

Therapeutic Penetrating Keratoplasty For Treatment Of Active Resistant Corneal Infection

Rasha Mousa

Memorial institute for ophthalmic research
Email: rashamoussa78@gmail.com

Abstract

Purpose: To evaluate the surgical outcome of therapeutic penetrating keratoplasty (TPK) done for resistant corneal infection not responding to medical treatment.

Setting: Memorial institute for ophthalmic research

Method: A retrospective case series study included 20 cases of the therapeutic penetrating keratoplasty done for patients with resistant progressive corneal microbial infection not responding to aggressive topical treatment at Memorial institute for ophthalmic research in Egypt between 2019-2021. Evaluation included the eradication of infection, restoration of globe integrity, rate of recurrence, and visual outcome 1 year postoperatively.

Results: The anatomical integrity of the eye was restored in 18/20 cases (90%). Recurrence occurred in three cases (15%). Regarding the visual outcome, 50% of the cases had corrected visual acuity between 0.05-0.6 in decimal while 35% had hand motion vision due to cataract, graft opacity or recurrence. Seven patients required an adjunctive surgical procedure: one underwent re-PKP, one required evisceration and five required cataract surgery.

Conclusion: Therapeutic penetrating keratoplasty done for resistant progressive microbial keratitis is a valuable treatment for eradication of infection, restoring anatomical integrity of the eye. Early TPK provides better surgical and visual outcomes.

Key words: Penetrating keratoplasty, microbial keratitis, TPK, resistant infection

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Introduction:

Infectious keratitis poses a significant risk to vision and is the primary contributor to corneal blindness in individuals of all ages, including both children and adults¹. Uncontrolled infectious keratitis can advance to corneal perforation or endophthalmitis and in some cases evisceration becomes unavoidable. To address cases of infectious keratitis that do not respond adequately to standard medical treatment, various supplementary techniques have been developed including intrastromal antimicrobial injection, amniotic membrane transplantation, patch or lamellar grafting and corneal collagen crosslinking². Nevertheless, there is currently no agreement on the effectiveness of each technique. As a result, therapeutic penetrating keratoplasty (TPK) is the preferred approach for restoring the structural

integrity of the cornea and eliminating the infective. Visual rehabilitation, on the other hand, is considered a secondary concern in this context³.

Recent review studies have shown that TPK contributed a range of 2.1% to 48.2% among various types of corneal transplantation despite the introduction of recent potent antimicrobials in the recent decades^{4,5}. Notably, the prevalence of TPK was significantly higher in developing countries compared to Western countries⁴⁻⁷. However, various studies have indicated that the graft survival rate for urgent keratoplasty, which is performed in patients with active corneal infection, is lower compared to other elective surgeries⁸. The risks associated with TPK included recurrent graft infection, graft rejection, endothelial decompensation, postoperative synechiae and secondary glaucoma³. In this retrospective study, we studied the results of therapeutic penetrating keratoplasty done for uncontrolled infectious keratitis at the Memorial institute for ophthalmic research in Egypt from 2019-2021 regarding the eradication of infection, restoration of globe integrity, rate of recurrence, and visual outcome 1 year postoperatively.

Material and Methods:

This retrospective study involved 20 cases of therapeutic penetrating keratoplasty which were done for medically uncontrolled microbial keratitis at Memorial institute for ophthalmic research from 2019-2021. The data collected from the patients records included age, sex, history of trauma, history of contact lens use, systemic disorders, preoperative best corrected visual acuity (BCVA) and 6 months postoperative BCVA in clear grafts. Microbiological data, such as findings from smears and cultures of preoperative corneal scraping.

All cases were unresponsive to aggressive topical antimicrobial treatment which was modified according to culture results. All surgeries were done under general anesthesia. The host bed was incised using a disposable vacuum Tecfen manufactured by precision ophthalmic products, located in Santa Barbara, USA. The incision was made with cutting edge extending at least 1mm beyond the infiltration border. For patients with extensive infiltration, a freehand dissection approach was used. To address exudative material and infectious debris in the anterior chamber,

iris ,and pupil, a balanced salt solution along with antibiotics known to be effective against the infective were used for irrigation. Forceps were used to remove inflammatory membranes over the iris tissue. Peripheral anterior synechiae were released using viscoelastic. One or more iridectomies were done to prevent postoperative pupillary block glaucoma. In cases where the infection was affecting the lens or the capsule is opened, cataract extraction was done without implantation of intraocular lens. All the grafts used were all clear imported grafts with good quality. The doner graft sizes were larger than the recipient by 0.5-1.0 mm. 10/0 interrupted nylon suture were used to suture the graft. Postoperative treatment was in the form of topical antimicrobial agents, corticosteroids, cycloplegics and antiglaucoma eye drops alongside lubricants eye drops.

The postoperative follow-up schedule involved daily visits for the first 3 days following the operation. Subsequently, visits were scheduled twice a week for a period of 2 weeks. After that, patients were required to come in for weekly visits for one month. Following the initial month, monthly visits were scheduled to monitor the progress and recovery of the patients.

The evaluation of outcomes for TPK focused on three key criteria. Firstly, the cure rate of infection after surgery was determined by examining whether there was any corneal infiltration or infectious endophthalmitis present at 1 month after the operation. if there is no signs of these conditions, the infection was considered cured. Secondly, the anatomical success rate was assessed by insuring the restoration of ocular integrity for at least 1 month after PKP without developing phthisis bulbi.if ocular integrity was maintained ,it was considered an anatomical success. Thirdly, the clarity of the graft was assessed at 1 month and 1 year postoperatively using slit lamp biomicroscope.

The statistical analysis was conducted using SPSS version 22.0(SPSS, inc, Chicago, IL,USA).For qualitative variables, the results are presented as the mean standard deviation. Qualitative variables are expressed as percentages. A p-value (p)less than 0.05 was considered statistically significant.

Results:

A total of 20 cases of TPK were included in this study which were done at Memorial institute for ophthalmic research Egypt between 2019-2021. The age of the patients at the time of diagnosis ranged from 5-66 years, with a mean age of 34.95 ± 21.35 years and a median age of 27 years. Among the enrolled patients, 9 (45%) were male and 11 (55%) were female (table 1).

The most common underlying cause from patient history was nonspecific in 6 cases (30%), followed by trauma in 5 cases (25%), and post-contact lens (CL) use in 3 cases (15%). Less frequently causes included post PKP, post-intracorneal ring implantation (ICR), rheumatoid arthritis (RA), and exposure keratitis, each found in one case. Preoperative vision was hand motion in most cases (90%). (table 1)

Age (years)	
Mean \pm SD	34.95 \pm 21.35
Median (range)	27.0 (5.0- 66.0)
Sex	
Male, n (%)	9 (45.0%)
Female, n (%)	11 (55.0%)
Causes of keratitis	
Corneal abscess , n (%)	6 (30.0%)
Post trauma , n (%)	5 (25.0%)
Post CL	3 (15.0%)
Post lasik	2 (10.0%)
Post PKP	1 (5.0%)
Post ICR	1 (5.0%)
RA, n (%)	1 (5.0%)
Exposure, n (%)	1 (5.0%)
Preoperative vision	
Hand motion, n (%)	18 (90.0%)
Light perception, n (%)	2 (10.0%)

Among the detected pathogens in the patients, bacterial infection was the most

common ,accounting for 45%of cases, followed by fungal infection in 35%of cases .polymicrobial infection was found in only one patient ,and two cases had acanthamoeba infection.(table 2)(figure 1)

Pathogens	
Bacterial, n (%)	9 (45.0%)
Fungal, n (%)	7 (35.0%)
Mixed bacterial+ fungal, n (%)	1 (5.0%)
Amoeba (acanthamoeba) , n (%)	2 (10.0%)
Viral, n (%)	1 (5.0%)

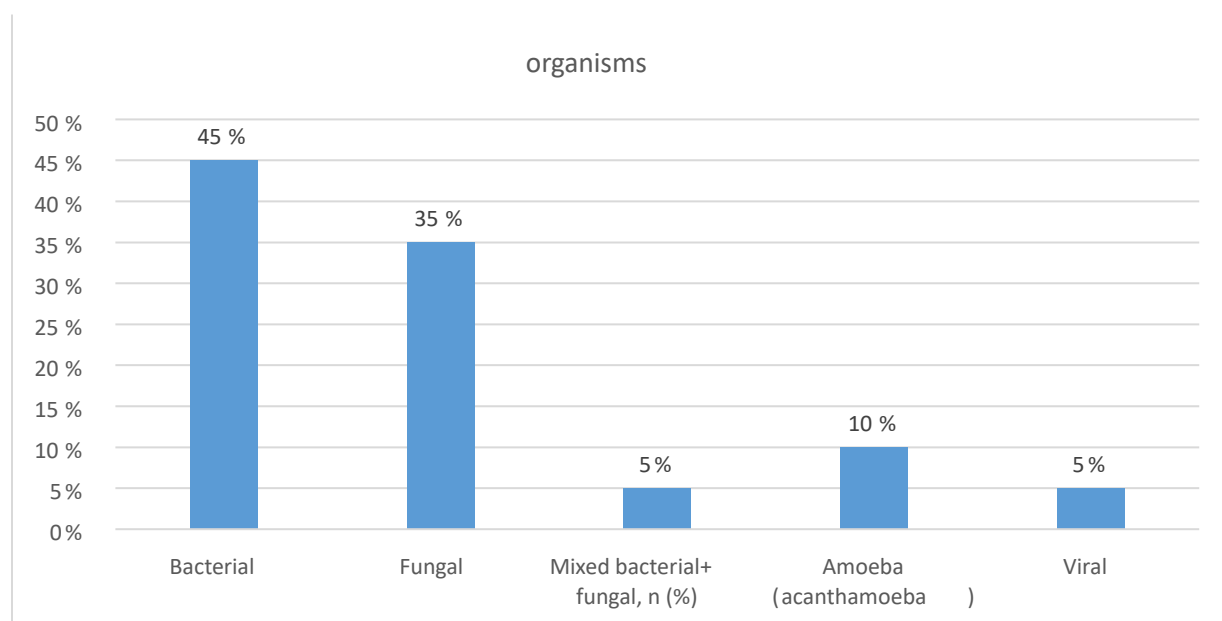


Fig. (1): pathogen detected in the studied patients.

In terms of postoperative outcomes, anatomical integrity of the eye was restored in 18 cases (90%).Recurrence of infection occurred in three cases (15%).35% of patients had vision of Hand motion as 25% of cases had cataract which required cataract surgery on a later stage to improve vision .seven patients required additional surgical procedures :one underwent PKP for recurrence of infection ,one required evisceration due to regression to endophthalmitis and five required cataract surgery (table 3)

Table 3. Clinical characteristics of the studied patients (n= 20)

Restore integrity	
Yes, n (%)	18 (90.0%)
No, n (%)	2 (10.0%)
Recurrence	
Yes, n (%)	3 (15.0%)
No, n (%)	17 (85.0%)
BCVA	
0.05, n (%)	1 (5.0%)
0.3, n (%)	1 (5.0%)
0.4, n (%)	1 (5.0%)
0.5, n (%)	5 (25.0%)
0.6, n (%)	2 (10.0%)
Hand motion, n (%)	7 (35.0%)
Light perception, n (%)	3 (15.0%)
Further surgery needed	
No, n (%)	13 (65.0%)
Cataract surgery, n (%)	5 (25.0%)
Evisceration, n (%)	1 (5.0%)
redoing PKP	1 (5.0%)

The analysis revealed that there were no statistically significant differences in age ,sex, causes of infection ,preoperative vision ,pathogens detected or postoperative BCVA between cases with and without recurrence .(table 4)

However ,there were two significant findings ,firstly ,patients with recurrence were significantly less likely to restore eye integrity compared to those without recurrence.in the recurrence group ,66.7%of patients did not achieve restoration of eye integrity whereas none of the patients in the no recurrence group experienced this outcome .This difference was statistically significant ($p=0.016$).Secondly , there was a statistically significant difference in the need for further surgery between cases with and without recurrence .patients with recurrence had a higher requirement for additional surgical procedures compared to those without recurrence($p=0.005$).These findings indicates that recurrence after TPK is associated with a lower likelihood of restoring eye integrity and a higher likelihood of requiring further surgical interventions.(table 4).

Table 4. Relation between recurrence and different parameters

	No recurrence(n= 17)	Recurrence (n= 3)	Test value	p- value
Age (years)				
Median (range)	25.0 (5.0- 65.0)	60.0 (50.0- 66.0)	Z ² MWU= 1.96	0.054
Sex				
Male, n (%)	9 (52.9%)	0 (0.0%)	X ² = 2.89	0.218
Female, n (%)	8 (47.1%)	3 (100.0%)		
Cause				
Infection, n (%)	4 (23.5%)	2 (66.7%)	X ² = 8.24	0.692
Trauma, n (%)	4 (23.5%)	1 (33.3%)		
Post CL, n (%)	3 (17.7%)	0 (0.0%)		
Post Lasik, n (%)	2 (11.8%)	0 (0.0%)		
Post PKP, n (%)	1 (5.9%)	0 (0.0%)		
Post ICR, n (%)	1 (5.9%)	0 (0.0%)		
RA, n (%)	1 (5.9%)	0 (0.0%)		
Exposure, n (%)	1 (5.9%)	0 (0.0%)		
Cataract				
Yes, n (%)	8 (47.1%)	3 (100.0%)	X ² = 2.89	0.218
No, n (%)	9 (52.9%)	0 (0.0%)		
Preoperative vision				
Hand motion, n (%)	16 (94.1%)	2 (66.7%)	X ² = 2.14	0.284
Light perception, n (%)	1 (5.9%)	1 (33.3%)		
Pathogens				
Bacterial, n (%)	9 (52.9%)	0 (0.0%)	X ² = 8.796	0.066
Fungal, n (%)	5 (29.4%)	2 (66.7%)		
Mixed bacterial+ fungal, n (%)	1 (5.9%)	0 (0.0%)		
Amoeba (acanthamoeba) , n (%)	2 (11.8%)	0 (0.0%)		
Viral, n (%)	0 (0.0%)	1 (33.3%)		
Restore integrity				
Yes, n (%)	17 (100.0%)	1 (33.3%)	X ² = 12.59	0.016
No, n (%)	0 (0.0%)	2 (66.7%)		
BCVA				
0.05, n (%)	1 (5.9%)	0 (0.0%)	X ² = 8.05	0.235
0.3, n (%)	1 (5.9%)	0 (0.0%)		
0.4, n (%)	1 (5.9%)	0 (0.0%)		
0.5, n (%)	5 (29.4%)	0 (0.0%)		
0.6, n (%)	2 (11.8%)	0 (0.0%)		
Hand motion, n (%)	6 (35.3%)	1 (33.3%)		
Light perception, n (%)	1 (5.9%)	2 (66.7%)		
Further surgery needed				
No, n (%)	12 (70.6%)	1 (33.3%)	X ² = 12.76	0.005
Cataract surgery, n (%)	5 (29.4%)	0 (0.0%)		
Evisceration, n (%)	0 (0.0%)	1 (33.3%)		
redoing PKP	0 (0.0%)	1 (33.3%)		

p≤0.05 is considered statistically significant, *p*≤0.01 is considered high statistically significant, SD: standard deviation, -comparison between groups done by *Mann-Whitney U test, Student T test, Chisquare Test or Fischer Exact test when appropriate

Discussion:

TPK continues to be the final resort for managing clinically uncontrolled infectious keratitis ,aiming to elimination of the infection and maintaining the integrity of the eye .Despite the development of stronger antimicrobial drugs and additional surgical techniques ,TPK is still necessary in approximately 8.3%to over 50%of infectious keratitis cases .This percentage is significantly higher in instances of fungal and acanthamoeba keratitis, as well as involving drug-resistant pathogens^{3,9,10}.

Therapeutic deep anterior keratoplasty (TDALK)has emerged as a potential alternative to full-thickness TPK for medically unresponsive infectious keratitis. TDALK has been suggested to be an effective treatment with a lower risk of infection recurrence and improve visual outcomes¹¹. However, in their study, TPK was still the preferred option for cases involving perforation or extension into the limbal or scleral areas.

In this study we reported the surgical outcomes of 20 cases of TPK performed for microbial keratitis at Memorial institute for ophthalmic research from 2019-2021 in terms of cure rate ,anatomical success rate ,graft survival and lastly visual outcome. The cure rate in our study was 85% and the rate of recurrence of infection was 15% of the cases which required surgical intervention in form of redo PKP in one case and evisceration in another one , which is comparable to the other studies^{3,12,13}.The preservation of the globe integrity in this study was 90% of the cases indicating surgical anatomical success rate .Graft clarity was maintained in 14 cases (70%) . As regard the visual outcome, BCVA measured in decimal was in 5cases (25%) 0.5, in 2 cases (10%) 0.6 ,3 cases (15%)ranges between 0.05 -0.4 and 7 cases (35%) of cases was having hand motion vision where 5 of them had cataract and needed later cataract surgery to improve vision .(table 3).light perception was found in 3 cases (15%)and one of them needed evisceration .

We found that performing TPK while the corneal infiltration is <8mm have better results regarding the cure rate and the anatomical success rate and carry better visual outcome. Using clear high-quality grafts decreases the incidence of early graft

failure and improves graft survival. This also is comparable to other studies³.

In summary, TPK proves to be advantageous in managing medically uncontrollable microbial keratitis. Ensuring that the procedure is performed at the appropriate time can lead to an improved outcome.

Conflict of interest declaration:

The author has no financial interest in any subject matter or materials discussed in this manuscript.

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