PHOTOTHERAPEUTIC KERATECTOMY IN RECURRENT CORNEAL EROSIONS REFRACTORY TO OTHER FORMS OF TREATMENT

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SUMMARY

Background: Recurrent corneal erosions can occur as a sequel of trauma, of dystrophies or spontaneously. Therapeutic options include topical lubricating and desiccating agents, therapeutic contact lenses, anterior stromal puncture and, most recently, phototherapeutic keratectomy. At present there are no studies available assessing the value of these different therapeutic options.

Methods: Fifteen eyes of 12 patients underwent therapeutic excimer photoablation after failure of other forms of treatment (lubricating agents in all cases, therapeutic contact lenses in 8, anterior stromal puncture in 2). Ablation depth was 5 µm, except in patients with stromal dystrophy or myopia (6 eyes), who had a deeper ablation.

Results: After a first photokeratectomy 9 eyes remained asymptomatic (mean follow-up 12.8 months), 2 eyes had persistent symptoms and 4 had recurrent corneal erosions after 1–24 months. The chance of success after one treatment was 60% after 12 months as calculated by the Kaplan–Meier method.

Conclusions: The method of photoablation as applied in this study has a similar chance of success to other surgical methods such as anterior surgical stromal puncture. Patients included in this study, however, were highly selected and were refractory to other forms of treatment.

Recurrent corneal erosion (RCE) is a common clinical disorder characterised by repeated episodes of ocular pain typically on waking in the morning or at night. Symptoms are related to breakdown of the corneal epithelium, possibly due to movement of the lid on waking or of the eye during rapid eye

movement sleep. Thinning of the tear film overnight may allow adhesion of the lids to the corneal surface resulting in a shearing force on the epithelium as the eye and lids move relative to each other. Physiological oedema of the corneal epithelium may also play a role.¹

In most cases acute erosive episodes are managed successfully with patching, cycloplegia and antibiotic ointment. Topical lubricants, used over several months, are often effective in preventing recurrences of such episodes or in controlling chronic symptoms. A few patients, however, do not respond to this treatment and require further measures such as a bandage contact lens or anterior stromal puncture. More recently excimer laser has been added to the therapeutic options for these recalcitrant cases.

This paper presents the results in a series of patients with RCE who failed to respond to established forms of treatment and who underwent excimer laser phototherapeutic keratectomy.

PATIENTS AND METHODS

Between November 1992 and December 1994, 15 eyes of 12 patients with persistent symptoms of RCE were treated with excimer laser photoablation. Six patients were women and 6 were men. The mean age was 44.6 years (range 19–71 years). Patient details are shown in Table I. Four patients (5 eyes) had clinical evidence of epithelial basement membrane dystrophy, 3 patients (5 eyes) had a full-thickness corneal dystrophy with superficial complications, 4 patients (4 eyes) gave a history of trauma prior to the onset of RCE and in another (1 eye) no cause for recurrent epithelial breakdown could be found. All patients were included after failure or prophylactic treatment – either topical lubricants (15 eyes), anterior stromal puncture (2), therapeutic contact lens (8) or any combination of these. All patients underwent refraction and video-keratoscopy

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Table I. Characteristics of 12 patients and 15 eyes with recurrent corneal erosions undergoing phototherapeutic keratectomy

Patient no.	Sex/age (years)	Aetiology	Pre-operative treatment	Pre-operative visual acuity and refraction	Depth of ablation (μm)	Post-operative visual acuity and refraction at 3 months	Outcome/follow-up (months)
1A	F, 25	Lattice dystrophy	Oc, TCL	6/12 ($-2.0/-3.0 \times 110$)	25	6/12 ($+0.25/-0.5 \times 100$)	Asymptomatic (20)
1B	F, 25	Lattice dystrophy	Oc	6/6 (s.c.)	25	6/12 ($+2.5/-0.5 \times 55$)	Recurrence after 24 months (28), on TCL now
2	M, 64	Lattice dystrophy	Oc, TCL	6/36 ($+2.0$)	90	6/18 (-5.0)	Asymptomatic (4)
3A	F, 28	Granular dystrophy	Oc	6/12 ($+1.75/-1.25 \times 25$)	10	6/6 ($+0.5/-1.25 \times 180$)	Asymptomatic (20)
3B	F, 28	Granular dystrophy	Oc	6/12 ($+1.5/-2.75 \times 25$)	25	6/18 ($+1.75/-3.5 \times 25$)	Asymptomatic (15)
4	F, 50	ABMD	Oc, TCL	6/12 ($+0.25/-0.75 \times 130$)	5	6/12 ($+0.25$)	Persistent symptoms after first PTK, asymptomatic after re-PTK at 5 months (15)
5A	F, 21	ABMD	Oc, TCL	6/6 ($+0.25/-0.75 \times 180$)	5	6/5 ($+0.25/-9.25 \times 180$)	Recurrence after 1 month, re-PTK at 5 months, persistent symptoms, back on TCL (13)
5B	F, 21	ABMD	Oc, TCL	6/6 ($-0.25/-0.25 \times 95$)	5	6/5 ($+0.5/-0.5 \times 65$)	Recurrence after 8 months, back on TCL (11)
6	F, 67	ABMD, myopia	Oc	6/60 ($-4.5/-4.5 \times 39$)	57	6/12 ($+2.75/-2.0 \times 85$)	Asymptomatic (12)
7	M, 70	ABMD	Oc	6/18 ($-2.75/-1.0 \times 20$)	5	6/18 ($-2.75/-1.0 \times 20$)	Asymptomatic (5)
8	M, 28	Trauma	Oc, TCL	6/6 ($-0.25/-3.5 \times 15$)	5	Unchanged	Recurrence after 6 months, back on TCL (16)
9	M, 55	Trauma	Oc	6/18 (uncorrected)	5		Asymptomatic (8)
10	M, 38	Trauma	Oc	6/6 ($-1.75/-0.5 \times 80$)	5	Unchanged	Asymptomatic (8)
11	M, 19	Trauma	Oc, ASP, TCL	6/5 (uncorrected)	5	Unchanged	Asymptomatic (3)
12	F, 71	Spontaneous	Oc, TCL, ASP	6/9 ($-0.25/-0.75 \times 77$)	5	6/9 (-0.5)	Persistent symptoms, asymptomatic after re-PTK at 6 months (14)

Oc, ointment; TCL, therapeutic (bandage) contact lens; ASP, anterior stromal puncture; ABMD, anterior basement membrane dystrophy.

(Eyesys) before excimer laser treatment. These were repeated at 1, 3 and 6 months after treatment.

Surgical Procedure

Several drops of 1% amethocaine were instilled, and a lid speculum was inserted. The epithelium was removed manually in the area of the cornea in which the epithelium appeared abnormal on slit-lamp examination. Photoablation was done with the VISX 2020 excimer laser (VISX, Santa Clara, CA). Ablation depth varied from 5 μm to 90 μm depending on the underlying pathology and pretreatment refraction. Following treatment one drop of diclofenac and antibiotic ointment was instilled and the eye padded for 24 hours. Antibiotic drops were continued until the epithelium was healed and dexamethasone 0.1% drops were used for 2 weeks to reduce inflammation.

Fig. 1. Relative number of asymptomatic patients after the first phototherapeutic keratectomy.

RESULTS

After a mean follow-up of 12.8 months (range 3–28 months), in 9 eyes there were no further episodes of acute erosion (Table I). Using the Kaplan–Meier method, the probability of success after the first photokeratectomy was 60% after 12 months (Fig. 1).

In two eyes symptoms persisted (patients 4 and 12) and a second photoablation was performed, leaving the patients asymptomatic. Four eyes of 3 patients (patients 1B, 5A, 5B, 8) suffered a recurrent erosion which required further treatment. Patient 8 had a traumatic RCE which recurred 6 months after photokeratectomy outside the previously treated area and was refitted with a contact lens. In patients 4 and 5 symptoms of acute erosion persisted (4) or recurred 1 (5A) and 8 months (5B) after laser treatment. Both had an epithelial dystrophy. In patient 5A the epithelium broke down adjacent to the previously treated area while in patient 5B the recurrent erosion developed in an already ablated area.

In patients treated for recurrent erosions alone (depth of ablation 5 μm) no post-operative haze or scarring was detected and no video-keratoscopic change was noted in the cornea.

DISCUSSION

RCE can occur on a background of a wide variety of corneal disorders,² but the majority of cases follow

trauma or are related to an inherited dystrophy, in particular anterior basement membrane dystrophy (ABMD). Post-traumatic RCE typically shows a unilateral, isolated irregularity of the basement membrane while in ABMD clinical signs are found in both eyes with a more diffuse involvement of the cornea. Idiopathic cases of RCE have also been described.

In both the dystrophic³ and the post-traumatic⁴ forms alterations in the junctional complexes (hemidesmosomes and anchoring fibrils) between the basal epithelial cells and the epithelial basement membrane are thought to account for the increased susceptibility of the epithelium to minor trauma.

Even in the absence of treatment acute erosive episodes generally resolve after several hours, leaving a foreign body sensation with recurrence of the acute symptoms some days, weeks or months later. Between such episodes the corneal epithelium is often seen to be of abnormal quality and symptoms of ocular discomfort may or may not be present. Only very rarely is the corneal stroma involved⁵ and the prognosis for vision is good.

Initial therapy of the acute erosion involves pressure patching, antibiotics and cycloplegia, leading to resolution of symptoms in 95% of cases.⁶ To prevent recurrence, topical lubricating agents (Hypromellose drops, simple ointment) or desiccating agents (hypertonic saline drops or ointment) may be useful in about 90% of cases.^{6,7} These need to be continued over several months and in the case of hypertonic saline intolerance may be a problem. Hypertonic saline does not appear to be any more effective than simple ointment.⁶ Debridement of the epithelium may bring about symptomatic relief and assist healing where a large area of loosely adherent epithelium is present, but does not prevent recurrence of acute erosive episodes.⁷

Where initial resolution of the acute erosion is delayed or if prophylactic measures have failed, a high water content soft therapeutic contact lens (TCL) with high oxygen transmission can be used to protect the regenerating epithelium from lid movement. To be effective a TCL should be worn for at least 6 weeks (the minimum time required for the re-formation of junctional complexes) and possibly for several months.⁸ Such long-term contact lens wear is associated with a risk of corneal infection and neovascularisation (all the more serious because of the generally good visual prognosis of RCE) in addition to the cost of prophylactic, preservative-free antibiotics. In the only formal comparative study of the use of TCL and lubricating agents, relief of symptoms was seen to be inferior and the rate of complications higher in patients using a TCL.⁹ The beneficial effect of TCL in the treatment of RCE of all cases is of the order of 30–50%.^{9–11}

Anterior stromal puncture (ASP) with a needle¹² or YAG laser¹³ and microdiathermy¹⁴ have been used to produce small lesions penetrating Bowman's membrane into superficial stroma in the hope of obtaining a more firmly anchored epithelium. The success rate of these modalities lies between 70% and 80%. However, a certain amount of scarring is induced and therefore the techniques are not applicable to lesions that involve the visual axis or a large part of the corneal surface. Staphylococcal keratitis following ASP has been reported in insulin-dependent diabetic patients.¹⁵

In RCE secondary to ABMD which has not responded to treatment with topical agents or TCL, superficial keratectomy to remove the abnormal basement membrane has been carried out with around 85% success.^{16,17}

A more recent form of treatment has become available with the excimer laser. This allows removal of corneal tissue with extreme precision and without damage to non-irradiated areas.¹⁸ The rationale for a partial ablation of Bowman's layer is given by experimental work suggesting that the formation of a smooth new bed for the migrating epithelium results in new hemidesmosomal adhesion complexes.¹⁹ Deep ablation, in which the anterior portion of the stroma has been removed (patients 1, 2, 3A, 6), leads to resynthesis of adhesion structures under re-stratified epithelium.¹⁹ These structures include hemidesmosomes, small segments of basement membrane, and the anchoring fibril collagen. This newly formed adhesion complex may result in an improved cell-matrix interface. The main undesirable effect of excimer laser phototherapeutic keratectomy (PTK) is central flattening of the cornea, which induces a hyperopia that may be unacceptable to patients who are not myopic pre-operatively. The degree of hyperopic shift induced is related to the depth of ablation performed. In the treatment of RCE only 5 μ m depth ablation is attempted. The results in this series confirm that such a superficial ablation has no significant refractive effect and does not induce irregular astigmatism with off-centre treatment. It can be used both on and off the visual axis.

The few published reports of excimer laser treatment of RCE generally stress the favourable results that have been achieved. Forty-three of 45 patients treated by Dausch and Schröder²⁰ had no further erosion following excimer ablation of unspecified depth. Forster *et al.*²¹ treated 9 eyes with post-traumatic RCE, with 1 patient suffering 'brief recurrence of pain' within 6 months of treatment. They treated their patients with topical lubricants for 3½ months following laser, thus making the accurate assessment of the efficacy of laser therapy difficult. One hundred per cent success in

preventing recurrence of erosion was reported in 37 patients (mean follow-up 15 months) by Fagerholm *et al.*,²² of whom 6 needed more than one session of ablation. However, 14 patients (37.8%) had persistent symptoms of foreign body sensation on waking, although the need for continued topical treatment was not stated. In another paper, the same group found an overall success rate of 46% in 76 eyes.²³ They compared ablation of 3 or 5 μm after epithelial removal, with ablation of 20 μm directly on the epithelium, and found that the results were best with 5 μm ablation depth after epithelial removal. Successful treatment has also been reported in other small series.^{24–26}

Our series, with a probability of success of 60% at 12 months after the first photokeratectomy, shows that photoablation is a relatively successful procedure in recurrent corneal erosions. This result is similar to what would be expected with topical treatment or ASP. It has to be borne in mind, however, that the patients included in this study were highly selected: they were refractory to other forms of treatment. Six eyes of our series needed further treatment, of which 2 were successfully managed by re-treatment with laser. Three of these eyes had ABMD and it may be that a more widespread, and possibly deeper, initial ablation is required to prevent recurrence of symptoms in these cases.

The great majority of patients with RCE respond to topical treatment with lubricants or desiccating agents – a safe modality that remains the initial treatment of choice. The 10% of patients who continue to suffer recurrent erosive episodes form a heterogeneous group and can be difficult to treat. Superficial excimer laser ablation is beneficial in some, but its exact place in the therapy of RCE remains to be defined.

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