

# Graft survival and visual outcome after simultaneous penetrating keratoplasty and cataract extraction

*Mansour M. Al-Mohaimed*

Department of Ophthalmology, College of Medicine, Qassim University, Qassim, Kingdom of Saudi Arabia

**Correspondence to:** Mansour M. Al-Mohaimed. Department of Ophthalmology, College of Medicine, Qassim University, Qassim, PO Box 6655, Buraidah 51452, Kingdom of Saudi Arabia. drmohaimed@hotmail.com  
Received: 2012-12-25 Accepted: 2013-04-08

## Abstract

• **AIM:** To evaluate the indications, complications, and visual and graft survival outcomes in eyes that had undergone simultaneous cataract extraction and penetrating keratoplasty (PKP).

• **METHODS:** We described a retrospective study of 101 patients who had undergone simultaneous cataract extraction and PKP at King Khaled Eye Specialist Hospital between January 1, 2001, and December 31, 2002. All patients were followed up postoperatively with maximum follow-up 68 months.

• **RESULTS:** The mean age of patients was 61 years. The mean overall follow-up was 27 months. The most common indications for surgery were corneal scarring (45.5%), previous failed graft (15.8%), corneal ulcer (12.9%), Fuchs endothelial dystrophy (8.9%), stromal dystrophy (2.9%), and other conditions (14.5%). Overall, 69 grafts (68.3%) remained clear at final follow-up. Previous glaucoma or postoperative glaucoma had no statistically significant effects on graft outcome ( $P > 0.05$ ). The graft rejection rate (17.8%) was a significant risk factor for failure ( $P = 0.00$ ). Age, gender, indications for surgery, corneal graft diameter, and intraoperative vitreous loss had no statistically significant effects on the PKP outcome ( $P > 0.05$ ). Postoperative visual acuity was significantly associated with preoperative visual acuity ( $P < 0.01$ ).

• **CONCLUSION:** The present study provides evidence that performing a combined procedure results in more rapid visual rehabilitation and good graft clarity.

• **KEYWORDS:** penetrating keratoplasty; cataract extraction; graft failure

**DOI:10.3980/j.issn.2222-3959.2013.03.24**

Al-Mohaimed MM. Graft survival and visual outcome after simultaneous penetrating keratoplasty and cataract extraction. *Int J Ophthalmol* 2013;6(3):385-389

## INTRODUCTION

In patients with both corneal and lenticular opacities, combined cataract extraction/intraocular lens (IOL) insertion with penetrating keratoplasty (PKP), which is known as the triple procedure, is one treatment option [1]. Sequential procedure, an alternative technique in which cataract extraction and IOL implantation are delayed until sometime post-PKP has also been investigated [2]. Combined cataract extraction and PKP was first reported by Katzin and Meltzer in 1966 [3]. In 1976, IOL insertion was added by Taylor [4]. The present study retrospectively assesses the outcomes of the combined procedure, with graft clarity and visual acuity (VA) as the main outcome measures.

## SUBJECTS AND METHODS

**Subjects** After approval had been obtained from the local research ethics committee, the medical records of every patient who had undergone simultaneous PKP and cataract extraction at King Khaled Eye Specialist Hospital between January 1, 2001, and December 31, 2002, were retrospectively reviewed. All patients included in this retrospective review had been followed up for a minimum period of 2 months. Members of the Anterior Segment Division in the Department of Ophthalmology at King Khaled Eye Specialist Hospital performed all surgeries.

**Methods** Following surgery, patients were administered topical corticosteroids (Prednisolone acetate 1%) and antibiotics. After about 2 to 4 weeks, the administration of topical antibiotics was discontinued. Based on the clinical outcome, patients underwent a gradual taper from topical steroids over at least a 6-month period. Most patients were evaluated on the first postoperative day; after 1 week; after 1 month, 3, 6, 9, 12, 18, and 24 months; and annually thereafter. Treating ophthalmologists either removed all sutures after 12 to 36 months or only selectively removed loose or tight sutures that induced unacceptable levels of postoperative astigmatism. Data extracted from the medical records included demographic data, previous medical and surgical interventions, indications for the procedure, donor and recipient information, concomitant surgical procedures, graft clarity, visual acuity (VA), postoperative complications, and follow-up interval. The primary outcome measures were graft survival and VA. Graft failure was strictly defined as irreversible loss of central graft clarity, irrespective of the level of VA. If the graft remained clear, the follow-up

interval was defined as the interval between surgery and the most recent examination. If the graft failed, the follow-up interval was defined as the interval between surgery and the first visit when irreversible loss of graft clarity was documented. Measurements of VA were recorded preoperatively and at the most recent examination. The best-corrected VA (BCVA) measurements were used if available. If the BCVA measurements were not available, the uncorrected VA measurements were considered to be equivalent to the BCVA measurements for the purpose of statistical analysis.

**Statistical Analysis** All data were entered into SPSS 17.0 for analysis. Descriptive statistics were used to calculate mean±standard deviation (SD) for numeric variables like age. Chi-square was used for analysis of variance. Graft survival was analyzed using Kaplan-Meier survival analysis. Nominal *P* values were used for all comparisons, and the term significance was accepted if  $P \leq 0.05$ .

## RESULTS

During the study interval, a total of 101 eyes underwent simultaneous PKP and cataract extraction surgery performed by members of the Anterior Segment Division. The patients included 55 men (54.5%) and 46 women (45.5%). Surgery was performed on 40 right eyes (39.6%) and 61 left eyes (60.4%). Patient mean age at the time of surgery was 60.82 years (SD±16 years). The mean overall follow-up period was 27 months (range, 2-68 months), with 78 eyes (77.2%) having a follow-up of 1 year or more. The mean follow-up for clear grafts was 31 months (range, 2.7-68 months). Although the differences in mean follow-up of clear grafts among the surgical indications were not statistically significant, the number of patients with the maximum follow-up period (68 months) belonged to the corneal scar category. The mean initial best-corrected visual acuity (BCVA) was counting fingers (CF) at 3 feet preoperatively (range, 20/50 to light perception [LP]). The intraocular pressure (IOP) was uncontrolled in two patients. The mean host corneal bed size was 7.2mm (SD±0.6), and the mean donor corneal button size was 7.5mm (SD±0.6). In 4 eyes (4.0%), donor and host sizes were the same; in 48 eyes (47.5%), a 0.25mm oversized donor graft was selected; in 49 eyes (48.5%), a 0.5mm oversized donor graft was used. A planned PKP with cataract extraction/IOL implantation procedure was performed in 96 eyes (95.0%). A planned cataract extraction without IOL insertion procedure for high myopic patients was performed in 5 eyes. The presence of trichomatous corneal scarring with no adherent leucoma was the most common indication of PKP and accounted for 46 eyes (45.5%). A previous failed graft was the second most common indication and accounted for 16 eyes (15.8%). The presence of a corneal ulcer ranked as the third most common indication and accounted for 13 eyes (12.9%). Fuchs

endothelial dystrophy was the fourth leading overall indication for PKP in this study and accounted for 9 eyes (8.9%) (Table 1). Of the 101 eyes undergoing cataract surgery with keratoplasty, the Ahmed glaucoma valve implantation was simultaneously performed in 2 eyes to treat uncontrolled glaucoma. Meticulous anterior vitrectomy was performed in 14 eyes (13.9%) in which vitreous loss had occurred; of these 14 eyes, 3 eyes were aphakic, and 4 ended by failure. No IOL complications such as decentration and dislocation occurred. Overall, 69 grafts (68.3%) remained clear at final follow-up. Graft rejection was detected in 18 eyes (17.8%). Graft failure occurred in 32 (31.7%) of the 101 transplanted eyes. Of these 32 eyes, graft failure occurred as a result of graft rejection in 14 eyes (43.8%), and graft failure developed following prolonged elevation of IOP in 9 eyes (28.1%). The mean time of graft failure to occur was 18 months after transplantation (range 2-46.5 months). The difference between men and women regarding the clarity of graft was statistically insignificant. No significant differences were found in the PKP outcome of patients with regard to recipient average age and gender. Previous glaucoma or postoperative glaucoma had no statistically significant effects on PKP outcome ( $P > 0.05$ ). A Kaplan-Meier cumulative survival curve shows that graft survival probability was 0.86 at 12 months and 0.59 at 36 months (Figure 1).

A comparison of BCVA values preoperatively and postoperatively revealed the following: A BCVA of 20/40 or better was found in only 1 eye (1.0%) preoperatively compared with 25 eyes (25.0%) postoperatively; 7 eyes (7.0%) had a BCVA in the range of 20/50 to 20/150 preoperatively compared with 20 eyes (20.0%) postoperatively; and 92 eyes (92.0%) presented with a BCVA of 20/200 or worse compared with 55 eyes (55.0%) postoperatively. Table 2 shows a statistically significant difference between preoperative and postoperative BCVA of patients. When failed grafts were excluded, 25 of 68 eyes (36.8%) achieved a BCVA of 20/40 or better and 27 (39.7%) achieved a BCVA of 20/200 or worse ( $P = 0.00$ , Figure 2).

At the end of the study, the BCVA had improved by more than 2 lines in 72 eyes (72.0%), deteriorated by more than 2 lines in 7 eyes (7.0%), and remained at the same level in 21 eyes (21.0%). Graft clarity and final VA outcomes varied by indication for transplantation (Table 3). Fewer grafts performed for repeated failed graft were clear at final follow-up ( $n = 7$ , 43.8%) than grafts performed for corneal scarring ( $n = 35$ , 76.1%), but the difference was not statistically significant ( $P > 0.05$ ).

The most common intraoperative complication was vitreous loss, which occurred in 14 eyes (13.9%), with 3 eyes becoming aphakic and 4 ending by failure. No IOL complications such as decentration or dislocation occurred. Following surgery, 23 eyes (22.8%) developed glaucoma

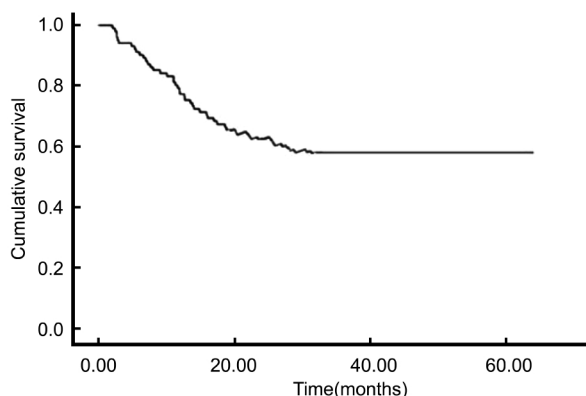
**Table 1 Demographic and clinical features of patients who underwent triple procedure n(%)**

Variables	Clear graft	Failed graft	Total	P
Gender				
Male	36(65.5)	19 (34.5)	55	>0.05
Female	33(71.7)	13 (28.3)	46	
Age (a, mean)	63.61	60.03		
Follow-up (months)	31(2-67.8)	18 (2-46.5)		0.00
Diagnosis				
Keratoconus	0(0)	1 (100.0)	1	
Scar	35(76.1)	11(23.9)	46	
Failed graft	7(43.8)	9(56.3)	16	
Ulceration	8(61.5)	5(38.5)	13	>0.05
Stromal dystrophy	3(100.0)	0(0)	3	
Fuchs endothelial dystrophy	8(88.9)	1(11.1)	9	
Others	8(61.5)	5(38.5)	13	
Recipient bed diameter (mm)	7.1(6.0-10.5)	7.3 (6.0-9.5)		
Donor graft diameter (mm)	7.4783(6.5-11.0)	7.6259 (6.0-10.0)		
Lens status				
Pseudophakia	65(69.9)	28(30.1)	93	>0.05
Aphakia	4(50.0)	4(50.0)	8	
Recipient size				
≤7.5mm	65(70.7)	27(29.3)	92	>0.05
>7.5mm	4(44.4)	5(55.6)	9	
Previous surgery	7(43.8)	9(56.3)	16	0.021
Previous glaucoma	16(69.6)	7(30.4)	23	>0.05
Glaucoma escalation	14(60.9)	9(39.1)	23	>0.05
Rejection	4(22.2)	14(77.8)	18	0.00

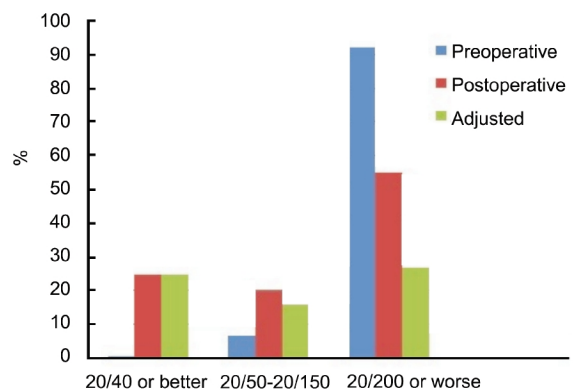
**Table 2 Comparison between preoperative and postoperative best-corrected visual acuity**

Parameters	Preoperative BCVA		Postoperative BCVA		Adjusted BCVA <sup>1</sup>		P
	n(%)	Cumulative %	n(%)	Cumulative %	n(%)	Cumulative %	
20/40 or better	1(1)	1.0	25(25.0)	25.0	25(36.8)	36.8	<0.001
20/50-20/150	7(7)	8.0	20(20.0)	45.0	16(23.5)	60.3	
20/200 or worse	92 (92.0)	100.0	55(55.0)	100.0	27(39.7)	100.0	
Total <sup>2</sup>	100	100	100	100	68	100.0	

<sup>1</sup>Adjusted BCVA: BCVA, excluding failed grafts; <sup>2</sup> BCVA was not checked for one child.



**Figure 1 Kaplan-Meier cumulative survival proportion curve showing graft survival after triple procedure.**



**Figure 2 Distribution of best -corrected visual acuity comparing preoperative and postoperative vision.**

escalation, with 14 of these eyes (60.9%) being diagnosed as having glaucoma before surgery. Of these 23 eyes, 15 eyes were managed successfully with topical glaucoma medications, 5 eyes required Ahmed implantation, and 3 eyes underwent cyclophotocoagulation. Postoperatively, 26.1% of

those eyes that developed glaucoma obtained a final VA of 20/200 or better ( $P=0.01$ ). Glaucoma escalation during follow-up after PKP occurred in 9 eyes (28.1%) of the 32 grafts that failed and in 14 eyes (20.3%) of the 69 grafts that did not fail over time.

**Table 3 Graft and visual outcomes by indications for corneal transplant** n (%)

Characteristics	Corneal scarring	Failed graft	Corneal ulcer	Fuchs endothelial dystrophy	Stromal dystrophy	Keratoconus	Others
Graft clarity							
Clear	35(76.1)	7(43.8)	8(61.5)	8(88.9)	3(100.0)	0(0)	8(61.5)
Not clear	11(23.9)	9(56.3)	5(38.5)	1(11.1)	0(0)	1(100.0)	5(38.5)
Final VA							
20/40 or better	12(26.1)	5(31.3)	3(23.1)	2(22.2)	1(33.3)	0(0)	2(16.7)
20/50 to 20/150	12(26.1)	2(12.5)	0(0.00)	1(11.1)	1(33.3)	0(0)	4(33.3)
20/200 or worse	22(47.8)	9(56.3)	10(76.9)	6(66.7)	1(33.3)	1(100.0)	6(50.0)

**DISCUSSION**

In the present study, corneal scarring was the most common reason for combined PKP and cataract extraction. This finding is in agreement with those of Bersudsky *et al*<sup>[5]</sup> (corneal scarring, 66%) and Sridhar *et al*<sup>[6]</sup> (corneal scarring, 66.4%). Whereas Fuchs endothelial dystrophy was found to be the main cause for PKP in many previous studies<sup>[7-12]</sup>, it was identified as the fourth leading overall indication for PKP in the present study. This difference may be explained by the variation in the demographic data of the present study. Both male and female patients from a wide age range were included in this study. Hence, the results indicating that gender and age had no significant effects on the outcome measures could be generally valid. In the present study, vitreous loss occurred in 14 eyes (13.9): 8 eyes were aphakic, and 4 of them developed graft failure. The rate of vitreous loss reported here is lower than that in the 2004 study by Bersudsky *et al*<sup>[5]</sup> because most of the present study's surgeries were done under general anesthesia and a Flieringa ring was routinely used. Because meticulous anterior vitrectomy was performed in the 14 eyes in which vitreous loss had occurred, graft failure developed in only 4 of those eyes.

The rate of graft clarity in keratoplasties combined with cataract surgery has been reported, ranging from 69% to 100%<sup>[6,7,12,13-19]</sup>. Bersudsky *et al*<sup>[5]</sup> and Sridhar *et al*<sup>[6]</sup> reported graft survival rates of 69% and 72%, respectively, in their studies, which are comparable to the graft survival rate of 68.3% determined in the present study. The surgical mix of indications for the triple procedure had a major impact on the overall prevalence rate. Although it correlated with the risk of graft failure, it was not statistically significant. Fuchs endothelial dystrophy and stromal dystrophy, which accounted for a total of 11.8% of the patients in the present study, produced 88.9% and 100% graft survival rates, respectively. By contrast, corneal scarring and corneal ulcer, which accounted for 58.5% of the PKP in this study, generated 76.1% and 61.5% graft survival rates, respectively, which may explain the lower graft survival rate in the present study. Williams *et al*<sup>[16]</sup> reported a 1-year graft survival rate

of 89% for the same kind of procedure, which is comparable to the 1-year graft survival rate found in the present study. The increased risk of graft failure was mainly attributed to rejection episodes. Patients who had rejection episodes suffered from failed grafts in 77.8% of cases, which is a statistically significant difference ( $P=0.00$ ).

The BCVA was 20/40 or better in 25% of all cases in the present study. In 36.8% of the clear graft cases, the VA was 20/40 or better. This finding does not compare favorably with those of previous studies in which a clear graft and a VA of 20/40 or better were achieved in 68% to 77% of cases<sup>[7,9,12,13,15,17,19-27]</sup>. However, some previous studies reported that this level of vision was achieved in only 38% to 46% of cases<sup>[6,18]</sup>. Geerards *et al*<sup>[28]</sup> also reported that the BCVA was better than 20/40 in 37.5% of cases. In the present study, a statistically significant correlation was found between the preoperative VA and the postoperative VA. The number of patients in the present study who had a VA of 20/40 or better preoperatively is lower than that reported in previous research<sup>[7]</sup>, which may explain the lower rate of 20/40 or better VA achieved postoperatively in the present study.

In conclusion, although the present study does have some limitations owing to its non-comparative and retrospective design, it does provide evidence that performing a combined procedure results in more rapid visual rehabilitation and good graft clarity.

**REFERENCES**

- Inoue Y. Corneal triple procedure. *Semin Ophthalmol* 2001;16 (3): 113-118
- Shimmura S, Ohashi Y, Shiroma H, Shimazaki J, Tsubota K. Corneal opacity and cataract: triple procedure versus secondary approach. *Cornea* 2003;22(3):234-238
- Katzin HM, Meltzer JF. Combined surgery for corneal transplantation and cataract extraction. *Am J Ophthalmol* 1966;62(3):556-560
- Taylor DM. Keratoplasty and intraocular lenses. *Ophthalmic Surg* 1976;7 (1):31-42
- Bersudsky V, Rehany U, Rumelt S. Risk factors for failure of simultaneous penetrating keratoplasty and cataract extraction. *J Cataract Refract Surg* 2004;30(9):1940-1947
- Sridhar MS, Murthy S, Bansal AK, Rao GN. Corneal triple procedure: indications, complications, and outcomes: a developing country scenario. *Cornea* 2000;19(3):333-335

- 7 Green M, Chow A, Apel A. Outcomes of combined penetrating keratoplasty and cataract extraction compared with penetrating keratoplasty alone. *Clin Experiment Ophthalmol*2007;35(4):324-329
- 8 Das S, Langenbacher A, Jacobi C, Nguyen NX, Kruse FE, Naumann GO, Seitz B. Long-term refractive and visual outcome after penetrating keratoplasty only versus the triple procedure in Fuchs' dystrophy. *Graefes Arch Clin Exp Ophthalmol*2006;244(9):1089-1095
- 9 Cazabon S, Quah SA, Jones MN, Batterbury M, Kaye SB. Sequential versus combined penetrating keratoplasty and cataract surgery. *Optom Vis Sci*2010;87(7):482-486
- 10 Meyer RF, Musch DC. Assessment of success and complications of triple procedure surgery. *Am J Ophthalmol*1987;104(3):233-240
- 11 Brightbill FS, Stainer GA, Hunkeller JD. A comparison of intracapsular and extracapsular lens extraction combined with keratoplasty. *Ophthalmology*1983;90(1):34-37
- 12 Crawford GJ, Stulting RD, Waring GO III, Van Meter WS, Wilson LA. The triple procedure. Analysis of outcome, refraction, and intraocular lens power calculation. *Ophthalmology*1986;93(6):817-824
- 13 Baca LS, Epstein RJ. Closed-chamber capsulorhexis for cataract extraction combined with penetrating keratoplasty. *J Cataract Refract Surg* 1998;24(5):581-584
- 14 Davis EA, Azar DT, Jakobs FM, Stark WJ. Refractive and keratometric results after the triple procedure: experience with early and late suture removal. *Ophthalmology*1998;105(4):624-630
- 15 Busin M, Arffa RC, McDonald MB, Kaufman HE. Combined penetrating keratoplasty, extracapsular cataract extraction, and posterior chamber intraocular lens implantation. *Ophthalmic Surg*1987;18(4):272-275
- 16 Williams KA, Hornsby NB, Bartlett CM, Holland HK, Esterman A, Coster DJ. The Australian Corneal Graft Registry 2004 Annual Report. Adelaide, Australia: Snap Printing; 2004
- 17 Pineros OE, Cohen EJ, Rapuano CJ, Laibson PR. Triple vs nonsimultaneous procedures in Fuchs' dystrophy and cataract. *Arch Ophthalmol* 1996;114(5):525-528
- 18 Sanford DK, Klesges LM, Wood TO. Simultaneous penetrating keratoplasty, extracapsular cataract extraction, and intraocular lens implantation. *J Cataract Refract Surg*1991;17(6):824-829
- 19 Nguyen DQ, Mumford LL, Jones MN, Armitage WJ, Cook SD, Kaye SB, Tole DM. The visual and refractive outcomes of combined and sequential penetrating keratoplasty, cataract extraction, and intraocular lens insertion. *Eye (Lond)*2009;23(6):1295-1301
- 20 Katz HR, Forster RK. Intraocular lens calculation in combined penetrating keratoplasty, cataract extraction, and intraocular lens implantation. *Ophthalmology*1985;92(9):1203-1207
- 21 Binder PS. Intraocular lens powers used in the triple procedure. Effect on visual acuity and refractive error. *Ophthalmology*1985;92(11):1561-1566
- 22 Mattax JB, McCulley JP. The effect of standardized keratoplasty technique on IOL power calculation for the triple procedure. *Acta Ophthalmol Suppl*1989;192:24-29
- 23 Musch DC, Meyer RF. Prospective evaluation of a regression-determined formula for use in triple procedure surgery. *Ophthalmology* 1988;95(1):79-85
- 24 Skorpik C, Menapace R, Gnad HD, Grasl M. The triple procedure—results in cataract patients with corneal opacity. *Ophthalmologica*1988;196 (1):1-6
- 25 Kirkness CM, Cheong PY, Steele AD. Penetrating keratoplasty and cataract surgery: the advantages of an extracapsular technique combined with posterior chamber intraocular implantation. *Eye*1987;1:557-561
- 26 Geggel HS. Intraocular lens implantation after penetrating keratoplasty. Improved unaided visual acuity, astigmatism, and safety in patients with combined corneal disease and cataract. *Ophthalmology* 1990;97 (11): 1460-1467
- 27 Price FW Jr, Whitson WE, Marks RG. Progression of visual acuity after penetrating keratoplasty. *Ophthalmology*1991;98(8):1177-1185
- 28 Geerards AJ, Hassmann E, Beekhuis WH, Remeyer L, van Rij G, Rijnveld WJ. Triple procedure; analysis of outcome, refraction, and intraocular lens power calculation. *Br J Ophthalmol* 1997;81(9):774-777