The Results of Phototherapeutic Keratectomy in the Superficial Corneal Opacities and Recurrent Corneal Erosions

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Abstract

Purpose: To study the effect of phototherapeutic keratectomy (PTK) in the treatment of various superficial corneal pathologies.

Methods: We performed a nonrandomized, prospective study on patients who presented with superficial corneal disease and/or poor vision. Fifty eyes were included; recurrent corneal erosion (RCE): 25 eyes, Salzmann’s nodular degeneration: 9 eyes, spheroidal degeneration: 4 eyes, trachoma keratitis scar: 5 eyes, traumatic scar and pseudophakic bullous keratopathy: each one 2 eyes, macular dystrophy, herpetic corneal scar, and band keratopathy each of them 1 eye. All patients were treated with Nidek EC-5000 excimer laser. A central 4-8 mm ablation zone was determined by opacity diameter. Follow up ranged from 90 days to 20 months; mean 304±165 days for RCE group and 395±197 days for others.

Results: Uncorrected visual acuity (UCVA) improved from mean of 20/50 (logMAR=0.44) and 20/400 (logMAR=1.1) preoperatively to 20/30 (logMAR=0.2) and 20/120 (logMAR=0.78) postoperatively in RCE and opacity groups respectively. Best corrected visual acuity (BCVA) improved from mean of 20/30 (LogMAR=0.22) and 20/200 (logMAR=0.96) preoperatively to 20/25 (logMAR=0.07) and 20/100 (logMAR=0.65) postoperatively in RCE and opacity groups respectively. Recurrent erosion dramatically reduces in RCE group.

Conclusion: PTK can improve UCVA and BCVA in various superficial corneal pathologies and reduce spontaneous corneal erosions but proper case selection is crucial.

Keywords: phototherapeutic keratectomy, corneal opacities, recurrent corneal erosions

Introduction

Phototherapeutic keratectomy (PTK) is a surgical method that ablates the superficial layers of cornea using excimer laser, to treat and improve vision in patients with superficial corneal pathologies. In 1985, Seiler used PTK in eyes with potential vision for the first time. In 1995 FDA approved two laser systems (Visx and Summit) to perform PTK.

In patients with superficial corneal disorders, PTK has many advantages in comparison to superficial keratectomy. PTK makes a smooth surface after ablation and makes a clear border of treated versus non treated area.

Penetrating keratoplasty (PK) or lamellar keratoplasty (LK) are other options for treatment of these patients, but due to complications of these techniques, a successful PTK is preferred method, which may delay PK or LK for several years later.

In addition, follow up of these patients after PTK is much easier and patients who should travel a long distance, will benefit much.

This study, presents the vision and refractive error (sphere and cylinder) changes and complications of PTK. The other group of patients is recurrent corneal erosion (RCE) who are resistant to medical and conservative treatment, are included in this study to be treated with PTK.

Methods

In this interventional non-randomized, prospective study, 50 eyes from 47 patients who were referred to Farabi Eye Hospital from March 2003 to August 2005, due to decreased vision because of superficial corneal opacities and RCE (resistant to medical and conservative treatment), were treated by PTK.

Twenty five eyes had RCE, 5 eyes had trachoma keratitis, 4 eyes had spheroidal degeneration, 9 eyes had Salzmann’s nodular degenerations, 2 eyes had traumatic scar, 1 eye had band keratopathy, 2 eyes had pseudophakic bullous keratopathy (PBK), 1 eye had macular dystrophy, and 1 eye had herpetic scar.

Preoperative examinations were slit lamp examination, and if possible manifest and subjective refractions. Patients with a central pachymetry of less than 400 µ thickness were excluded.

Depth of lesion was estimated by a careful slit lamp exam. All patients were treated by Nidek EC-5000 (Gamagori, Japan).

Surgical technique

After installing a tetracaine drop for anesthesia, prep and drape and lid speculum. Epithelium was removed manually with a hockey knife.

In patients with RCE, the involved part of epithelium was detected by a dry merocele and this area and adjacent area were treated by excimer laser. The depth of ablation in these patients was 10-15 microns and optical zone was 4-8 mm.

In patients with Salzmann’s nodular degeneration, the elevated part of scar was removed by crescent knife and for remaining parts of scar, and smoothing the surface, excimer laser was used.

Optical zone for patients with superficial corneal opacity was at least 5.5 mm and 8.00 mm at most, depending on the size of lesion, ablation depths were different for different types of lesions: at least 10 µ for RCE and 150 µ for band keratopathy (transepithelial PTK).

Therapeutic contact lens was inserted after operation. Steroid, antibiotic, and diclofenac drops were prescribed.

Diclofenac was prescribed for pain relief for 2 days postoperatively. Antibiotic drop for 1 week and steroid tapered up to 6 weeks.

In RCE, therapeutic contact lens was continued for 1 month and fluorometholone drop for 2 months.

Results

We analyzed the results of study in 2 groups (RCE & superficial corneal opacity). Visual acuity analyzed after conversion to logMAR (Tables 1 and 2).
**Table 1. Effects of PTK in recurrent corneal erosions**

<table>
<thead>
<tr>
<th></th>
<th>Mean±SD</th>
<th>Min.</th>
<th>Max.</th>
</tr>
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<tbody>
<tr>
<td>Age (year)</td>
<td>38.5±12.5</td>
<td>21</td>
<td>67</td>
</tr>
<tr>
<td>Follow up (day)</td>
<td>304±165</td>
<td>126</td>
<td>575</td>
</tr>
<tr>
<td>Preoperative BCVA (logMAR)</td>
<td>0.22±0.25 (20/30)</td>
<td>20/120</td>
<td>20/20</td>
</tr>
<tr>
<td>Postoperative BCVA (logMAR)</td>
<td>0.07±0.17 (20/25)</td>
<td>20/120</td>
<td>20/20</td>
</tr>
<tr>
<td>Preoperative refractive error (SE) (Diopter)</td>
<td>0.41±1.7</td>
<td>-7</td>
<td>+2</td>
</tr>
<tr>
<td>Postoperative refractive error (SE) (Diopter)</td>
<td>0.35±1.63</td>
<td>-7</td>
<td>+2</td>
</tr>
<tr>
<td>Preoperative cylindrical refractive error (Diopter)</td>
<td>-1.22±0.91</td>
<td>-3.75</td>
<td>0</td>
</tr>
<tr>
<td>Postoperative cylindrical refractive error (Diopter)</td>
<td>-0.58±0.54</td>
<td>-2</td>
<td>0</td>
</tr>
</tbody>
</table>

PTK: phototherapeutic keratectomy, BCVA: best-corrected visual acuity, SE: spherical equivalent

**Table 2. Effects of PTK on corneal opacities**

<table>
<thead>
<tr>
<th></th>
<th>Mean±SD</th>
<th>Min.</th>
<th>Max.</th>
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<tbody>
<tr>
<td>Age (year)</td>
<td>58.2±16.6</td>
<td>20</td>
<td>77</td>
</tr>
<tr>
<td>Follow up (day)</td>
<td>395±197</td>
<td>20</td>
<td>669</td>
</tr>
<tr>
<td>Preoperative BCVA (logMAR)</td>
<td>0.96±0.43 (20/200)</td>
<td>FC 0.5 m</td>
<td>20/50</td>
</tr>
<tr>
<td>Postoperative BCVA (logMAR)</td>
<td>0.65±0.26 (20/70)</td>
<td>FC 0.5 m</td>
<td>20/30</td>
</tr>
<tr>
<td>Preoperative refractive error (SE) (Diopter)</td>
<td>2.21±2.4</td>
<td>-2</td>
<td>+8.5</td>
</tr>
<tr>
<td>Postoperative refractive error (SE) (Diopter)</td>
<td>1.98±2.18</td>
<td>-1.5</td>
<td>+7</td>
</tr>
<tr>
<td>Preoperative cylindrical refractive error (Diopter)</td>
<td>-2.1±1.86</td>
<td>-6.5</td>
<td>0</td>
</tr>
<tr>
<td>Postoperative cylindrical refractive error (Diopter)</td>
<td>1.03±1.24</td>
<td>-4.5</td>
<td>0</td>
</tr>
</tbody>
</table>

PTK: phototherapeutic keratectomy, BCVA: best-corrected visual acuity, SE: spherical equivalent

**I: RCE group**
In 2 eyes with lattice and map-dot finger-print dystrophy, PTK was performed bilaterally due to RCE.  
Age of patients was 21 to 67 year old with mean of 38.5±12.5. Preoperative uncorrected visual acuity (UCVA) in this group was between $20/200$ (logMAR=1) to $20/20$ (logMAR=0) the mean follow up was 305±165 days.  
Postoperative UCVA and BCVA improved significantly (P values 0.00 and 0.002, respectively).  
There was no change in spherical equivalent postoperatively the event that can be predicted (due to minimum (10 µ) ablation).  
In follow up, one patient reported one episode of symptoms of recurrent erosion but not repeated.  
One patient developed mild corneal haze 2 mm paracentrally which had no effect on patient’s vision.

**II: Non RCE group**
The age of these patients were 20 to 77 years with a mean of 58±16.5 years.  
The mean follow up period was 395±197 days. UCVA and BCVA were improved after
PTK significantly (P values: 0.001 & 0.002 respectively).
There was no significant change in spherical equivalent although the average ablation was 63 μ. So there was no significant hyperopic shift after PTK.
The amount of cylindrical error in these patients reduced significantly (P value 0.0001). That could be due to reduction in irregularities and removal of elevated lesions, with PTK. Two patients developed persistent epithelial defect (PED) with a diagnosis of herpetic scar and band keratopathy. PED was treated by therapeutic contact lens in the herpetic scar but in the second one blepharorrhaphy was done.
In 2 patients with PBK, PED was happened, that did not respond to C.L or blepharorrhaphy, but responded to regraft in one case and conj flap for pain relief in another case.
In other cases, there was general improvement and reduction in opacity.

Discussion

PTK is a relatively easy and low cost method for the treatment of superficial corneal pathologies (including RCE) with various advantages in comparison to keratoplasty techniques (LK or PK) and acceptable results.
Szentmary et al6 showed performing PTK would not affect the result of future PK.
There are 3 major groups of indications for PTK:7-9
A: Removing superficial corneal opacities.
B: Smoothing of surface irregularities.
C: Increasing attachment of corneal epithelium in RCE.
In RCE, we need a very superficial keratectomy. We performed 10 µ ablation in this study (after epithelial removal). The important point in this method is to detect the loose epithelial area by a dry merocele and there is no need to use masking agent.3
The most common indication for PTK is RCE4 for which the results are good.
Dausch et al7 reported the first PTK in 1990. There are several retrospective studies7 which showed more than 68% success rate.
There is only one randomized prospective study10 that showed adding excimer laser could improve the results significantly. This study also showed that the most recurrences in RCE after PTK will happen in the first 4 months, which we had no case in this period.
There are 2 methods for surface smoothness in superficial elevated corneal opacities:
1- Polishing method: in this method the surgeon fixes the head of the patient and patient’s eye will be uniformly rotated.
2- Masking agents for filling of depressed area to protect non affected area from laser beam.3 the most common masking agents are carboxymethyl cellulose 0.5% and 1%.
In our study we used polishing method, and normal saline as the masking agent.
The success of PTK is measured by BCVA. In Maloney et al’s11 study, which was one of the largest prospective and a multi-center studies in Summit PTK study group, showed 45% improvement in BCVA and in our study this improvement was 58%. They showed decrease in BCVA in 9% of patients and in our study this decrease was 8% and the results can be seen in other studies.12,13
The result of PTK is also related to underlying corneal pathologies. Maloney et al11 showed that patients with congenital corneal dystrophies, Salzmann’s nodular degeneration and corneal scars will have the best results.
In our study, the clearest cornea after PTK was in patients with Salzmann’s nodular degeneration.
There was no improvement in patients with band keratopathy and this was due to presence of calcium in band keratopathy that will not be removed by excimer laser.
Holmez16 et al16 for increasing the efficacy of PTK in RCE used patient serum as artificial tear film and they concluded that there was no recurrence after 15.5 months while we had similar results without adding serum.
Ardjomand et al17 presented a new technique of PTK similar to epi-LASIK. In this technique they removed epithelial flap and then performed PTK. They suggested that pain in the first post op day was less in this technique.
Chaw et al18 studied PTK in RCE with 5 µ ablation depth. In their study the success rate was 85% Hafens et al19 had similar results for
PTK in superficial corneal opacities as in our study.

**Conclusion**

PTK is a successful method for the treatment of various superficial corneal pathologies and has many advantages over keratoplasty techniques, although the visual outcome in PK will be much better.

PTK is a highly successful modality in the treatment of RCE resistant to medical therapy. Not only does it reduces the pain but also restores cornea clarity. In elevated corneal pathologies, PTK smoothes the surface and this in turn allows uniform distribution of tear film on cornea. Use of topo-linked or wavefront-guided excimer laser systems may help achieving better outcomes in the future.

**References**