

Original Paper

Outcome of Penetrating Keratoplasty (PKP) and Redo PKP among Jordanian Population

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Abstract

Background: *The success of penetrating keratoplasty (PKP) is determined by the duration of graft survival, which is the time to graft failure. Our study aims to identify various indications of corneal graft among our Jordanian population, their success rate as well as spotting the light on cases of re-grafting.*

Methods: *In this study, we analyzed data for patients who had PKP as well as re-do PKP in the period from January 2014 to June 2017. For each study eye, we identified pre-operative visual acuity as well as visual acuity at six months and one year. We also focused on the specific indication for PKP, the surgical procedure and graft clarity at one year post-op. On SPSS statistical analysis software, we used repeated measure ANOVA, Pearson correlations, and Fischer's exact test to analyze our study's variables.*

Results: *We included a total of 230 patients in this study with a mean age of 34.22 (± 19.32). They were 112 (48.7%) males and 118 ($\pm 51.3\%$) females. We found a significant difference in mean age and outcome ($p < 0.001$), as the mean age for patients with successful PKP was 31.55 (± 16.55) compared to 44.1 (± 25.1) for patients with failed PKP. the success rate for patients with KC as an indication was 96.7% compared to only 58.3% for other indications. We found that failure rate in redo surgeries was*

significantly higher than first time surgeries.

Conclusion: *Among the Jordanian population, we found that Keratoconus was the main indication for PKP in our population, where we also found that it was associated with the best prognosis.*

Keywords

Penetrating keratoplasty, Keratoconus, Cornea, Graft, Jordan

1. Introduction

The Greece physician Galen (130-200 AD) was the pioneer of corneal surgery concept. However, true surgical experiment came into reality in the 19th century. A Successful human penetrating keratoplasty (PKP) was first performed by Eduard Zirm in 1905 for a patient with severe bilateral alkali burn (Crawford, Dipika, & Charles, 2013). The indications of corneal transplantation differ among various geographic areas. Pseudophakic bullous keratopathy and re-graft are the leading causes for keratoplasty in US and Canada. On the other hand, keratoconus is the most frequent indication in Iran and New Zealand, while post infectious and traumatic corneal scars are the main indications in China and India (Altar et al., 2016). The success of penetrating keratoplasty (PKP) is determined by the duration of graft survival, which is the time to graft failure. Though, no clear definition of graft failure came to an agreement; some studies consider loss of clarity as graft failure which is applied on optical grafts but not on therapeutic or tectonic grafts. While others convey success at improving visual outcome rather than graft clarity alone (Patel, 2011). Risk factors like preoperative glaucoma, presence of anterior or posterior synechiae, quadrants of stromal vessels, chemical burn as indication for graft showed the strongest association with graft failure (Edwards, Clover, Brookes, Pendergrast, Chaulk, & McGhee, 2002).

Our study aims to identify various indications of corneal graft among our Jordanian population, their success rate as well as spotting the light on cases of re-grafting.

2. Methods

We conducted a prospective clinical study using chart review at Jordan University Hospital, Amman, Jordan, from January 2014 to June 2017. Two hundred thirty eyes (230) of two hundred seventeen 217 patients who underwent penetrating keratoplasty were enrolled in this study. For each study eye, we identified pre-operative visual acuity as well as visual acuity at six months and one year. The specific indication for PKP, the surgical procedure which was performed (PKP only, PKP with cataract extraction and IOL (Triple procedure) or PKP with scleral fixation IOL (double procedure) and graft clarity at one year post-op. For those with graft failure, we identified the causes of failure (graft opacification, rejection, endophthalmitis). The success of the graft was determined by its clarity rather than final BCVA improvement.

The study protocol adhered to the tenets of the Declaration of Helsinki and was approved by the local institutional review board and ethics committee (IRB at Jordan University Hospital and The Faculty of

Medicine).

SPSS version 21.0 (Chicago, USA) was used in our analysis. Mean (\pm standard deviation) were used to describe continuous variables, and used count (frequency) to describe other nominal variables. Moreover, Classification Tree Analysis (CTA) in IBM SPSS Modeler version 18.1 for Mac was used to test independent variables for their predictive performance regarding the corneal grafting outcome.

After testing for distribution via bar charts and sphericity via Mauchly's test, we used repeated measure ANOVA to study the mean difference between baseline VA and VA during subsequent visits, and we presented data in mean (95% confidence interval (CI)). We used Pearson correlations to analyze the relation between age and BCVA pre-op, 6 months, and 1-year post op. We used Fischer's exact test to analyze the relation between redo status and outcome, and between KC as an indication and other indications on one hand, and outcome on the other hand. We adopted a p value of 0.05 as a significant threshold.

3. Results

We included a total of 230 patients in this study with a mean age of 34.22 (\pm 19.32). They were 112 (48.7%) males and 118 (\pm 51.3%) females. Table 1 shows the indication for PKP surgeries, with Keratoconus was the most frequent indication in our series (53%), Followed by Pseudophakic bullous keratopathy (PBK) (27%), and the lest one was perforation (1.3%)

211 (91.7%) were only PKP surgeries, 12 (5.2%) were double surgeries (PKP + scleral fixation IOL), and only 7 (3%) were triple surgeries. From the 230 PKPs, 28 (12.2%) were redo surgeries. The overall failure rate was 49 (21.3%).

Table 1. The Frequency of Each Indication for the Penetrating Keratoplasty

		Frequency	Percent
Valid	KC	122	53.0
	PBK	27	11.7
	Corneal dystrophy	21	9.1
	Failed graft	15	6.5
	Keratitis	11	4.8
	Scarring	10	4.3
	Trauma	9	3.9
	Congenital glaucoma	9	3.9
	Others	3	1.3
	Perforation	3	1.3
	Total	230	100.0

We found a significant difference in mean age and outcome ($p < 0.001$), as the mean age for patients with successful PKP was 31.55 (± 16.55) compared to 44.1 (± 25.1) for patients with failed PKP. Upon analyzing success rate between patients with KC as an indication for PKP (122 patients; 53%) and those with other indications (108; 47%), we found a significant difference ($p < 0.001$), as the success rate for patients with KC as an indication was 96.7% compared to only 58.3% for other indications. 106 (46.1% were done on right eye and 124 (53.9%) were done on left eye. No significant difference between success rate and either gender, laterality, or BCVA.

We analyzed the number of PKP per year from 2014 to 2017, where the percentage of redo and the success rate are shown in (Table 2).

Table 2. Percentage of Redo and the Success Rate

	PKP done	Outcome				Redo					
		Failure		Success		Yes		No			
		Count	%	Count	%	Count	%	Count	%		
Date of	2014	75	32.6	19	25.3%	56	74.7%	13	17.3%	62	82.7%
Operation	2015	65	28.3	15	23.1%	50	76.9%	8	12.3%	57	87.7%
	2016	75	32.6	10	13.3%	65	86.7%	6	8.0%	69	92.0%
	2017	15	6.5	5	33.3%	10	66.7%	1	7.1%	13	92.9%

We found that failure rate in redo surgeries was significantly higher than first time surgeries ($p = 0.047$), as failure rate in redo surgeries was 35.7% compared to 19.4% in first time surgeries, taking into consideration that no significant difference between redo surgeries and either indication or age. The causes of failure for the included sample are shown in (Table 3).

Table 3. Cause of Failure

	Frequency	Percent
Opacification	21	9.2
Rejection	21	9.1
Endophthalmitis	4	1.7
Recurrence	3	1.3
Total	230	100.0

We found a steady increase in BCVA among visits with average BCVA 0.05 at baseline preoperatively and 0.2 at 1 year postoperatively (all had a $p < 0.001$) as shown in (Figure 1). We didn't find significant correlation between age and BCVA.

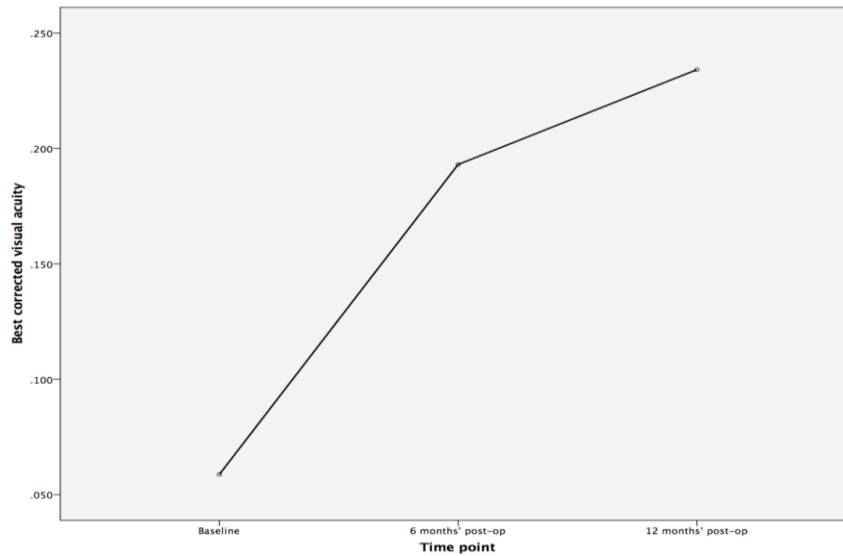


Figure 1. A Steady Increase in BCVA among Visits with Average BCVA 0.05 at Baseline Preoperatively and 0.2 at 1 Year Postoperatively (All Had a $p < 0.001$)

4. Discussion

In our study, we report the clinical indications for PKP in 230 cases from Jordan University Hospital between 2014-2017. To the best of our knowledge, this is the first study of this topic in Jordan. We reported the followings as major indications for PKP: Keratoconus was the most common (53%) followed by Bullous keratopathy (11.7%), then corneal Dystrophy (9.1%) (Table 1). Keratoconus was the main indication for PKP in our population, which is in concordance with reports from New Zealand (Edwards, Clover, Brookes, Pendergrast, Chaulk, & McGhee, 2002), Israel (Yahalom, Mechoulam, Solomon, Raiskup, Peer, & Frucht-Pery, 2005) and Iran (Kanavi, Javadi, Motevasseli, Chamani, Kanavi, Kheiri, & Safi, 2016). In most studies, bullous keratopathy is the main indication in developed countries, while infectious keratitis and corneal scars are the leading causes in developing countries (Patel, 2011). Most previous studies agreed that the indication for PKP is one of the most important factors affecting the success rate (Yamazoe, Yamazoe, Shimazaki-Den, & Shimazaki, 2013; Williams et al., 2008; Williams et al., 2006), which is consistent with our study, where we compared keratoconus with other indications. A previous study classified the indication for PKP into low, moderate, and high risk keratoplasties, where keratoconus is classified as one of the low risk keratoplasties (Yamazoe, Yamazoe, Shimazaki-Den, & Shimazaki, 2013). Moreover, in our study, we found that redo PKP is associated with also higher failure rate, in concordance with previous literature (Weisbrod, Sit, Naor, & Slomovic, 2003; Al-Mezaine & Wagoner, 2006). Our results showed that, age was found to be significantly associated with successful PKP with a mean age of 10 years lower than those with failed PKP. This finding is poorly reported in literature, as other studies focused on donor age more than recipient age, as increasing donor age exert a deleterious, although weak effect on outcome (Yamazoe, Yamazoe, Shimazaki-Den, & Shimazaki, 2013; Williams et al., 2006), although other studies did not find a

significant effect for age, neither for donor nor for recipient (Yamazoe, Yamazoe, Shimazaki-Den, & Shimazaki, 2013; Williams et al., 2008).

Our results also indicated that factors related to type of surgery (PKP only vs. PKP + IOL or PKP + IOL + Cataract extraction), or preoperative BCVA are not relevant to success rate. However, their prognostic role varies in literature, as some studies agree and others do not (Yamazoe, Yamazoe, Shimazaki-Den, & Shimazaki, 2013; Williams et al., 2008). Success of penetrating keratoplasty is defined either by graft clarity or its effect on final visual outcome (Patel, 2011). In retrospective study done in UK including 784 eyes, the overall success rate was 66%, reaching 98% in Keratoconus, 86% in infectious keratitis and 84% in bullous keratopathy (Beckingsale, Mavrikakis, Al-Yousuf, Mavrikakis, & Daya, 2006). While in India, a prospective analysis of 100 donor corneas showed the success rate in Keratoconus was 66.6%, pseudophakic bullous keratopathy 28.6% and 20.9% in corneal opacity (Gupta, Sharma, & Ichhpujani, 2014). In another retrospective non comparative case series done in United States including 3992 eyes from 1982-1996, graft survival was 90% at 5 years and 82% at 10 years, for both Keratoconus and Fuch's Dystrophy, the success rate at 5 years was 97% (Thompson, Price, Bowers, & Price, 2003).

So far, plenty of evidence support the notion that the failure rate of a repeated corneal graft exceeds the failure rate for a first time graft (Weisbrod, Sit, Naor, & Slomovic, 2003; Al-Mezaine & Wagoner, 2006; Yalniz-Akkaya, Nurozler, Yildiz, Onat, Budak, & Duman, 2009), a notion that also supported in our study on Jordanian patients. It was also found that BCVA is also worse after redo surgery compared to first time graft (Claesson & Armitage, 2013). The main argument behind worse outcome after redo surgery is that repeated PKP share most of the risk factors of the original procedure in addition to other risk factors acquired since the original PKP (Al-Mezaine & Wagoner, 2006). In a previous study aimed to investigate the reason behind the higher failure rate for redo surgeries found that both groups share common risk factors for graft failure, namely, the original diagnosis leading to corneal transplantation, the presence of preoperative peripheral anterior synechia, and the development of postoperative corneal neovascularization. The difference in graft survival rates between the two groups can be partially explained on the basis of higher rates of the latter two risk factors among redo surgeries (Weisbrod, Sit, Naor, & Slomovic, 2003).

To investigate the factors that are associated with improved outcome in redo surgeries, Kelly et al. found that if the previous graft had survived ≥ 10 years, surgery was performed at a favorable location, the recipient was aged less than 60 years at graft, and graft rejection and neovascularization were circumvented (Kelly, Coster, & Williams, 2011). The discordance in the significance of prognostic factors might be related to several unmeasured factors related to ethnicity, surgeon experience, patient care following the graft, and several other factors that were not assessed in this and previous studies. We believe that our study has several limitations; the most important one is the small sample size as future studies should include a larger representative samples. Increasing the period of follow up should also be considered in future studies.

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