·Clinical Research·

Early phototherapeutic keratectomy in recurrent corneal erosion

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Abstract

• AIM: To evaluate the morphological and functional outcomes of earlier excimer laser phototherapeutic keratectomy (PTK) for treatment of recurrent corneal erosion (RCE).

• METHODS: A total of 25 eyes of 23 patients with RCE were enrolled in a prospective non-randomized consecutive study. In all cases, RCEs were unresponsive to conventional treatment methods. No one had experienced stromal puncture or tried contact lens previously. After complete ophthalmologic examination, central excimer laser PTK with ablation depth of 10μ m and optical zones of 4-8 mm was performed. Uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA), spherical equivalents (SE) and refractive cylinder (RC) were compared before and after phototherapeutic keratectomy.

• RESULTS: Previously 2 patients had undergone epithelial scraping. Duration of disease ranged from 2 months to 3 years prior to PTK (mean=9.3 months). The mean follow-up time was 10.1± 5.5 months (4.2-19.2 months). Success rate after PTK, regarding prevention of recurrence was 96% when they were under follow-up. BCVA was also increased from 0.69± 0.30 to 0.90± 0.23 (P<0.001). Mean SE remained constant with values of 0.41± 1.67D preoperatively and 0.35± 1.63D postoperatively (P=0.26). Mean RC was also improved from -1.22± 0.90D preoperatively to -0.57± 0.57D postoperatively (P<0.001).

• CONCLUSION: PTK using 193nm excimer laser is an effective and safe choice of treatment for a fast epithelial closure, an increase of visual acuity and alleviating symptoms in most patients with RCE in earlier course of the disease.

• KEYWORDS: phototherapeutic keratectomy; excimer laser; recurrent corneal erosion

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INTRODUCTION

Recurrent corneal erosion (RCE) is a disorder of the epithelial basement membrane which is frequently associated with a previous history of shallow corneal injury and, less frequently with epithelial basement dystrophy[1].

It is characterized by repeated episodes of breakdown of corneal epithelium due to a defect in adhesion to the basement membrane[2]. Episodes of RCE are heralded by the sudden onset of eye pain, usually at night or upon awakening, accompanied by redness, photophobia and tearing. The episodes can last from hours to days and cause reduced quality of life due to eye pain or discomfort and poor or unstable vision[3].

A number of treatments for RCE have been described, including use of topical hyperosmotic agents or lubricants[1,4-6], therapeutic contact lens wear [4-6], needle anterior stromal puncture [1,4,5], scraping or superficial epithelial keratectomy[7,8], Nd:YAG laser anterior stromal puncture [9,10], and micro-diathermy [11]. A variety of treatments are available for RCE, reflecting the lack of total efficacy of any single treatment. Although many eyes with RCE heal spontaneously or after using hyperosmotic agents or lubricants in some cases more invasive procedures could help. Therapeutic contact lenses can be used but they can cause some dangerous complications like bacterial keratitis[1].

Phototherapeutic keratectomy (PTK) has been performed and evaluated for many years [12] and has been proven very successful in several contexts [13]. It is essentially indicated for eyes with superficial opacities, surface irregularities or

refractive errors due to disease, trauma or previous surgery. The goal of the treatment is to improve visual acuity and avoid corneal transplantation. Intraoperative and postoperative complications of PTK are minimal. Visual acuity, glare, and photophobia are improved for most patients [14]. It reduces contact lens complication such as bacterial keratitis. Recently, several authors have reported the use of excimer phototherapeutic keratectomy (PTK) for this condition[15-23]. However, reported success rates for this treatment have varied in different studies and many studies had not evaluated quantitative refractive outcomes after PTK [16,17,21]. In most of them only refractory cases were included.

As there is no report of PTK efficacy for RCE in Iranian population, present study was conducted to evaluate the morphological and functional outcomes of earlier excimer laser PTK for treatment of recurrent corneal erosion.

MATERIALS AND METHODS

Subjects Twenty-five eyes of 23 patients with recurrent corneal erosion (RCE) were enrolled in this prospective non- randomized consecutive clinical study. The study was conducted in Farabi ophthalmology center, between February 2004 and July 2005. It was reviewed and approved by the ethical committee of Medical Faculty of Tehran University of Medical Sciences. Informed consents were also obtained from all participants in this study.

Diagnosis of RCE had been made in each case based on the presence of a spontaneously occurring local epithelial defect and/or an area of loosely adherent edematous epithelium. In all cases, the recurrent corneal erosions were unresponsive to conventional treatment methods, such as topical hyper-osmotic agents or lubricants.

Patients with history of contact lens or stromal puncture were excluded. All patients underwent complete ophthal-mologic examination including manifest and subjective refraction, slit-lamp biomicroscopy, and pachymetry. In some patients, because of severe opacity or irregularity, refraction was impossible. Erosion depth was assessed in slit-lamp examination and only patients with anterior stromal corneal lesions were included. Those with pachymetry below 400 were excluded form the study.

Methods On all eyes, the PTK was performed by a single surgeon under topical anesthesia. Affected corneal epithelium was removed manually with a Hockey blade before the photoablation was started. Affected corneal epithelium was defined as area of the epithelium that was not firmly adhered to the underlying stroma. Before epithelial ablation, dry merocele was used for detecting the margins of affected area.

Excimer laser phototherapeutic keratectomy (PTK) with ablation depth of 10μm was performed as the surgical tool for treatment of corneal erosion. Depending on the width and location of the erosions, optical zones varied from 4 to 8mm. To avoid irregularities in optical zone, we tried to perform a central ablation in all eyes.

Postoperative treatment consisted of therapeutic contact lenses with topical antibiotics, corticosteroid and NSAIDs. Diclofenac drops were applied in the following two days. Chloramphenicol was continued up to 3 days after complete epithelial healing and betamethasone drops were administered four times a day initially, then tapered off within 2 months.

Patients were examined daily until complete epithelial healing. Follow-up was continued in the clinic at 1, 4 and 12 weeks, and thereafter at 6 months intervals. During each visit, ophthalmologic examinations identical to those done preoperatively were performed. Main outcome measures included uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA), spherical equivalents (SE), refractive cylinder (RC), and recurrences of the erosion.

Statistical Analysis Descriptive statistics was used to report demographic characteristics by means of SPSS statistic package version 13.5. Paired t test was used to compare patients' UCVA, BCVA, SE and RC before and after phototherapeutic keratectomy.

RESULTS

Analysis was performed on 25 eyes with complete information of pre- and post-operative UCVA, BCVA, SE and RC. Two patients had bilateral involvement. Age of the participants ranged from 21 to 67 years(mean,38.84±12.25). Eight (35%) were male and fifteen (65%) were female. All patients had a history of conservative treatment with lubricant and patching before presenting at our clinic. Two patients had undergone epithelial scraping. No one had tried bandage contact lenses and no one had experienced stromal puncture previously. Duration of disease prior to PTK was from 2 months to 3 years (mean = 9.3 months).

No intraoperative complications or delayed complete epithelial healing occurred in any of our cases. Central ablation could be achieved in all cases except one. Patients

Table 1 Comparison of preoperative and postoperative visual parameters

	Preoperation		Postoperation		*P* value
	Mean	Range	Mean	Range	
UCVA(decimal)	0.46±027	0.10-1.00	0.72±0.29	0.10-1.00	0.000
UCVA(LogMAR)	0.42±0.27	0.00-1.00	0.20±0.25	0.00-1.00	0.000
BCVA(decimal)	0.69±0.30	0.16-1.00	0.90±023	0.25-1.00	0.000
BCVA(LogMAR)	0.22±0.24	0.00-0.80	0.06±0.17	0.00-0.60	0.000
SE	0.41±1.67	-7.00-2.00	0.35±1.63	-7.00-2.00	0.265
RC	-1.22±0.90	-3.75-0.00	-0.57±0.57	-2.00-0.20	0.001

Paired *t* test; UCVA=uncorrected visual acuity; BCVA= best corrected visual acuity; SE= spherical equivalents and RC = refractive cylinder

experienced ocular pain for 24 to 48 hours after PTK, which was usually relieved by diclofenac drops. The mean follow-up time was 10.1±5.5 months (4.2-19.2 months). After PTK, only one patient (4%) had an episode of corneal erosion and the others were free of symptoms for the time they were under follow-up (success rate = 96%).

UCVA and BCVA were improved by one or more lines in 20 (80%) and 14 (56%) eyes respectively. The rest eyes remained unchanged. Mean preoperative UCVA was 0.46± 0.27 and mean postoperative UCVA was 0.72±0.29. The difference was statistically significant(P<0.001, paired t test). BCVA was also increased from 0.69±0.30 preoperatively to 0.90±0.23 postoperatively(P<0.001, paired t test)(Table 1). Mean spherical equivalent remained constant with values of 0.41±1.67D (-7.00-2.00D) preoperatively and 0.35±1.63D (-7.00-2.00D) postoperatively (P=0.265, Paired t test). At the time of follow-up, 18 eyes (72%) had no refractive changes; 2 (8%) showed hyperopic and 5 (20%) showed myopic shifts by at least 0.25 D. However, there were no significant refractive changes (more than 1.00D).

Mean refractive cylinder was also improved, with -1.22± 0.90D(-3.75-0.00D) preoperatively and -0.57±0.57D(-2.00-0.20D) postoperatively (P<0.001, Paired t test). Nineteen eyes showed a decrease in refractive cylinder by at least 0.25D after PTK. Only in one eye there was an increase of 0.5D (from -0.50 D to -1.00D) in refractive cylinder.

Only a mild corneal haze was seen in one eye, which was 2mm distance from the corneal center, but it had no effect on patient's vision and disappeared with topical steroid. No patients reported visual symptoms such as glare or halos.

DISCUSSION

We showed that a superficial ablation of 10μm with excimer laser had good effect on healing of recurrent erosions. Our study demonstrated statistically significant improvement of UCVA, BCVA and RC and no significant SE changes after PTK in the eyes with visual disturbances. One experienced single episode of corneal erosion and others were symptom-free when they were under follow-up. Only a mild haze was also seen.

Cell adhesion molecules of the integrin family are largely responsible for the adhesion of the corneal epithelium to the stroma[24]. The presumptive cause of RCE is loss of adhesion due to a defect in the basement membrane [2]. Absence of hemidesmosomes in nontraumatic RCE has also been shown in electron microscopic studies [3]. The mechanism of action of a PTK may be strengthening the adhesion of the basal epithelial cells to the underlying tissue, via anchoring fibrils and hemidesmosomes [25]. Animal studies have confirmed upregulation of both anchoring fibril constituents and hemidesmosomes following excimer ablation [26]. When superficial keratectomy is performed with excimer laser, the irregular basement membrane is removed and fibroblasts in the anterior stroma are stimulated to form new anchoring fibrils for firmer epithelial adhesion[26,27]. However, a genetic change in these cells should eventually cause recurrence of dystrophic signs in the photoablation area[28].

There are several reports on the treatment of RCE by excimer laser PTK [15-23]. The reported rates of success, regarding alleviation of symptoms and prevention of recurrence of epithelial erosion, ranges between 64% and 100%[15-23]. Our results are in line with the highest success rate reported.

Significant improvement of BCVA in our study was also comparable with other studies [15,18,23]. The volume reduction in PTK per se has a strong influence on corneal refraction[29]. Irregular astigmatism becomes more regular, thereby increasing visual acuity with spectacle correction. The regular astigmatism is also reduced in general and is probably one cause for improved vision.

Consistent with previous studies[18,19,23], in our study spherical equivalent remained constant after PTK. We had no significant refractive shift, which is in contrast to hyperopic

shift after PTK in other corneal pathologies [12-14]. This finding can be explained by an ablation depth of 10mm after epithelial removal, leaving the bowman layer intact. Some studies reported refractive shift even in RCE [15,19]. Hyperopic shifts can be explained by relatively deeper ablation. But the reason for myopic shift is unclear. Significant improvement of RC in our study is in contrast with some previous studies [18,20], which showed RC remained constant postoperatively. We performed a central excimer treatment in all except one to avoid causing irregularities in optical zone. Only in this patient there was an increase in refractive cylinder.

RCE is often difficult to treat and is painful and frustrating for patients, interfering with their daily life [21]. Success rate after PTK is higher in the treatment of certain corneal dystrophies than in the treatment with conventional methods only.

The excimer laser is easier for the surgeon to use [29]; it is a less invasive method and patients are also rehabilitated faster [14,29-31]. It is also possible to treat affected areas that encroach on the visual axis with excellent visual rehabilitation[32]. Besides, PTK could be performed earlier in the course of the disease and re-treatments can be performed if it fails to relieve the symptoms, and keratoplasty can still be applied[14,31].

One concern even with a PTK treatment profile is the possibility of inducing a refractive change[32]. This appears to be less likely with a shallow ablation [32]. Other potential general complications include wound-healing problems, infection, inflammation, or recurrence of the underlying disease or continuity of minor symptoms due to small area of non-adhesion remaining in the periphery [13,21]. Haze normally accompanies PTK. However, it is much less pronounced than after photorefractive keratectomy (PRK)[29]. Different results cited in various studies for recurrence rate and changes in visual parameters might be caused by ethnic differences in populations affected by RCE, different surgical techniques such as variety in ablation depth, different post surgery follow-up and different symptom duration before PTK.

High success rate in our study could be explained by our less complicated samples and earlier use of this procedure. Our patients had relatively short symptom durations. In many of them PTK was performed immediately after failure in conservative treatments, before any other invasive procedures. As the success rate after PTK is higher than conventional methods [30], earlier performance of PTK in the course of disease may lead to earlier recurrence freeness. Thus it would reduce everyday use of topical medications, reduce complications related to contact lenses i.e. dry eye and bacterial keratitis [1], and improve lifestyle.

Following excimer laser keratectomy, the anchoring fibrils, hemidesmosomes and the basal lamina do not completely normalize even after 15 months [33]. Therefore it is imperative to follow these patients for at least 15 months after PTK before any conclusion is drawn regarding the effect of this treatment on the recurrence of RCE. One of our limitations was the relatively short time of follow-up after PTK which may lead to an underestimation in recurrence rate of RCE. Future controlled comparisons on the effectiveness of early PTK are needed. Prospective long-term studies on the recurrence tendencies of corneal dystrophies are also needed.

In conclusion, PTK using 193nm excimer laser is an effective and safe choice of treatment for a fast epithelial closure, an increase of visual acuity and alleviation of symptoms in most patients with RCE. It can be considered for treatment of RCE in earlier course of the disease even before contact lens usage.

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