratopathy (n=14, 25.9%), followed by corneal scar (n=10, 18.5%). Table 1 shows the clinical diagnosis, associated eye diseases, indications, and surgical procedures. The pre-operative mean visual acuity was 2.3±0.7 Log MAR, and post-operative mean visual acuity was 1.6±0.9 Log MAR. The mean of visual improvement was 0.7±0.8 Log MAR (paired t-test=5.6, df=42, sig 2 tailed p-value 0.00 at 95% CI). In addition, the paired correlation of pre-operative visual acuity and post-operative mean visual acuity was statistically significant (paired correlation 0.5, p-value 0.001).

Graft failure was found in 24 patients which was 48%, caused by irreversible graft rejection, recurrent infection, corneal ulcer on graft, and graft perforation. Late endothelial failure was one of the causes as well. The graft failure outcome was significantly higher in patients with pre-existing glaucoma before operating PKP (68.2% versus 31.0%, Pearson chi-square test, p-value 0.008), re-grafting for previous graft failure was significantly higher (85.7% versus 40.9%, Fisher's exact test, p-value 0.04), and secondary post-operative glaucoma (75.0% versus 29.0%, Pearson chi-square test, p-value 0.001).

In contrast, post-operative increased intraocular pressure (IOP) was not significantly different (50.0% versus 46.0%, Pearson chi-square test, p-value 0.835) either simple PKP versus combined procedures was not significantly different (60.0% versus 38.0%, Pearson chi-square test, p-value 0.137), or Graft size

Table 2. Literature review of indication and outcome of penetrating keratoplasty in Southeast Asia

Authors	Country	No. eyes treated	Indication	Outcome	Year
Ausayakhun, et al.[8]	Thailand	103	Corneal ulcer (37.9%)	-	1990 to 1995
Chaidaroon, et al.[9]	Thailand	45	Bullous keratopathy (28.9%)	-	1996 to 1999
Pariyakanok, et al.[7]	Thailand	3,582	Corneal scar (20.44%)	-	1996 to 2008
Isipradit, et al.[10]	Thailand	62	Bullous keratopathy (40.3%)		2002 to 2007
Tan, et al.[2]	Singapore	1,130	Bullous keratopathy (23.4%)	86.6% at 1 year, 72.0% at 3 years, 63.7% at 5 years, 52.0% at 10 years	1991 to 2003
Dong, et al.[11]	Vietnam	1,390	Infectious corneal ulcer (48.2%)	-	2002 to 2013

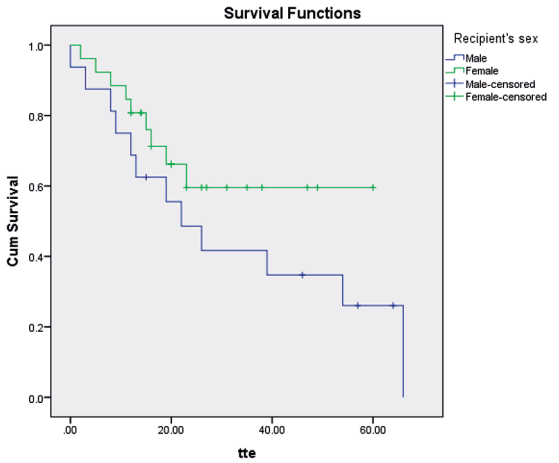

Figure 1. Survival curve shows female had better outcome of clear graft than male.

diameter of more than 8.0 mm (61.5% versus 42.1%, Pearson chi-square test, p-value 0.226).

More analyses on survival and the failure rate of male, which was higher than female is shown in Figure 1. Survival curve showed that female had better outcome of clear graft than male especially 20 months after the operation, although there was no significant difference in sex influencing to survival rate by Cox regression.

Discussion

Although lamellar keratoplasty is performed more nowadays with different technique and indication, PKP remains the mainstay treatment in many situations. There are many indications of PKP in many studies from different countries. Similar to the present review, the study from Singapore[2] showed that optical reason is still the most common indication (87%), and the main diagnoses were bullous keratopathy and post-infectious scarring. Graft survival rate were 86.6%, 72%, and 63.7% at 1, 3, and 5 years, respectively. Study in The United State also reported bullous keratopathy as the most common indication and the graft survival rate were 90% and 82% at 5 and 10 years[3], respectively.

The indications for PKP differ in developed and developing countries. In Thailand, the biggest series is from the Thai Red Cross Eye Bank that reported corneal scar as the major indication[7]. There are two reports from tertiary hospital in Chiang Mai[8,9]. The data during 1990 and 1995 showed that corneal ulcer was the main indication, but later, bullous keratopathy became the major indication, similar to the present study and the result from Isipradit and Prapaipanich[10], and Tan et al[2]. Recent development in antibiotics and increase in the number of cataract surgeries may play the role in this change. However, the data between 2002 and 2013 from Vietnam[11], which is in the same region as Thailand, showed that infectious corneal ulcer remained the leading indication for PKP (Table 2).

In the present study analyses, pre-existing glaucoma, previous graft failure, and secondary post-operative glaucoma showed a significant correlation with graft failure. Yamamoto et al[12] and Rahman et al[13] also reported that a history of rejection or previous failure and glaucoma tend to have poor outcome for graft survival. There was higher incidence of graft rejection in group with corneal graft diameter 8.00 mm or larger in the report from Li et al[14] but graft size did not show significant correlation to graft survival in the present study.

Conclusion

In conclusion, PKP remains an effective treatment in many corneal conditions. The most common indications in the present study are bullous keratopathy and corneal scar. However, the graft failure rate is quite high. Pre-existing glaucoma, re-grafting for previous graft failure, and secondary post-operative glaucoma are found to be the risk factors. Further reviews of corneal transplantation should continue to offer an important insight into the trend and outcome of PKP.

What is already known on this topic?

The indications for PKP changed over the decades. The clinical outcomes depend on many factors.

What this study adds?

Pre-operative and post-operative glaucoma are the major risks for graft failure, while secondary increasing intraocular pressure is not. Thus, pre-operative preparation, post-operative early detection of raising IOP, and proper IOP control will reduce rate of graft failure. The benefits of this treatment far outweigh any risks.

There is no correlation of graft size to the risk for graft failure in optical purpose.

Acknowledgement

The authors would like to thank Supasit Pannarunothai MD, PhD for statistical analysis and for English proof reading.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Sugar A, Tanner JP, Dontchev M, Tennant B, Schultze RL, Dunn SP, et al. Recipient risk factors for graft failure in the cornea donor study. Ophthalmology 2009;116:1023-8.
2. Tan DT, Janardhanan P, Zhou H, Chan YH, Htoon HM, Ang LP, et al. Penetrating keratoplasty in Asian eyes: the Singapore corneal transplant study. Ophthalmology 2008;115:975-82.
3. Thompson RW Jr, Price MO, Bowers PJ, Price FW Jr. Long-term graft survival after penetrating keratoplasty. Ophthalmology 2003;110:1396-402.
4. Sugar A, Gal RL, Kollman C, Raghinaru D, Dontchev M, Croasdale CR, et al. Factors associated with corneal graft survival in the cornea donor study. JAMA Ophthalmol 2015;133:246-54.
5. Al-Yousuf N, Mavrikakis I, Mavrikakis E, Daya SM. Penetrating keratoplasty: indications over a 10 year period. Br J Ophthalmol 2004;88:998-1001.
6. Holladay JT. Visual acuity measurements. J Cataract Refract Surg 2004;30:287-90.
7. Pariyakanok L, Erjongmanee S, Saonanon P. Indications for corneal transplantation in Thailand between 1996 and 2008. Asian Biomed 2011;5:843-48.
8. Ausayakhun S, Juntaramanee J. Clinical indications for penetrating keratoplasty in Maharaj Nakorn Chiang Mai Hospital, 1990-1995. Thai J Ophthalmol 1997;11:17-23.
9. Chaidaroon W, Ausayakhun MS, Ngamtiphakorn S, Prasitsilp J. Clinical indications for penetrating keratoplasty in Maharaj Nakorn Chiang Mai Hospital, 1996-1999. J Med Assoc Thai 2003;86:206.
10. Isipradit S, Prapaipanich P. Indications for penetrating keratoplasty in a tertiary care hospital in central part of Thailand. Thammasat Thai J Ophthalmol 2008;3:33-43.
11. Dong PN, Han TN, Aldave AJ, Chau HT. Indications for and techniques of keratoplasty at Vietnam National Institute of Ophthalmology. Int J Ophthalmol 2016;9:379-83.
12. Yamamoto S, Shimmura-Tomita M, Satake Y, Shimazaki-Den S, Shimmura S, Shimazaki J. Factors Affecting outcomes of repeated penetrating keratoplasty. Nippon Ganka Gakkai Zasshi 2015;119:625-31.
13. Rahman I, Carley F, Hillarby C, Brahma A, Tullo AB. Penetrating keratoplasty: indications, outcomes, and complications. Eye (Lond) 2009;23:1288-94.
14. Li C, Zhao GQ, Che CY, Lin J, Li N, Jia WY, et al. Effect of corneal graft diameter on therapeutic penetrating keratoplasty for fungal keratitis. Int J Ophthalmol 2012;5:698-703.