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# CLINICAL AND FUNCTIONAL FEATURES OF PENETRATING KERATOPLASTY IN THE KINGDOM OF JORDAN. A SINGLE-CENTER EXPERIENCE

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**Objective:** to determine the indications for penetrating keratoplasty (PK) in the Kingdom of Jordan and evaluate its clinical and functional outcomes. **Materials and methods.** 213 patients underwent PK at the ophthalmology department of King Abdullah University Hospital (KAUH) in Jordan from January 1, 2010 to December 31, 2018. While 196 (92.2%) patients were operated on in one eye, 17 (8.8%) underwent PK in both eyes. For all patients, the best corrected visual acuity (BCVA) was checked using the Snellen table and compared with the BCVA before surgery; biomicroscopy of the anterior segment of the eye, as well as applanation tonometry, were carried out. **Results.** Keratoconus was found to be the most common indication for PK – 154 patients (73.2%). For all patients, the BCVA improved from 0.08 before surgery to 0.25 after surgery. **Conclusion.** Keratoconus is the most common indication for PK in both men (97, 71.3%,  $p < 0.05$ ) and women (57, 74%,  $p < 0.05$ ) in the Kingdom of Jordan. PK is an effective method for treating various corneal disorders.

**Keywords:** corneal transplantation, indications, penetrating keratoplasty, keratoconus.

## INTRODUCTION

Eye diseases are one of the most important economic and social problems in the world. According to the World Health Organization (WHO), corneal opacities affected 1.9 million people (5.1% of the total number of blind people) [1].

It is estimated that about 23 million people worldwide suffer from unilateral corneal blindness [2]. Common pathologies leading to vision loss include keratoconus, trachoma, onchocerciasis, neonatal conjunctivitis, and keratomalacia as a result of vitamin A deficiency [1].

Penetrating keratoplasty (PK) is the main intervention for restoring corneal structure and improving vision in these patients. This surgical procedure involves replacing the pathological cornea with a donor one [3].

Eduard Konrad Zirm performed the first successful PK in 1905. It was a solid organ transplant in a human. This solved one of the major problems of ophthalmology at the time – helping patients with bilateral corneal leukoma. “It was a ray of light that cut through the gloom of despondency,” prominent Soviet ophthalmologist and surgeon Vladimir Filatov noted later [4].

Having learned about the success of PK, many researchers all over the world began to identify more and more new indications for such an intervention [5–9]. These conditions include keratoconus, pseudophakic bullous keratopathy, scars, corneal perforations, consequences of keratitis, and trachomatous keratopathy being a major problem in certain regions [1, 10].

Graft rejection was one of the most serious complications. This problem was later resolved through repeated PK with preoperative HLA typing of donor and recipient histocompatibility [11].

All the above conditions have a global prevalence and similar clinical symptoms – total corneal opacity requiring corneal replacement.

The number of PK surgeries performed in some regions that are endemic for certain diseases is quite high. For example, in the Kingdom of Jordan, 10,548 operations have been performed over the past 10 years.

The purpose of this study is to determine the indications for PK in the Kingdom of Jordan and to evaluate its clinical and functional outcomes.

## MATERIALS AND METHODS

Data from patients at the ophthalmology department of King Abdullah University Hospital (KAUH) in Jordan who underwent PK from January 1, 2010 to December 31, 2018 were retrospectively analyzed. Approval from the KAUH Institutional Review Board (IRB) was obtained prior to the study (reference 13/3/122). The study enrolled 213 patients (136 males and 77 females), their ages ranging from 14 to 97 years ( $46.6 \pm 19.6$ ). The data were obtained from the annual statistical report of the Jordan Eye Bank of the University of Jordan.

The quality of the donor material is the key to the success of PK. According to annual reports, the number of cornea donors has increased significantly over the past

decade due to programs aimed at raising public awareness. These programs are regularly published freely on the Internet.

The following socio-demographic characteristics were taken into account: gender, age, marital status, educational level, nature of activity (presence of harmful factors affecting the eye), as well as existing concomitant diseases, including hereditary ones, and genetic defects aggravating the course of eye disease.

Further examination for all patients included checking the best corrected visual acuity (BCVA) using the Snellen table and comparing it with the BCVA before surgery, biomicroscopy of the anterior segment of the eye, applanation tonometry (in the absence of contraindications) and corneal topography on Pentacam system (OCULUS Optikgeräte GmbH). SPSS software (SPSS, Inc., Chicago, Illinois, USA) was used for data analysis. A p-value less than 0.05 was considered statistically significant.

## RESULTS

Characteristics of the clinical material (213 patients); 196 (92.2%) of them underwent PK on one eye and 17 (8.8%) on both eyes.

The study included 136 males (63.8%) and 77 females (36.2%). It was found that keratoconus was the leading indication for PK both in men (71.3%,  $p < 0.05$ ) and in women (74%,  $p < 0.05$ ). This was followed by corneal opacities due to viral infection and dystrophies. Further, in descending order, were eye injuries and burns of various degrees of severity and previous graft rejection. Stevens-Johnson syndrome was the least among the indications for PK (Table).

Before PK was performed, patients had different visual acuity in correlation with age: from correct light

Table

**Indications for penetrating keratoplasty by gender**

Indications	Men	Women	Total	
			n	%
Keratoconus	97	57	154	72.3
Herpes keratitis	9	6	15	7
Graft rejection	11	4	15	7
Injury	10	4	14	6.7
Corneal dystrophy	8	2	10	4.7
Fungal keratitis	1	3	4	1.8
Stevens-Johnson syndrome	0	1	1	0.5
Total	136	77	213	100

projection to 0.5 (mean value 0.08). These results are shown in Fig. 1.

Visual acuity improved after PK. The mean postoperative BCVA in correlation with age in these patients ranged from 0.05 to 1.0 (mean 0.25). The results are shown in Fig. 2.

## DISCUSSION

Penetrating keratoplasty is currently the only possible way out for many corneal diseases. One of such conditions is keratoconus at advanced stages with changes in all corneal layers (Amsler-Krumeich classification 1998). Others include such urgent conditions as corneal ulcers with perforation [12].

It was established that PK makes it possible to obtain transparent engraftment in 93% with 60% stability.

Annual reports from the Jordan Eye Bank show that in Jordan, a country that is endemic for keratoconus, the number of PK operations has increased. This is due to an increased number of corneal donors, which has shortened the queue for this medical care [13].

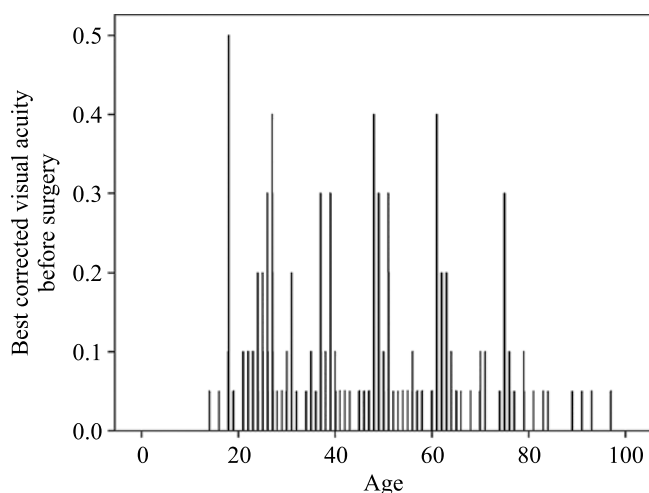


Fig. 1. Comparative characteristics of the best corrected visual acuity before penetrating keratoplasty in different age groups

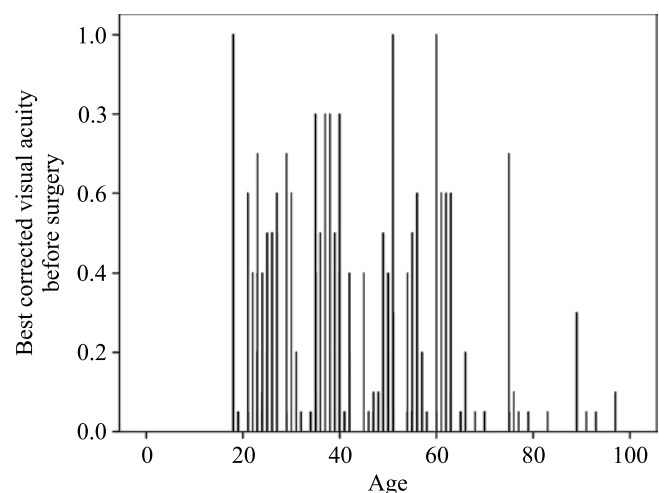


Fig. 2. Comparative characteristics of the best corrected visual acuity after penetrating keratoplasty in different age groups

Moreover, in two parallel independent studies by Gharaibeh et al. and Altay et al., it was noted that the most common indication for corneal transplantation was keratoconus, which is fully consistent with our study – 72.3% [14, 9]. According to Yorston et al., PK can also be a method for treating keratoconus and various corneal dystrophies in Africa [15].

Our data showed that PK is a highly efficient method in various corneal conditions. This has been justified by the significant improvement in visual acuity by 3 times from 0.08 to 0.25. These data quite correlate with the results obtained by Viera et al. from the University Hospital, São Paulo, Brazil, showing that PK is the gold standard for surgical treatment of keratoconus [16].

## CONCLUSION

Keratoconus is the most common indication for PK in Jordan, accounting for 72.3%. PK is an effective method for treating various corneal diseases, improving visual acuity significantly. Eye care practice in Jordan provides a high percentage of corneal transplants, due to availability of donor material and qualified specialists.

*The authors declare no conflict of interest.*

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