ORIGINAL ARTICLE

IMPROVEMENT IN VISUAL ACUITY SIX MONTHS AFTER PENETRATING KERATOPLASTY IN PATIENTS OF KERATOCONUS

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Background: Keratoconus (KC) is a bilateral, asymmetric, corneal disorder that is characterized by progressive thinning, steepening, and potential scarring. In the early stages of keratoconus treatment can be modulated with contact lenses but once it reaches to scarring, penetrating keratoplasty (PK) is the standard procedure of care. As there is not enough published data on penetrating keratoplasty in Pakistan and also early visual outcomes post keratoconus keratoplasty have not been established so this study would be beneficial for further research and opting keratoplasty as a procedure for management of advance keratoconus. To determine the frequency of improvement in the visual acuity six months after penetrating keratoplasty in patients of Keratoconus. **Methods:** Sixty-five eyes of 65 patients fulfilling the inclusion criteria were taken from the Outdoor Clinic of Layton Rahmatulla Benevolent Trust Free Eye and Cancer Hospital. Informed consent was taken and socio-demographic data (name, age, gender, address and contact number) was also recorded. Examination included Visual Acuity with Snellen's Chart with assessment of light projection in patients with Visual Acuity hand movements or light perception. Slit lamp examination with Haag Streit BQ 900 Slit lamp for assessing the condition of cornea was done. Indirect ophthalmoscopy was performed using 90D lens for fundus examination. B-scan (ocular ultrasonography) with Alcon B-scan was done where fundus examination was not possible. Standard surgical procedure of Penetrating Keratoplasty was carried out on all patients. Visual Acuity was recorded on Day 7, 90 and 180 after the surgery **Conclusion:** Penetrating Keratoplasty is a safe and reliable procedure for improvement in visual acuity of patients with keratoconus and should be conducted on mass level to avoid blindness caused by keratoconus

Keywords: Visual Acuity; Keratoconus; Penetrating Keratoplasty

Citation: Ansari MSA, Zulfiqar N, Nafees K, Shaheen M. Improvement in visual acuity six months after penetrating keratoplasty in patients of keratoconus. J Ayub Med Coll Abbottabad 2021;33(2):289–92.

INTRODUCTION

Over several decades, corneal transplantation has been most frequent and successful human tissue to be transplant.[1,2] According to World Health Organization (WHO) about 314 million people worldwide have visual impairment. In order of frequency cataract, uncorrected refractive error, glaucoma, age related macular degeneration followed by corneal opacities (11.8%) are leading causes of blindness.[3–5] Keratoconus (KC) is a corneal dystrophy resulting from non-inflammatory thinning and ectasia of the cornea, it is slowly progressive and often bilateral. The prevalence of keratoconus in Pakistan is not cited in literature.[6] In management of keratoconus contact lenses are the mainstay of therapy in 90% of patients.[7] Early in the disease, soft lenses of toric design and then more complex rigid gas permeable lenses and hybrid lens are used.[8,9] Penetrating Keratoplasty (PK) is a procedure in which the damaged or opaque cornea of the patient is replaced by a healthy cornea of the donor. The recipient cornea is cut out with the help of trephine and corneal scissors at its geometrical center in a circular fashion and the donor cornea is placed over it and sutured. Penetrating Keratoplasty has been standard of care for treating corneal opacities and endothelial failure for many years. However, the disadvantage of this procedure includes prolonged visual rehabilitation, high astigmatism, and suture-related complications, such as broken sutures, infectious keratitis, wound dehiscence, and graft rejection, even years later.[10] Recent studies have shown that PK is a safe, effective and reasonable treatment for corneal blindness all over the world.[5]

The main aim of my study is to assess the improvement in visual acuity (VA) six months after Penetrating Keratoplasty in patients with keratoconus. As there is not enough work done regarding keratoconus and keratoplasty in Pakistan so this procedure is not conducted at mass level in our country. The main purpose of my study is to create more awareness regarding the disease and the procedure, so that our community and health service providers can use this procedure more widely at multiple centers throughout Pakistan to prevent blindness from keratoconus which is one of the leading causes of preventable blindness in Pakistan.

MATERIAL AND METHODS

Sixty-five eyes of 65 patients fulfilling the inclusion criteria were taken from the Outdoor Clinic of Layton Rahmatulla Benevolent Trust Free Eye and Cancer Hospital. Informed consent was taken and socio-demographic data (name, age, gender, address and contact number) was also be recorded. Examination included Visual Acuity with Snellen's Chart with assessment of light projection in patients with Visual Acuity hand movements or light perception. Slit lamp examination with Haag Streit BQ 900 Slit lamp for assessing the condition of cornea. Indirect ophthalmoscopy was performed using 90D lens for fundus examination. B-scan (ocular ultrasonography) with Alcon B-scan was done where fundus examination was not possible. Standard surgical procedure of Penetrating Keratoplasty was carried out on all patients. To control the bias, only one expert surgeon who had performed, at least, 25 independent penetrating keratoplasties had done the surgery. A trephine was used to cut a partial depth, circular incision in the cornea, centered at the geometric center of cornea. Excision of the recipient corneal button was completed with a curved corneal scissors. Donor button was applied and interrupted sutures were placed (10-0 nylon) to hold the graft. Visual Acuity by Snellen's Chart was done on Day 7, 90 and finally 180 to determine the frequency of improvement in VA. Patients with damage to the cornea during surgery, failure to comply with post-operative medication and who were unable to come for follow up were all excluded from the study. All the required information will be collected on a specially designed *pro forma*.

RESULTS

In this study the frequency of improvement in visual acuity was determined six months after PK in patients of KC. According to age group, 33 (50.77%) patients were between the ages 10–20 years, 24 (36.92%) were between 21–30 years. Only 8 (12.31%) patients were aged between 31–40 years while none of the patient was older than 40 years of age. The Mean age±SD turns out to be 21.88±7.268 years.

All the 65 eyes that underwent PK due to keratoconus had pre-op visual acuity of 6/60 on the Snellen's chart. Most patients with pre-op visual acuity better than this opted for other treatment options like corneal cross linkage or hard contact lens etc, hence were not included in the study.

All the surgeries were uneventful and were performed by a single surgeon. Patients were given topical and oral steroids, topical antibiotics and topical lubricants to reduce irritation due to sutures. Antacids were also given to avoid gastric irritation due to steroids and non-steroidal anti-inflammatory drugs (NSAIDs) were given in selected patients.

One week after the surgery the patients were followed up. Slit lamp examination was done to check the condition of the graft and visual acuity was measured using Snellen's chart. Twenty-one (32.30%) patients showed mild deterioration of vision (Counting Fingers = CF) as compared to pre-op vision of 6/60. While 31 (47.70%) patients had visual acuity of 6/60 that was equal to the pre-op vision and 13 (20.00%) patients showed improvement in visual acuity (6/36) as compared to pre-op vision but not amounting to significant improvement, i.e., 2 lines improvement on Snellen's chart. None of the patients achieved visual acuity of 6/24 or better at first week post-op.

At 3 months follow-up the number of patients having vision of CF dropped to mere 5 (7.70%) as compared to 1st week (32.30%), also only 5 (7.70%) patients had visual acuity of 6/60. Thirty-one (47.70%) patients achieved vision 6/36 on Snellen's chart (improvement but not significant). While 22 (33.80%) and 2 (3.10%) patients showed visual acuity of 6/24 and 6/18 respectively. Overall, 24 (36.90%) patients showed significant improvement in visual acuity after 3 months according to the operational definition.

In 8 (12.30%) patients the visual acuity either remained same (6 Patients) as pre-op or deteriorated (2 Patients). The best visual acuity in my study was 6/12 that was achieved by 12 (18.50%) patients.

Post-operative complications encountered were severe graft reaction, suture related complications and cataract formation. Severe Graft reaction occurred in 10 (15.38%) patients out of which 2 (3.08%) patients showed no improvement even after aggressive treatment. Suture related complications included broken sutures, loose sutures or stitch abscess. These occurred in 17 (26.15%) of patients and were managed accordingly. Cataract formation occurred only in 4 (6.15%) patients that too at the end of our study. Eventually these patients went on for cataract surgery later on. There were 65 eyes of 65 patients included in the study, 38 (58.50%) were males and 27 (41.5%) were females.

At 180th (6 months) post-operative day and the last follow-up of the study only 2 (3.10%) patients had deterioration of vision (CF) as compared to pre-op vision of 6/60. Twelve (18.50%) patients achieved a very good vision of 6/12 at 6 months.

Significant Improvement = Improvement of 2 lines on Snellen's chart from baseline

Overall frequency of improvement in visual acuity 6 months after PK in patients of keratoconus remained 57 (87.70%), i.e., at the end of the study 57 (87.70%) patients showed significant improvement in visual acuity with confidence level of 95% and margin of error being 8.5%.

Table-1: Distribution of cases by gender (n = 65)

Sex	Number of cases	Percentage
Male	38	58.50
Female	27	41.50
Total	65	100.00

Table-2: Visual acuity 6 months post-op (n = 65)

Visual Acuity	Number of patients (Frequency)	Percentage %
6/12 or Better	12	18.50
6/18	18	27.70
6/24	27	41.50
6/36	0	0
6/60	6	9.20
Counting Finger	2	3.10
Total	65	100.00

Note: Pre-op Visual Acuity of all patients was 6/60 on Snellen's chart

Table-3: Frequency of Improvement in visual acuity after 6 months (n = 65)

Significant improvement	Number of cases (Frequency)	Percentage %
Yes	57	87.70
No	08	12.30
Total	65	100.00

DISCUSSION

This study was conducted at LRBT eye hospital to demonstrate the efficacy of PK in improving the visual acuity of patients suffering from keratoconus.

The main indication for PK in our study was either acute hydrops/ descemtic opacities (40%) or decreased visual acuity even with contact lens. Patients that opted for PK in our study that was contact lens intolerant were 45% which is comparable to other case series reported in literature.[11-13]

Sangnieres *et al* in their study reported the ratio of patients with acute hydrops opting for KP much higher (80%) than what we observed in our study (40%).[6]

Almost two-thirds (58.5%) of the patients in our study were males that is comparable to what was reported by Lim *et al.* with 55% males.[11] Although literature suggest there is no role of gender in progression of disease so that patient requires PK.[14] Also there is no role of gender in final visual outcome or graft survival.[6] Although literature do suggest that keratoconus involves females more commonly (two-thirds) than males[15] but that could not be assessed in our study due to sampling technique and time constraints.

Keratoconus is usually diagnosed in late adolescence or early adulthood[16–18] and its evolution is not linear. It includes stationary phases alternating with phases of progression. Pouliquen *et al.*[16] estimate that the average period of evolution between diagnosis and end stage requiring a transplant is 10 years.

The mean age at transplantation was 21.88±7.268 years in our study, which is far from that reported in Britain by Al-Yousuf *et al.*[17] with 32.5±11 years. Sagnieres *et al.* reported an even higher mean age (35.4±11 years) at transplantation in France.[6] Lim *et al.* in his study reported the mean age of 31.6 years at the time of KP.[11] The mean age at transplantation in middle-east or sub-continent is not cited in literature.

The main reason that the mean age is much less in our study is that most of the patients could not afford other treatment options for keratoconus and KP is provided free of cost at our center, so most of the patients opted for early surgery.

Most of the studies that encompass on PK in patients of keratoconus have shown improvement in visual acuity on long term follow ups of 2 years or more. No study reported early visual rehabilitation and that was one of the main purposes of my study to show that PK can provide early visual improvement that continue to get better over a period of time provided the graft remain healthy.

Significant visual improvement occurred in 87.70% of the patients in my study at the end of 6 months study period. Olson *et al.* in their long-term review of 3 and an half years on PK for keratoconus reported improvement in 87% patients at some time postoperatively, although 23% had decreased visual acuity on the last visit.[19]

Lim *et al.* reported improved visual acuity in 86% of the patients at the final follow up.[11] The best VA achieved in their study was 6/12 or better which is comparable to what we have achieved in our study. The mean duration of their study was 46 months.

Sagnieres *et al.*[6] at 2 years follow up reported improvement in VA in 75% of the patients which is much lower than what has been reported in our study and literature.[20–23]

Our study showed significant improvement in VA in 87.70% of the patients 6 months after surgery which is a very high percentage. Even better results could have been achieved if we had estimated the best corrected visual acuity and followed up patients for a longer period of time but that was beyond the scope of our study.

CONCLUSION

Penetrating Keratoplasty is a safe and reliable procedure for improvement in visual acuity of patients with keratoconus and should be conducted on mass level to avoid blindness caused by keratoconus.

Penetrating Keratoplasty should be considered in any KC patient as the best treatment option who is either contact lens intolerant, developed acute hydrops/ descemtic opacities or not willing for undertaking other treatment options.

Finally, my study showed that PK can lead to early visual rehabilitation in patients of KC which has not been reported earlier and the vision tends to improve over the period of time provided graft remains healthy.

Hence it is suggested that PK can be conducted early and safely in patients of keratoconus to prevent blindness caused by keratoconus. Also, multiple centers should be made by the government where this procedure should be provided free of cost to the non-affording people.

AUTHORS' CONTRIBUTION

MS, AA: Concept and designing of manuscript, actual write up of manuscript, literature research, analysis and interpretation of data. NZ: Concept and design of manuscript, Final approval of version of manuscript to be submitted. MS: Manuscript drafting and revision of intellectual content. KN: Critical appraisal of finding with literature

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Submitted: November 4, 2020	*Revised: February 1, 2021*	*Accepted: February 14, 2021*

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