

Three-year outcomes of alcohol delamination of corneal epithelium for recurrent corneal erosions of traumatic etiology

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Purpose: Alcohol delamination of the corneal epithelium (ADCE) is a therapeutic option for patients with recurrent corneal erosion (RCE) who do not respond to nonsurgical management of lubricants and extended wear contact lens. The aim of the study is to report on three-year efficacy and safety of ADCE for RCE of traumatic etiology. **Methods:** This is a retrospective review of consecutive patients who underwent ADCE for traumatic RCE in a local hospital between January 2010 and January 2020. The outcomes at a 3-year follow-up review are included. Nonsurgical therapy used; intra- and postoperative complications were recorded. ADCE was only offered to those who remained symptomatic despite maximum topical lubrications and/or extended wear contact lens. Success was defined as the absence of recurrence of corneal erosion. **Results:** Twenty-six eyes of 26 patients with RCE caused by trauma underwent ADCE. The mean age of patients was 39 years. The follow-up period was a minimum of 36 months. Three eyes (11.5%) had recurrence of corneal erosion after ADCE at the 3-year follow-up. Recurrence was noted at months 2, 23, and 36 postoperatively in these patients. All patients reported significant improvement in symptoms associated with recurrent erosion. Ten eyes (38.5%) stopped all topical lubricants postoperatively. No intra- or postoperative complications were noted in our study. **Conclusion:** This study documents the long-term safety and efficacy of alcohol delamination of corneal epithelium at 3 years for patients with RCE of traumatic origin.

Key words: Alcohol delamination, efficacy, traumatic recurrent corneal erosions

Recurrent corneal erosion (RCE) is a result of weak attachment between basal cells of the corneal epithelium and the underlying Bowman's membrane leading to recurring cycles of epithelial breakdown.^[1] It causes extreme ocular pain and chronic discomfort typically noted at waking time, when shearing forces of opening the eye causes tearing of the corneal epithelium.^[2,3] Symptoms often subside over the course of the day.^[4,5] The pain is attributed to the dense innervation by nociceptive nerves from the ophthalmic division of the trigeminal nerve.^[4] RCE was first described by Hansen in 1872, who termed it *intermittent neuralgic vesicular keratitis*^[6] and has been documented as a disease entity for nearly 150 years.

RCE is largely a clinical diagnosis based on history and slit-lamp bio-microscope examination.

The main aim of treatment is to promote epithelial regeneration. Medical management for RCE such as topical lubricants has remained the mainstay of treatment. Extended wear bandage contact lens is used to relieve pain and protect the corneal epithelium from the mechanical rubbing of the eyelid.^[7] Oral doxycycline and corticosteroids have been reported to be effective by inhibiting the key metalloproteinases and promote epithelial healing.^[8] Autologous serum eye drops have also been trialed.^[9]

Surgical options are available when episodes are too recurrent and disabling. Procedures such as mechanical epithelial debridement with or without the use of diamond burr,^[10] anterior stromal puncture,^[11] debridement with diamond burr, and phototherapeutic keratectomy (PTK)^[12] are described in literature. Recently, there has been increasing interest in the role of alcohol delamination of corneal epithelium for treating RCE.

Localized loose epithelium is debrided with the idea that new epithelial cells will regenerate and form a stronger adhesion structure. Alcohol delamination cleaves the epithelial attachment at the hemidesmosomal level leaving a smooth base behind, which is ideal in facilitating epithelial cell migration and attachment.^[13] This procedure has also been shown to enable efficient removal of the epithelium with an almost complete preservation of the lamina densa in traumatic RCE.^[14]

The aim of this study is to evaluate 3-year outcomes of efficacy and safety of Alcohol delamination of the corneal epithelium (ADCE) specifically for RCE of traumatic etiology.

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Methods

A retrospective review of medical records of all patients who underwent ADCE for traumatic RCE between January 1, 2010 and January 5, 2020 was carried out in the local hospital. ADCE as a therapeutic option was offered to patients who remained symptomatic despite maximal topical lubrication and/or extended wear contact lens. This could range from 2 to 6 months from the first clinic visit, depending on the individual patient's symptoms as well as tolerance and response to medical treatment. Patients with a history of herpes simplex keratitis were excluded from the procedure. Only patients who completed at least 3 years of follow-up were included. Nonsurgical therapy used prior to the procedure; the intra- and postoperative complications and duration of follow-up were recorded. The use of lubricants before and after ADCE was also recorded.

The primary outcome measure was the recurrence of corneal erosion. Recurrence was defined as experiencing symptoms of similar intensity any time after surgery, which prompted a visit to an optician and/or subsequent onward referral to ophthalmologists. Success was defined as an absence of recurrence of corneal erosion. The secondary outcome measure was the complete cessation of topical lubricants postoperatively.

The ethical principles outlined in the Declaration of Helsinki (2008) were adhered to in carrying out this retrospective review.

All the surgical procedures were performed by the same surgeon. A circular well of appropriate diameter to cover the area of erosions was placed onto the cornea. Twenty percent alcohol was then instilled into the well. After 40 s, the alcohol was drained with a surgical sponge and the cornea irrigated with a balanced salt solution. The circular area of the epithelium treated with the alcohol was removed using a cellulose sponge. Specific care was taken to ensure no sharp object such as a surgical knife/needle touched the cornea to prevent any damage to Bowman's membrane. A bandage contact lens was placed at the end of the procedure. The postoperative regime included topical antibiotic (Chloramphenicol 0.5% preservative-free eye drops) and preservative-free lubricant eye drops for 1 week. A bandage contact lens was removed 1 week after the procedure.

Results

Twenty-six eyes of 26 consecutive patients with RCE caused by trauma underwent ADCE. Demographics of patients are shown in Table 1. The mean age of patients was 39 years, and 65.4% of the patients were females. All patients completed a minimum 3-year follow-up period (Range: 36–116.4 months; mean: 69.9 months). All patients were previously treated with intense topical lubricants and offered extended wear bandage contact lens. However, only 12 eyes (46.2%) tolerated bandage contact lens treatment before alcohol delamination.

In our study, 23 eyes (88.5%) achieved surgical success with the absence of recurrence of corneal erosion during the follow-up period of 3 years. Three eyes (11.5%) had a recurrence of corneal erosion after ADCE. Recurrence was noted at months 2, 23, and 36 postoperatively in these patients. All three patients

Table 1: Demographics of patients

Demographics	Description
Age (year)	Range: 23-62 (mean 38.88 SD 11.33)
Sex (n=26)	Female: 17 (65.4%) Male: 9 (34.6%)
Eye (n=26)	Right: 11 (42.3%) Left: 15 (57.7%)
Management before alcohol delamination (n=26)	Topical lubricants: 26 (100%) Bandage contact lens: 12 (46.2%)

were treated with topical lubricants and did not require further surgical management.

All patients reported significant improvement of symptoms. Ten eyes (38.5%) did not need topical lubricants at all after the initial postoperative period of 1 week. None of the patients required an extended wear contact lens for control of symptoms.

No intra- or postoperative complications were observed in our study. At the 3-year review, all patients retained Snellen visual acuity of 6/9 or better.

Discussion

Trauma as an etiology for RCE accounts for the largest majority in published literature.^[1,3,15-17] This study reports on outcomes specific for RCE of traumatic origin. Nontraumatic etiology of RCE are heterogeneous groups of conditions, which could include corneal dystrophies (epithelial basement membrane dystrophy, lattice dystrophy), corneal degeneration (band keratopathy), dry eye syndrome, diabetes mellitus, meibomian gland dysfunction, and ocular rosacea.^[15]

Each of the nontraumatic condition has its own unique pathophysiology that can affect the efficacy of ADCE. For instance, in epithelial basement membrane dystrophy, there were redundant layers of the basement membrane preventing normal migration of deeper epithelial cells to the apical surface, leading to poor adherence of the corneal epithelium to the underlying stroma.^[18]

Patients with meibomian gland dysfunction and ocular rosacea had increase free fatty acids in their meibomian secretions, which was postulated to interfere with the cornea healing process.^[16]

In comparison, trauma causes disruption of the epithelial basement membrane and weakens the extracellular adhesion network at the level of the hemidesmosomes and can also result in defective junctional complexes.^[15,16]

The results of this study gain significance because it informs the management plan and consent process for patients with RCE specifically of traumatic origin.

A review by Ewald *et al.*^[19] suggested that although the basic history and underlying pathophysiology of RCEs have not changed, recent advances in the treatment of erosions have resulted in a lower recurrence rate and greater patient comfort.

There are a few advantages of ADCE. This technique does not ablate or damage Bowman's membrane (unlike the procedures of phototherapeutic keratectomy or stromal

puncture). Preservation of the Bowman's layer helps to prevent the accumulation of cellular and amorphous debris that could affect epithelial adhesion.^[20,21] It is also a simple and inexpensive procedure. The surgical procedure we used has been described by Dua *et al.*^[21] and Singh *et al.*^[22] but with minimal modification.

The efficacy of ADCE in reducing the symptoms of RCE has been previously reported to be as high as 87% (Singh *et al.*^[22]) and 91% (Dua *et al.*^[21]) with 20 patients and 12 patients in their cohorts, respectively. The follow-up period was shorter in both these reports (Singh *et al.*^[22] range of 12–38 months with a mean of 24 months and Dua *et al.*^[21] range of 6–40 months with a mean of 23.5 months). Our study reports outcomes at a minimum 3-year follow-up period, where all patients had a dramatic improvement in their symptoms and 88.5% of the eyes had no recurrences of RCE during a follow-up period of at least 3 years.

A recent study by Mhéalóid *et al.*^[23] analyzed results in 42 eyes with RCE treated with ADCE over a mean follow-up period of 12.8 months. They reported a higher recurrence rate of 26.2% occurring at an average of 10.4 months after the procedure. In their study, ADCE was offered after a trial of lubricants, bandage contact lenses, and oral tetracyclines with or without topical steroids. Trauma was the cause in only 52.4% of their cohort with the rest of the cohort of varied etiology. By grouping RCE of varied etiology into their cohort, the report underplays the significantly higher efficacy and safety of ADCE in RCE of traumatic origin. Pathophysiology of the RCE in nontraumatic causes is very different.^[24–26]

The higher success rates observed in our retrospective review when compared to the study by Mhéalóid *et al.*^[23] may be attributable to three factors. First, all patients in our cohort had RCE of traumatic etiology. Second, we may have offered alcohol delamination at an earlier stage after patients continue to be symptomatic despite maximal topical lubrication and/or extended wear contact lens. While there was no time frame reported, some patients in the study by Mhéalóid *et al.* also had other treatment such as oral matrix metalloproteinase inhibitors prior to surgery, which potentially could add on to the time from first clinic visit to undergoing alcohol delamination. Third, specific care was taken during the procedure of ADCE to prevent any damage to Bowman's membrane by the use of a cellulose sponge to remove the epithelium and ensured no sharp object such as a surgical knife/needle touched the cornea.

In terms of the safety profile of ADCE, in our cohort, at the 3-year review, no intra- or postoperative complications were observed. All patients retained Snellen visual acuity of 6/9 or better. Other studies have reported treatable minor postoperative complications such as transient subepithelial haze,^[22,27] unstable refractive error,^[22] herpetic disciform keratitis,^[22] and herpetic dendritic ulcer,^[21] which resolved eventually. ADCE is also an alternative to other surgical techniques described such as PTK and anterior stromal puncture.

Kampik *et al.*^[28] evaluated 17 eyes that underwent intraepithelial PTK and 13 eyes that underwent ADCE over a mean follow-up of 4.2 years. They noted a 15% recurrence overall in the ADCE group, which showed no statistically significant difference compared to intraepithelial PTK. A randomized-controlled trial^[27] compared the efficacy of

ADCE and PTK for the treatment of RCE. The recurrence rate was similar in both groups. At 24 months, it was found that the ADCE group had statistically significant improvement from baseline in pain score, which was not seen in the PTK group. The authors also suggested ADCE should be considered as an alternative treatment for the management of RCE with promising results compared with PTK. However, the procedure of PTK is more complex and consumes more resources.

Anterior stromal puncture creates fine scars, which then stimulates secure epithelial adhesion to the underlying stroma.^[29] It is a simple treatment that can be performed at a slit-lamp microscope. However, it is also recognized that such scarring may affect visual acuity if done near the visual axis. A high recurrence rate of 37.1% was reported in a recent study of 35 eyes over a median follow-up of 3 months.^[11]

There are a few limitations of our study. Although a 3-year outcome data is useful in the consent process, a longer period of follow-up is desirable. Other modalities of surgical treatment have not been compared. Pain scores were not used.

Conclusion

This study has demonstrated the long-term efficacy and safety of alcohol delamination of corneal epithelium for RCE of traumatic etiology. In the most common form of RCE (traumatic), the results of this study gain significance because it informs the management plan and the consent process.

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Conflicts of interest

There are no conflicts of interest.

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