

Indications, Surgical Techniques and Visual Outcomes of Pediatric Keratoplasty

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ABSTRACT

Purpose: In our study, we aimed to present our nine-year pediatric keratoplasty (KP) experience in a tertiary hospital with indications, surgical techniques and visual results.

Methods: Pediatric patients who underwent KP surgery between 2012 and 2021 in our department were retrospectively analyzed. Patients' gender, age at transplantation, indications, surgery technique, combined surgeries, best corrected visual acuity (BCVA), intraocular pressure (IOP), spherical equivalent (SE) values, postoperative complications and follow-up times were evaluated. Surgical success was considered as an IOP <22 mmHg with or without additional surgery, improvement or preservation of visual acuity.

Results: 72 eyes of 63 patients were included in the study. Twenty (31.7%) of the patients were female and 43 (68.3%) were male. There were keratoconus in 46 (63.9%) eyes, corneal scarring in 21 (29.2%) eyes, corneal dystrophy in 4 (5.6%) eyes, and corneal abscess in 1 (1.4%) eye. The mean age of transplantation was 14.03(4-17) years, and the follow-up period was 47.8(6-124) months. Recurrent KP surgery was performed in 1 (1.4%) patient due to graft failure. Preoperative BCVA was 1.13±0.64 logMaR, and postoperative BCVA was 0.45±0.63 logMaR (p<0.01). There were 65 (90%) eyes with a final BCVA of 20/200 or better, and 46 (64%) eyes with a final BCVA of 20/40 or better. Postoperative mean SE was 1.87±3.87 diopters. In 10 patients, higher IOP was detected in the postoperative controls, and trabeculectomy was performed in 2 patients.

Conclusion: After long-term follow-up of our patients, we achieved a vision of 20/200 or better in 63%. Although pre- and post-operative management is quite difficult in pediatric KP cases, long-term visual results can be satisfactory in correctly selected cases.

Keywords: Pediatric corneal transplantation, Penetrating keratoplasty, Deep Anterior Lamellar Keratoplasty

ÖZET

Amaç: Çalışmamızda üçüncü basamak bir hastanede dokuz yıllık pediatrik keratoplasti (KP) deneyimimizi, endikasyonları, cerrahi teknikleri ve görsel sonuçları ile sunmayı amaçladık.

Yöntemler: Kliniğimizde 2012-2021 tarihleri arasında KP cerrahisi yapılan pediatrik olgular retrospektif olarak incelendi. Hastaların cinsiyet, nakil olduklarındaki yaş, endikasyonları, cerrahi teknik, kombine cerrahiler, en iyi düzeltilmiş görme keskinliği (EİDGK), göz içi basıncı (GİB), sferik ekivalan (SE) değerleri, postoperatif komplikasyonlar ve takip süreleri değerlendirildi. Ek cerrahi yapılmaksızın ilaçlı veya ilaçsız GİB'in <22 mmHg olması, görme keskinliğinin iyileştirilmesi ya da korunması cerrahi başarı olarak kabul edildi.

Bulgular: Çalışmaya 63 hastanın 72 gözü alındı. Hastaların 20'si (%31,7) kadın, 43'ü (%68,3) erkekti. Kırk altı (%63,9) gözde keratokonus, 21 (%29,2) gözde korneal skar, 4 (%5,6) gözde korneal distrofi ve 1 (%1,4) gözde korneal abse mevcuttu. Ortalama nakil yaşı 14,03(4-17) yıl, takip süresi 47,8(6-124) aydı. Greft yetmezliğine bağlı 1 (%1,4) hastaya rekürren KP cerrahisi uygulandı. Preoperatif EİDGK 1,13±0,64 logMaR, postoperatif EİDGK 0,45±0,63 logMaR'dı(p<0,01). Nihai EİDGK düzeyi 20/200 ve üzerinde olan 65 (%90), 20/40 ve üzerinde olan ise 46(%64) göz mevcuttu. Postoperatif ortalama SE 1,87±3,87 diyoptriydi. 10 hastada cerrahi sonrası kontrollerde GİB yüksekliği tespit edildi ve 2 hastaya trabekülektomi uygulandı.

Sonuç: Hastalarımızın uzun dönem takipleri sonrasında %63'ünde 20/200 ve üzeri bir görme elde ettik. Pediatrik KP olgularında pre ve post-operatif yönetim oldukça zor olmakla birlikte doğru seçilmiş olgularda uzun dönem görsel sonuçlar yüz güldürücü olabilmektedir.

Anahtar Kelimeler: Pediatrik kornea nakli, Penetran keratoplasti, Derin Anterior Lamellar Keratoplasti

Pediatric keratoplasty has started to be applied in children with visual loss due to bilateral corneal pathology in the 1970s (1). Pediatric keratoplasty has become more common nowadays with the widespread use of keratoplasty, advances in surgical technique, graft rejection, awareness of risk factors affecting visual prognosis and taking necessary precautions against them. Despite all these positive developments, it is observed that more graft rejection and worse visual results are obtained in children compared to adults (2). There are many debates about the indications and management of pediatric keratoplasty although the anatomical success in pediatric keratoplasty has increased over the years (3).

Pediatric corneal opacities are classified in 3 groups as congenital, traumatic and non-traumatic acquired (4). In the literature, it has been reported that pediatric keratoplasty indications are 14-64% congenital, 19-80% non-traumatic acquired and 6-29% traumatic causes (5-10). In addition, the rate of pediatric keratoplasty indications varies according to the regions. While congenital opacities are the most common cause in North America, anterior segment developmental anomalies are prominent in Asia and sequelae of corneal scar or infectious keratitis are prominent in Africa (5, 7,11,12).

Pediatric age group differs in preoperative, intraoperative and postoperative applications from adults. Difficulties in preoperative patient evaluation and detailed examination, especially in the pre-speech period, may affect the timing of surgery (13). It has been reported in previous studies that it may have complicating effects on keratoplasty surgery various differences in pediatric ophthalmic anatomy like that thin cornea, narrow anterior chamber, weakness in scleral rigidity, high vitreous pressure (2, 12). It has many difficulties of the postoperative follow-up process in children. That difficulties are infection, graft rejection due to the high immunity, early loosening of the sutures, problems in the follow-up and correction of refractive errors and the risk of amblyopia (13, 14).

Despite all these differences and difficulties, by the agency of developing technology increase the frequency of pediatric keratoplasty day by day. In this study, we aimed to share nine-year our tertiary hospital experience about pediatric keratoplasty with indications, surgical techniques and visual results.

Methods

In our study, the data of pediatric patients who operated keratoplasty in Akdeniz University Hospital Ophthalmology department between January 2012 and January 2021 were evaluated retrospectively. Our study which was conducted in accordance with the principles of the Declaration of Helsinki was approved by local ethics committee of Akdeniz University Faculty of Medicine (KAEK - 822 / 30.11.2021).

Seventy-two eyes of 63 patients whose data could be accessed and followed up for at least 6 months postoperatively were included in the study. Detailed anamnesis, gender, age, surgical indications, best corrected visual acuity (BCVA), intraocular pressure, spherical equivalent (SE) values, anterior and posterior segment examination data were recorded. The technique applied during surgery, combined surgeries if any, postoperative complications and follow-up times were recorded. All surgeries were performed by the same physician (M.U.) under general anesthesia.

Surgical success was considered as an under 22 mmHg IOP with or without medication and improvement or preservation of visual acuity in the follow-up without additional surgery.

Statistical Analysis

Statistical analyzes were performed using SPSS for Windows 22.0 (Statistical Product and Service Solutions, Inc., Chicago, IL, USA). The normality assumption was checked with Kolmogorov-Smirnov test. Descriptive statistical analysis methods (mean, standard deviation) were used in the evaluation of the data. Comparisons between groups were made using the independent simple t-test on independent samples. A value of $P < 0.05$ was considered significant.

Results

Demographic characteristics of 63 patients in the study are summarized at Table 1. Preoperative diagnoses of 54 (75%) penetrating keratoplasty (PKP) and 18 (25%) deep anterior lamellar keratoplasty (DALK) surgery are summarized at Table 2. Before 72 keratoplasty, 63 (87.5%) eyes were phakic, 5 (6.9%) eyes were pseudophakic and 4 (5.6%) eyes were aphakic. The distribution of surgical techniques applied by years is shown in Figure 1. The mean follow-up time after surgery was 47.8 (range, 6-124) months.

Table 1: Demographic characteristics of the patients		
		n (%)
Gender	Male	43 (68.3%)
	Female	20 (31.7%)
Laterality	Right	41 (56.2%)
	Left	32 (43.8%)
Age (mean, year)		14.03
Age (range, year)	4-12	21 (30%)
	13-17	51 (70%)
Keratoplasty type	PKP	54 (75%)
	DALK	18 (25%)

PKP: Penetrating Keratoplasty, DALK: Deep Anterior Lamellar Keratoplasty

Table 2: Preoperative diagnoses			
		PKP	DALK
Diagnosis	n (%)	n (%)	n (%)
Keratoconus	46 (63.9%)	31(57.4%)	15(83.3%)
Corneal Scar	21 (29.2%)	19(35.2%)	2(11.1%)
Corneal Dystrophy	4 (5.5%)	3 (5.6%)	1 (5.6%)
Corneal Abscess	1 (1.4%)	1(1.9%)	0(0%)
Total	72(100%)	54(100%)	18(100%)

PKP: Penetrating Keratoplasty, DALK: Deep Anterior Lamellar Keratoplasty

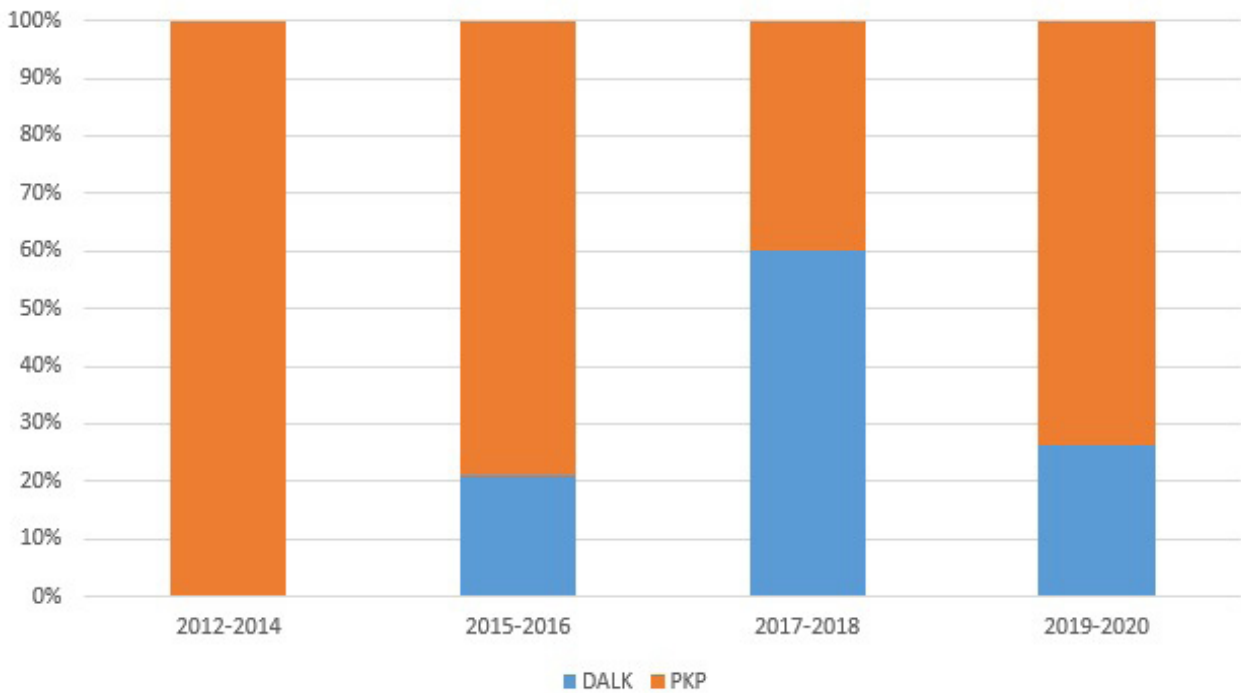


Figure 1: Distribution of pediatric keratoplasty technique by years

The mean BCVA before PKP was 1.19 ± 0.66 (range, 3.1 - 0.4) logMaR and after PKP was 0.46 ± 0.69 (range, 3.1 - 0) logMaR ($p < 0.01$). The mean BCVA before DALK was 0.95 ± 0.52 (range, 1.8 - 0.1) logMaR and after DALK was 0.40 ± 0.34 (range, 1.2 - 0.05) logMaR ($p < 0.01$). The mean BCVA before all surgeries was 1.13 ± 0.64 (range, 3.1 - 0.1) logMaR and after all treatments was 0.45 ± 0.63 (range, 3.1 - 0) logMaR ($p < 0.01$). Final BCVA was detected over

20/200 in 65 (90%) eyes and over 20/40 in 46 (64%) eyes after treatment.

The keratometric measurements which could not be evaluated preoperatively reliable could not be taken also in postoperative follow-up 21 eyes due to reasons such as graft loss, band keratopathy, and secondary glaucoma. With the mean keratometry and refraction values obtained in 51 (70.8%) eyes that could be measured, the postoperative mean SE was -1.87 ± 3.89 diopters.

Intraocular pressure elevation was detected in 10 eyes at postoperative controls and 8 eyes were brought under control after discontinuation of steroid treatment. Trabeculectomy was performed in 2 patients with high intraocular pressure. In 1 patient who developed graft failure in early controls; recurrent penetrating keratoplasty (re-PKP) was performed in 2 of 3 patients who developed late graft rejection, the mean time of re-PKP was 34.7 months. It was observed that the grafts of all 3 patients who underwent re-PKP were transparent in the follow-ups. No cataract or endophthalmitis development was observed in any of the patients postoperatively.

Discussion

Pediatric keratoplasty indications differ in developing and developed countries. While the most common indications in developed countries are keratoconus and corneal opacities, infectious keratitis and traumas take the first place in developing countries (10, 15-17). In our study, we see that the most common indication is keratoconus with a rate of 69.3% and second indication is trauma with a rate of 29.2%.

When we examined the studies related to graft survival rates in the literature, we saw that it varied a lot depending on the number of patients, follow-up time and the applied surgical method. Graft survival rates of at least 1 year after pediatric keratoplasty have been reported to be in the range of 35-82% (9, 15, 18-20). In our study, we found our graft survival rate to be 94.4%. When compared with previous studies, we detected that our survival rate was high. We think that this high rate may be due to the average age of over 10, the most common indication being keratoconus and DALK surgery was preferred in appropriate cases. In the literature, it has been reported that the rate of graft rejection increases as the age of previous keratoplasty application decreases (21).

Visual outcomes after pediatric keratoplasty are not always proportional to graft survival rates, especially in eyes with congenital opacities. Despite the presence of a transparent graft, low visual acuity has been attributed to the development of amblyopia, usually after visual stimulus deprivation (19). In studies evaluating visual acuities after pediatric keratoplasty, the rate of having 20/200 or better vision was reported as 33-80% (9, 22, 23). In our study, we achieved a final BCVA at 90% rate of 20/200 or better. We think that this high rate may be relative with the high preoperative visual acuity of keratoconus patients or the operated of relatively older children. In other study similar

to our study, it was reported that better visual results were obtained in keratoplasty performed at the age of 10 and above (23, 24).

Concomitant ocular morbidity, especially such as presence of glaucoma, may also adversely affect final visual acuity. In our study, there was no patient with a preoperative diagnosis of glaucoma. Intraocular pressure elevation was observed in 10 eyes in the postoperative period and trabeculectomy surgery was performed in only 2 eyes (2.8%) because of treatment-resistant glaucoma. Studies have reported that the presence of glaucoma may have negative effects on graft life and visual prognosis (18). It has also been reported that glaucoma surgeries performed after keratoplasty do not have a negative effect on graft transparency (18). Graft rejection has not observed in our two patients who underwent trabeculectomy surgery.

In addition, it has been reported in the literature that 10-50% of infectious keratitis and 2-7% of cataracts may develop in the postoperative period (12). In our study, no postoperative infectious keratitis and/or cataract development was observed.

Limitations of our study are its retrospective design, limited number of patients, and variable postoperative follow-up times. These limitations are also present in previous studies. Pediatric keratoplasty is carried out less frequently when compared to adults. Therefore, we think that the information provided by this single-centered long-term study is valuable.

Conclusion

In conclusion, the frequency of pediatric keratoplasty has been increasing over the last years. Although the surgical indication varies according to the regions, the most common indications in our hospital are keratoconus and corneal scars. Although penetrating keratoplasty is performed more frequently, DALK can be performed in suitable cases. Visual success rates are higher in keratoplasty performed after the amblyopic period.

Declarations

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Conflict of interest

The authors declare that they have no conflict of interest.

Ethical Approval

This study was approved by the Ethics Committee of the Akdeniz University Faculty of Medicine (KAEK - 822 / 30.11.2021). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Availability of data and material

All data and material are available on request from the authors. The data that support the findings of this study are available from the corresponding author, [L.Y.], upon reasonable request.

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