RESEARCH

# AETIOLOGY, OUTCOMES AND PROGNOSIS OF PENETRATING KERATOPLASTY PERFORMED ON PATIENTS AGED ABOVE 65 YEARS

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## Abstract

***Introduction:*** The objective of this study is to evaluate indications, outcomes and prognosis in geriatric patients who underwent penetrating keratoplasty (PKP).

***Materials and Method:*** 84 of 297 patients, who underwent PKP between January 2013-August 2016, were retrospectively analyzed. Age, gender, time between the onset of complaints and keratoplasty, duration of follow-up, other intraoperative-postoperative surgical procedures, complications, intraocular pressure (IOP), visual acuity were recorded. The data were statistically analyzed using paired-t test. P<0.05 was considered to be significant.

***Results:*** 84 eyes of 84 patients-49 (58.33%) male, 35(41.67%) female, mean age 65-83 (73.5±10.8) years-were included in the study. PKP was performed due to pseudophakic bullous keratopathy (PBK) in 35 (41.67%) patients, corneal leukoma 27 (32.14%), post-traumatic corneal scar 8 (9.52%), graft failure 6 (7.14%), aphakic bullous keratopathy 5 (5.95%), corneal dystrophy 3 (3.57%). The most common indication was PBK (41.67%). 23 (65.71%) of the PBK patients had posterior chamber intraocular lens (IOL), 10 (28.57%) anterior chamber, 2 (5.71%) scleral fixation. The time between the onset of complaints and keratoplasty was 3-31years. The mean duration of follow-up was 17.7 months. Intraoperatively, extracapsular cataract extraction+IOL implantation was performed on 13 (15.47%) patients, vitrectomy+lens extraction+IOL implantation 8 (9.52%), pupilloplasty 7 (8.33%), anterior chamber IOL extraction+anterior vitrectomy 6 (7.14%). Postoperatively, re-keratoplasty was performed on 9 (10.71%), secondary IOL implantation 8(9.52%), Ahmed glaucoma valve implantation 4 (4.76%), phacoemulsification 3 (3.57%), resuturation 1 (1.19%). Postoperative graft failure was observed in 9 (10.71%) patients, glaucoma 8 (9.52%), cataract 3 (3.57%), endophthalmitis 2 (2.38%), traumatic wound dehiscence 1 (1.19%). Preoperative-postoperative visual acuity was 1.43±0.76, 0.40±0.15 (logMAR), respectively (p<0.01). Preoperative-postoperative IOP was 13.78±6.50 mmHg, 16.01±2.29 mmHg, respectively.

***Conclusion:*** The most prevalent PKP indication in patients aged above 65 years was PBK; the results along with other surgical methods were quite satisfactory.

***Keywords:*** Geriatrics; Keratoplasty, Penetrating; Prognosis

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ARAŞTIRMA

# 65 YAŞ ÜZERİNDEKİ HASTALARDA UYGULANAN PENETRAN KERATOPLASTİNİN ETYOLOJİSİ, SONUÇLARI VE PROGNOZU

## Öz

***Giriş:*** Penetran keratoplasti uygulanan geriatrik yaş grubundaki olgularda endikasyonların, sonuçların ve prognozun değerlendirilmesi.

Gereç ve Yöntem: Ocak 2013-Ağustos 2016 tarihleri arasında penetran keratoplasti(PKP) uygulanan 297 hastadan 84'ünün dosyaları retrospektif olarak incelendi. Yaş, cinsiyet, şikayetler ile keratoplasti arasındaki süre, takip süresi, intraoperatif, postoperatif diğer cerrahi uygulamalar, komplikasyonlar, göz içi basıncı (GİB) ve görme keskinliği kaydedildi. İstatistiksel analizlerde paired-t testi kullanıldı. P<0.05 olması anlamlı kabul edildi.

***Bulgular:*** Çalışmaya; 49'u (%58.33) erkek, 35'i (%41.67) kadın, yaşları 65-83 (73.5±10.8) olan 84 hastanın 84 gözü dahil edildi. Hastaların 35'ine (%41.67) psödofakik büllöz keratopati(PBK), 27'sine (%32.14) korneal lökom, 8'ine (%9.52) travma sonrası korneal skar, 6'sına (%7.14) greft yetmezliği, 5'ine (%5.95) afakik büllöz keratopati, 3'üne (%3.57) korneal distrofi nedeniyle PKP uygulandı. En sık endikasyon PBK (%41.67) idi. PBK tanısıyla opere edilen hastaların 23'ünde (%65.71) arka kamara, 10'unda (%28.57) ön kamara ve 2'sinde (%5.71) skleral fiksasyonlu intraoküler lens (İOL) mevcuttu. Şikayetler ile keratoplasti arasındaki süre 3-31 yıldı. Postoperatif takip süresi ortalama 17.7 aydı. İntraoperatif 13 (%15.47) hastaya ekstrakapsüler katarakt ekstraksiyonu+İOL implantasyonu, 8 (%9.52) hastaya anterior vitrektomi+lens ekstraksiyonu+İOL implantasyonu, 7'sine (%8.33) pupilloplasti, 6'sına (%7.14) ön kamara İOL ekstraksiyonu+anterior vitrektomi uygulandı. Postoperatif 9 (%10.71) hastaya rekeratoplasti, 8(%9.52) hastaya sekonder İOL implantasyonu, 4 (%4.76) hastaya Ahmet glokom valf implantasyonu, 3 (%3.57) hastaya fakoemulsifikasyon, 1 (%1.19) hastaya resütürasyon uygulandı. Postoperatif komplikasyon olarak hastaların 9'unda (%10.71) greft yetmezliği, 8'inde (%9.52) glokom, 3'ünde (%3.57) katarakt, 2'sinde (%2.38) endoftalmi, 1'inde (%1.19) travmatik yara yeri ayrışması görüldü. Preoperatif görme keskinliği ortalama 1.43±0.76 (logMAR), postoperatif ise 0.40±0.15 (p<0.01) idi. Preoperatif GİB ortalama 13.78±6.50 mmHg, postoperatif 16.01±2.29 mmHg idi.

***Sonuç:*** Altmış beş yaş üzeri hastalarda en sık PKP endikasyonu psödofakik büllöz keratopati olarak tespit edilmiştir; diğer cerrahi yöntemlerle birlikte sonuçlar oldukça tatminkardır.

***Anahtar sözcükler:*** Geriatri; Penetran keratoplasti; Prognoz

## INTRODUCTION

Keratoplasty is an operation to replace a cornea with impaired transparency and/or geometry with a healthy cornea. Generally, it is performed for optical, tectonic, therapeutic, and cosmetic reasons. Keratoplasty can be performed for optical reasons in cases such as corneal nephelion and scar that obstruct vision, for tectonic reasons to ensure the integrity of globe following corneal perforation, for therapeutic purposes to cure corneal active infection or inflammation resistant to medical treatment, or for cosmetic purposes to fix impaired appearance of cornea even if it is not expected to achieve an improvement in vision (1).

Penetrating keratoplasty (PKP) is the most frequently and most successfully performed allograft tissue transplantation. Avascularity and immunologic advantages in cornea allows much higher success rates in corneal transplantations compared to other organ transplantations (2).

Primary indications for PKP are keratoconus, bullous keratopathy, scar or leukoma in cornea, corneal dystrophies and graft failure. In terms of PKP indications, corneal scars due to herpes simplex virus, opacities due to bacterial infections or traumatic events are more common compared to keratoconus and cornea dystrophies in the developing countries (3). Geriatric population is a separate clinical group in terms of corneal transplantation. The surgical indications differ compared to younger patients (4).

In PKP, cornea is extracted with all its layers and fully layered donor cornea is sutured in its place. Complications such as vitreous prolapses, suprachoroidal haemorrhage can be observed during the performance of this method due to open-sky operation, and problems can occur due to the traumatisation of graft endothelium. The success of PKP depends on many preoperative, intraoperative and postoperative factors such as healthy donor cornea, indications for operation, preferred saturation method, other operations performed and postoperative care (5).

Endothelial abnormalities are more common indications and keratoconus is a less common indication for surgery in the elderly compared to the young population. Eyes that undergo PKP usually have additional pathologies requiring surgery. When compared to the younger patient population, the possibility of other ocular diseases requiring surgery or previous surgical operation is higher in geriatric patients (4). Combined procedures such as cataract extraction and intraocular lens (IOL) implantation provide faster visual recovery than separately performed operations and prevent consecutive operations (6,7).

Despite a limited number of data on geriatric patients, there are many studies in the literature showing the clinical and demographic characteristics of patients who underwent corneal transplantation.

The objective of this study is to evaluate the indications of penetrating keratoplasty performed in geriatric patients aged above 65 years in our clinic and the outcomes and prognosis of penetrating keratoplasty and other combined operations.

## MATERIALS AND METHOD

84 of 297 patients, who underwent PKP in Ataturk University Faculty of Medicine Eye Diseases Clinic between January 2013 and August 2016, were retrospectively analyzed. The study was conducted in compliance with the ethical principles of the Declaration of Helsinki. Detailed ophthalmologic examination was performed on all patients at postoperative week 1 and months 1, 6, 12 and 18. Intraocular pressure (IOP) was measured using a applanation tonometer (Haag Streit, Bern, Switzerland) or Tono-Pen (Reichert Inc, Buffalo, New York, USA). The operation was performed under general anaesthesia using flieringa rings 0.25-0.50 mm oversize graft, 10-0 nylon interrupted suture technique. Systemic antibiotics, topical steroids, topical antibiotics and autologous serum drops were initiated postoperatively. Age, gender, time between the onset of complaints and keratoplasty, duration of follow-up, other intraoperative and postoperative

surgical procedures, complications, IOP and best corrected visual acuity (BCVA) were recorded. Oedema and irreversible loss of transparency were accepted as graft failure. In average, half of the separated sutures were taken at month 12 and the other half were taken at month 18.

### Statistical analysis

Descriptive and statistical analyses of the data were performed using SPSS version 21.0 software. The Paired-t test was used to compare pre- and post-treatment values. A p value<0.05 was considered to be statistically significant.

### Ethical considerations

The local ethic committee approval was obtained (2018/13-135).

## RESULTS

84 eyes of 84 patients-49 (58.33%) male and 35 (41.67%) female were included in the study. The mean age of the patients was 65-83 (73.5±10.8) years. PKP was performed unilaterally on all patients (45 on right eye and 39 on left eye). PKP was performed due to pseudophakic bullous keratopathy in 35 (41.67%) patients, corneal leukoma in 27 (32.14%) patients, post-traumatic corneal scar in 8 (9.52%) patients, graft failure in 6 (7.14%) patients, aphakic bullous keratoplasty in 5 (5.95%) patients and corneal dystrophy in 3 (3.57%) patients (Figure 1-4).The most common PKP indication was PBK (41.67%) (Table 1). 23 (65.71%) of the patients who were operated with PBK diagnosis had intraocular lens (IOL) with posterior chamber, 10 (28.57%) with anterior chamber and 2 (5.71%) with scleral fixation. The time between the onset of complaints and keratoplasty was 3-31 years. The mean duration of postoperative follow-up was 17.7 months. Intraoperatively, extracapsular cataract extraction+IOL implantation was performed on 13 (15.47%) patients, vitrectomy+lens extraction+IOL implantation on 8 (9.52%) patients, pupilloplasty on 7 (8.33%) patients and anterior chamber IOL extraction + anterior vitrectomy on 6 (7.14%) patients. Postoperatively, re-keratoplasty was performed on 9 (10.71%) patients, secondary IOL implantation on 8 (9.52%) patients, Ahmed glaucoma valve implantation on 4 (4.76%) patients, phacoemulsification on 3 (3.57%) patients, and resuturation on 1 (1.19%) patient (Table 2). As postoperative complications, graft failure was observed in 9 (10.71%) patients, glaucoma in 8 (9.52%) patients, cataract in 3 (3.57%) patients, endophthalmitis in 2 (2.38%) patients, and traumatic wound dehiscence in 1 (1.19%) patient (Table 3). The mean preoperative and postoperative BCVA was 1.43±0.76 and 0.40±0.15 (logMAR), respectively (p<0.01). There was a statistically significant difference found between preoperative and postoperative BCVA (p<0.01). The mean preoperative and postoperative IOP was 13.78±6.50mmHg and 16.01±2.29mmHg, respectively (Table 4).

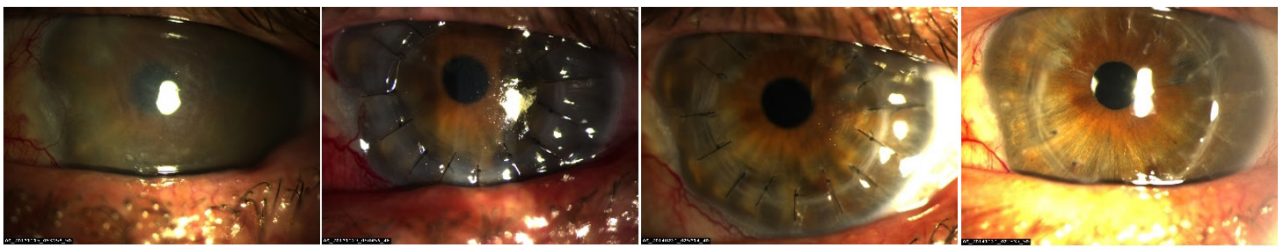

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**Figure 1.** Left eye of a 77-year-old male patient. Following the cataract operation, pseudophakic bullous keratopathy developed; cornea with total oedema, posterior chamber lens **(a)**. At week 1 after penetrating keratoplasty surgery; there are 360° separated 10/0 nylon sutures; graft is transparent **(b)**. At postoperative month 6, sutures are intact; graft is transparent **(c)**. At postoperative month 18, sutures are completely removed; graft transparency continues **(d)**.

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**Figure 2**. Left eye of a 72-year-old female patient. Large leucoma due to corneal abscess in the centre of cornea can be seen, pupillary distance is indistinguishable **(a)**. At week 1 after penetrating keratoplasty surgery; there are 360° separated 10/0 nylon sutures; graft is transparent **(b)**. At postoperative month 12; half of the sutures are removed; graft is transparent **(c)**. At postoperative month 18, sutures are completely removed; graft transparency continues **(d)**.

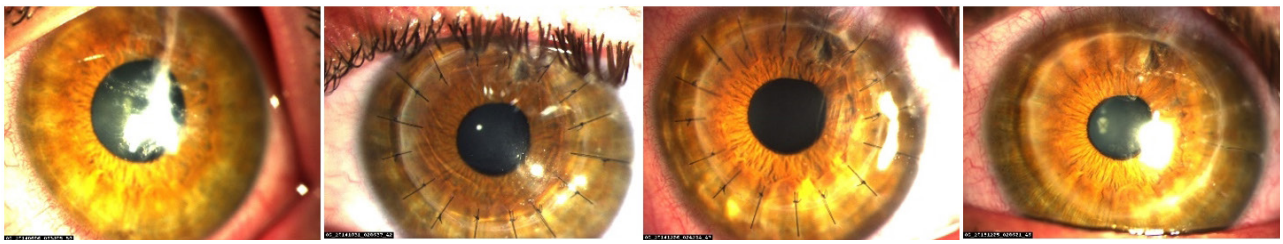

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**Figure 3.** Left eye of a 69-year-old male patient. Scar due to corneal perforation, ranging from the centre of cornea to the upper half can be seen **(a)**. At week 1 after penetrating keratoplasty surgery; there are 360° separated 10/0 nylon sutures, graft is transparent **(b)**. At postoperative month 6, sutures are intact, graft is transparent **(c)**. At postoperative month 18, sutures are completely removed, graft transparency continues **(d)**.

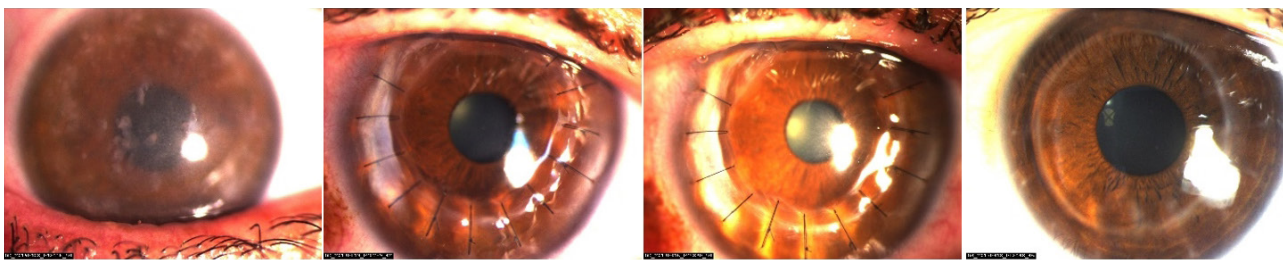

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**Figure 4.** Right eye of a 66-year-old female patient. Cornea with oedema and stromal corneal dystrophy with opacities **(a)**. At week 1 after penetrating keratoplasty surgery; there are 360° separated 10/0 nylon sutures, graft is transparent **(b)**. At postoperative month 6, sutures are intact, graft is transparent **(c)**. At postoperative month 18, sutures are completely removed, graft transparency continues **(d)**.

**Table 1.** Distribution of Penetrating Keratoplasty Indications.

| Indication | Number of eyes with PKP | % |
|---|---|---|
| Pseudophakic bullous keratoplasty | 35 | 10.71 |
| Corneal leukoma | 27 | 32.14 |
| Corneal scar | 8 | 9.52 |
| Graft failure | 6 | 7.14 |
| Aphakic bullous keratopathy | 5 | 5.95 |
| Corneal dystrophy | 3 | 3.57 |
| Total | 84 | 100.0 |

**Table 2.** Other intraoperative and postoperative operations.

| Operation | Intraoperative | Postoperative | % |
|---|---|---|---|
| Extracapsular cataract extraction (ECCE) + IOL implantation | 13 | | 15.47 |
| Phacoemulsification | | 3 | 3.57 |
| Secondary IOL implantation | | 8 | 9.52 |
| Anterior vitrectomy + lens extraction + IOL implantation | 8 | | 9.52 |
| Anterior chamber IOL extraction + anterior vitrectomy | 6 | | 7.14 |
| Pupilloplasty | 7 | | 8.33 |
| Ahmed glaucoma valve | | 4 | 4.76 |
| Resuturation | | 1 | 1.19 |
| Total | 34 | 16 | |

**Table 3.** Complications after Penetrating Keratoplasty (PKP).

| Complication | Number | % |
|---|---|---|
| Graft failure | 9 | 41.67 |
| Glaucoma | 8 | 9.52 |
| Cataract | 3 | 3.57 |
| Endophthalmitis | 2 | 2.38 |
| Traumatic wound dehiscence | 1 | 1.19 |

**Table 4.** Demographic characteristics and examination findings of the patients.

| **Characteristics** | |
|---|---|
| Male | 49 |
| Female | 35 |
| Total number of patients | 84 |
| Age (mean±sd) | 73.5±10.8 |
| Right eye | 45 |
| Left eye | 39 |
| Time between the onset of complaints and PKP | 3-31 years |
| Duration of postoperative follow-up | 17.7 months |
| Preoperative BCVA | 0.041±0.07 |
| Postoperative BCVA | 0.39±0.71 |
| Preoperative IOP | 13.78±6.50 mmHg |
| Postoperative IOP | 16.01±2.29 mmHg |

## DISCUSSION

Although many new corneal transplantation methods such as deep anterior lamellar keratoplasty (DALK), descemet stripping automated endothelial keratoplasty (DSAEK) have many advantages over PKP, PKP is still the most common corneal transplantation method (5).

Despite a limited number of data on geriatric patients who underwent PKP, there are many studies in the literature regarding PKP indications, patient demographic and clinical characteristics and prognosis. The surgical indications of the geriatric patients differ compared to younger patients (3-5,8).

Indication rate for keratoplasty differs based on the socioeconomic status and regional location of the countries (9). Although keratoplasty operations particularly due to keratoconus and aphakic corneal oedema were common before the 1970s, pseudophakic bullous keratopathy (PBK) became one of the most common indications with the increase of cataract extractions and lens implantations after 1980s and its prevalence continues to increase (10).

In the study by Boimer et al. (11) on a series of 7,755 keratoplasties in patients with a mean age of 69 years (ranging from newborns to 99-year-old patients) in Canada, the most common keratoplasty indications were PBK (28.3%), graft failure (21.5%), Fuchs endothelial dystrophy (16.6%) and keratoconus (13.8%).

In the study by Dobbins et al. (12) on 4,217 patients with an mean age of 67 years, who underwent penetrating keratoplasty, in the midwest of USA, the most common indication was PBK (31.5%) followed by Fuchs endothelial

dystrophy (23.2%), keratoconus (11.4%), corneal scars (11.2%), graft failure (8.9%) and aphakic bullous keratopathy (7.5%).

In our study, the most common PKP indication was PBK (41.67%). Although not all patients were geriatric in the studies by Boimer et al. (11) and Dobbins et al. (12), the mean age was above 65 years, and the most common indication was PBK as in our study.

In the study by Altay et al. (13) on 548 patients with an average age of 38.49 years, who underwent PKP in Ankara, 34.1% of the patients had keratoconus, 17% had bullous keratopathy, 13.3% had non-herpetic corneal infectious scar, 12.8% had traumatic corneal scar, 12.2% had herpetic corneal scar, 4.4% had graft failure and 4.9% had corneal dystrophy. In our study consisting of geriatric patients, the fact that keratoconus was not an indication is due to keratoconus which is observed in a younger population (14).

Duman et al. (4) performed keratoplasty on 271 eyes of 253 patients aged above 65 years in Wills Eye Centre (Wills Eye Institute Philadelphia, (USA) and reported that the most common indication was Fuchs endothelial dystrophy (41%) followed by PBK (26%), graft failure (18%), corneal scar (8%), other corneal dystrophies (3%) and trauma (1%). Similar to our study, Duman et al. included patients aged 65 and above, however the most common indication was fuchs endothelial dystrophy, whereas this was PBK in our study. We believe that this difference is caused by the difference of the regions and the genetic demographics as stated by Dobbins et al. (12) and Ono, et al. (14).

Ono et al. (14) reported the indications of 509 PKP cases with an average age of 68.9 years in Japan in 2017 to be corneal leukoma (42%), bullous keratopathy (27%), graft rejection (16%) and keratoconus (6.7%), and stated that corneal leukoma secondary to infectious keratitis being the most common indication is caused by regional differences.

In 2013, Bajracharya et al. (15) performed keratoplasty on 645 eyes of patients with an average age of 41.7 years in Nepal and reported the indications to be infective keratitis (40.9%), corneal leukoma (26.8%), graft rejection (11.2%), bullous keratopathy (9.0%), keratoconus (7%), corneal dystrophy (1.7%). In another study by Módis et al. (16) in Hungary, the indications of keratoplasty were reported to be corneal scar (24.9%), graft failure (18.6%), keratoconus (18.6%), pseudophakic/aphakic bullous keratopathy (12%), stromal corneal dystrophies (6%), non-infectious keratitis (4.7%) chemical injuries (3.3%), corneal degenerations (3%), mechanical trauma (1.7%), infectious keratitis (1.4%), endothelial corneal dystrophies (1.3%) and others (4.5%), respectively.

In our study including 84 geriatric patients who underwent PKP, the reason for PKP was PBK in 35 (41.67%) patients, corneal leukoma in 27 (32.14%), post trauma corneal scar in 8 (9.52%), graft failure in 6 (7.14%), aphakic bullous keratopathy in 5 (5.95%), corneal dystrophy in 3 (3.57%). PBK was detected as the most prevalent indication in our study with a rate of 41.67%.

In many series, the most common indications for corneal transplantation are similar in younger and older patients, outside of PBK becomes more common, and keratoconus much less common, in elderly patients (8-10). Fasolo et al. (17) and Pan et al. (18) have the youngest age group; they found keratoconus to be the most common indication. When compared to the other series including all ages; in our study with elderly patients PBK was the most common indication, and there were no keratoconus patients.

Dobbins et al. (12) stated that PBK was the most common indication but with a tendency of being less prevalent and attributed this to the developments in cataract surgery methods and IOP technology, the use of viscoelastics and the decreased intraoperative surgical complications. They stated that out of the patients, who underwent

PKP due to PBK, 73% had anterior chamber IOL, 21% had posterior chamber IOL and 6% had iris-fixated IOL.

In our study, out of the patients, who were operated with PBK diagnosis, 23 (65.71%) had posterior chamber, 10 (28.57%) had anterior chamber, and 2 (5.71%) had scleral-fixated IOL. Anterior chamber IOL location is not the only risk factor for PBK formation. Other risk factors such as low endothelium cell count, cornea guttate, previous intraocular surgery, chronic uveitis, intraoperative trauma, drug toxicity, peripheral anterior synechia and narrow anterior chamber have also an effect on the development of PBK (12).

Corneal pathologies can be accompanied by many ocular diseases in patients requiring PKP. The possibility of previous anterior segment surgery and other ocular diseases like anterior iris synechiae, vitreous adhesions, accompanying the existing pathology requiring PKP is very high particularly in geriatric patients than younger patients (4).

Procedures combined with PKP such as cataract extraction and IOL implantation provide better visual recovery compared to separately performed operations and prevent the increased number of operations (6,7).

Duman et al. (4) performed PKP, anterior vitrectomy and IOL exchange in 18% and a triple procedure (PKP, ECCE, and IOL implantation) in 14% of the 135 patients aged above 65 years who underwent PKP.

Sridhar et al. (19) performed a triple procedure (PKP, ECCE, and IOL implantation) in 104 patients and came to the conclusion that it is a safe surgical operation with transparent graft and satisfactory visual recovery.

Bajracharya et al. (15) performed ECCE and posterior capsule IOL implantation combined with PKP in the same session in 76.2%, secondary IOL implantation in 7.14% and ECCE in 3.97% of 560 eyes.

Green et al. (20) compared the cataract extraction and IOL implantation combined with PKP with PKP alone and found similar graft rejection and cornea transparency rates. Thus, they stated that secondary or tertiary operations required to be combined with PKP provide more satisfactory and faster visual correction.

In our study, we performed ECCE+IOL implantation in 13 (15.47%) patients, anterior vitrectomy + lens extraction+IOL implantation in 8 (9.52%) patients, pupilloplasty in 7 (8.33%) patients, anterior chamber IOL extraction + anterior vitrectomy in 6 (7.14%) patients in combination with PKP in the same session. These additional operations, performed in the same session as PKP, decrease the number of operations and thus increase the patient compliance and comfort. Corneal pathologies requiring PKP, particularly cataract, can be accompanied by many intraocular diseases in elderly patients. We believe that PKB, if required, should be combined with other intraocular surgeries for faster visual recovery.

Many complications can be observed after PKP. Graft failure, secondary glaucoma, cataract, peripheral anterior synechia, fibrin reaction in anterior chamber, posterior capsular haze, graft infiltration, posterior chamber IOL decentralization, wound dehiscence, endophthalmitis, persistent epithelial defect, cystoid macula oedema, retinal detachment can be considered as some of these complications. Rahman et al. (5) evaluated the postoperative complications of 203 patients who underwent PKP in England and found graft failure in 18%, glaucoma in 18%, microbial keratitis in 8% of the patients. In the study by Eifring et al. (21), the prevalence of post-PKP endophthalmitis was reported to be 0.08%. Yildirim et al. (22) reported that glaucoma, graft failure and postoperative infection developed after PKP in 34%, 17% and 10% of the patients, respectively.

A greater probability and severity of systemic diseases and use of many systemic medications may also influence the follow-up and compliance of geriatric patients compared to younger cohorts. Cooperation and compliance with postoperative medications affect the success of corneal transplantation and may be lower in geriatric patients. The immune system declines with increasing age (23). Also, age may effect wound healing, immunologic response, and the incidence of intraoperative and postoperative complications. Nevertheless in studies published in the literature, young recipient age is associated with a higher rate of failure from rejection (4,24).

Pan et al. (18) had the youngest study group, with mean age of 41.5 years, and found 21.2% graft failure rates after PKP with a mean follow-up period of 25.5 months.

In our study greft failure rate (10.71%) was found to be lower in older patients aged 65-83, compared to the studies with young patients.

The risk of rejection is increased in regrafts and in eyes with several conditions such as previous anterior segment surgery, uveitis, keratitis, anterior iris synechiae, vitreous adhesions, and multiple surgeries at the same time (17). Even though glaucoma does not certainly predispose to rejection, it is an substantial risk factor for graft failure (18).

In our study, the postoperative complications observed were graft failure, glaucoma, cataract, endophthalmitis and traumatic wound dehiscence in 9 (10.71%), 8 (9.52%), 3 (3.57%), 2 (2.38%) and 1 (1.19%) of the patients, respectively.

Since it is performed on the patients with low vision, the outcomes of PKP in terms of level of vision are quite satisfactory.

In the study by Tabin et al. (25) on 472 PKB patients, BCVA level at postoperative month 6 was found to be 6/18 or better, 6/18 to 6/60 and 6/60 to 3/60 in 15%, 37% and 17.7% of the patients, respectively.

In the study by Yildirim et al. (22) PKP was performed on 80 eyes and the mean preoperative and postoperative BCVA level was 2.13±0.16 and 1.17±0.85, respectively. In our study, the mean preoperative and postoperative BCVA level was 1.43±0.76 and 0.40±0.15, respectively.

We found a statistically significant difference between preoperative and postoperative BCVA levels ($p<0.01$).

Geriatric patients are a fast-growing population group around the world. Geriatric patients, whose many characteristics are different to the general patient population, constitute a separate clinical group in terms of cornea transplantation. Their surgical indications, demographic and clinical characteristics are different from younger patients. The possibility of the geriatric patients having a history of eye surgery or other ocular diseases accompanying the current pathology is high (4).

There have been many published reports on demographic and clinical outcomes of patients after corneal transplantation, but there are limited published data on older patients. To the best of our knowledge, our study is one of the few studies in the literatüre that specifically analyzes the indications, outcomes and prognosis of keratoplasty surgery in the elderly.

Endothelial abnormalities are more common indications and keratoconus is a less common indication for surgery in the elderly compared to the young population.

The most common PKP indication in the patients aged above 65 years was PBK. When performed in combination with other surgical methods, its outcomes are quite satisfactory. We believe that it is appropriate for PKP to be combined with other intraocular operations, when necessary, because it decreases the number of operations, increases the patient satisfaction and comfort and provides faster visual recovery.

**Conflicts of interest**

The authors declare no conflict of interest.

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