

CLINICAL COMMUNICATION

Acute red eye (non-ulcerative keratitis) associated with mini-scleral contact lens wear for keratoconus

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Mini-scleral lenses are an increasingly popular contact lens modality; however, there are relatively few reports regarding the unique aspects of their fitting and potential complications. We report a complication of mini-scleral lens wear in a 44-year-old female patient using the lenses for keratoconus. Her mini-scleral contact lenses were non-fenestrated and fitted to vault over the cornea and seal at the periphery. The patient presented with an acute red eye (non-ulcerative keratitis), characterised by unilateral severe conjunctival and limbal hyperaemia, corneal infiltration and pain. Refitting the lens to increase the corneal vault clearance did not prevent recurrence of the keratitis, some five months later. Successful prevention of further episodes of the acute red eye was achieved through improved patient compliance with lens cleaning, disinfection and lens case procedures. Lens hygiene may be particularly important for mini-scleral lenses with a sealed fitting.

Key words: cornea, contact lenses, keratitis, keratoconus

Mini-scleral contact lenses combine the optical performance advantage of a gas-permeable lens material, together with the comfort and stability benefits of the larger lens diameter usually associated with a soft lens. Mini-scleral lenses use a standard gas-permeable material but with a total lens diameter of 13 to 18 mm.¹ The large diameter improves the stability of the fitting and improves lens comfort for the patient, as there is less lid interaction and lower lens movement.

Mini-scleral lenses can be prescribed for patients with irregular corneal topography, such as in keratoconus or following keratoplasty, to provide good vision where standard corneal gas-permeable lenses no longer provide a suitable fit. Mini-scleral lenses can also be used to form a 'liquid corneal bandage', for conditions where therapeutic contact lenses have a proven benefit, including ocular surface disease,² for pain relief in bullous keratopathy and recurrent erosions³ and to promote recovery in limbal stem cell disease.⁴

An acute red eye in contact lens wear was characterised in 1978 by Zantos and Holden,⁵ as a non-ulcerative keratitis, associated with acute ocular pain and marked conjunctival hyperaemia. Even earlier in 1973,

Dohlman, Boruchoff and Mobilia⁶ reported an acute non-infectious infiltrative keratitis requiring immediate cessation of lens wear. Since then, there have been many reported cases of acute red eye in contact lens wearers but to our knowledge, this complication has not been reported in association with mini-scleral lens wear.

An acute red eye is a potentially serious condition, since failure to remove the contact lens, or to stop lens wear following repeated episodes in the same patient, can lead to a more severe inflammatory reaction involving the anterior uvea, including aqueous flare and keratic precipitates.⁷ Ultimately, a sterile endophthalmitis with hypopyon formation can result and this has been reported in three cases of aphakic hydrogel extended wear.^{8,9}

This paper presents an acute red eye as a complication of mini-scleral lens daily wear for keratoconus.

CASE REPORT

A 44-year-old female patient with keratoconus presented with symptoms of a painful and red right eye. She normally wore mini-scleral contact lenses but had discontinued right lens wear since the onset of symptoms

late in the previous day. Vision of the right (unaided) eye was less than 6/120 with hand movements at three metres and left (with a contact lens) was 6/9.5. The patient was healthy in all other respects and was not diabetic or immuno-compromised.

Slitlamp examination showed severe (Grade 3.5+, Efron scale) bulbar conjunctival and limbal hyperaemia in the right eye (Figure 1), the superior eyelid was slightly swollen and the cornea showed three small (less than 0.5 mm) diffuse infiltrates positioned in the 2 o'clock to 4 o'clock position in the mid-peripheral cornea. There was no corneal ulceration and only minimal punctate corneal fluorescein staining. Other potential signs of corneal infection were absent, with no discharge and the anterior chamber was quiet.

Intraocular pressure and dilated fundus examination were normal. The left eye appeared normal. Management consisted of cessation of right contact lens wear, cold compresses and topical lubricants both four times daily (Refresh Celluvisc unit dose, Allergan, Irvine, CA, USA).¹⁰ An antibiotic was not prescribed, given the absence of an infective process or a significant epithelial defect. A mild steroid could have been prescribed to hasten symptomatic relief but

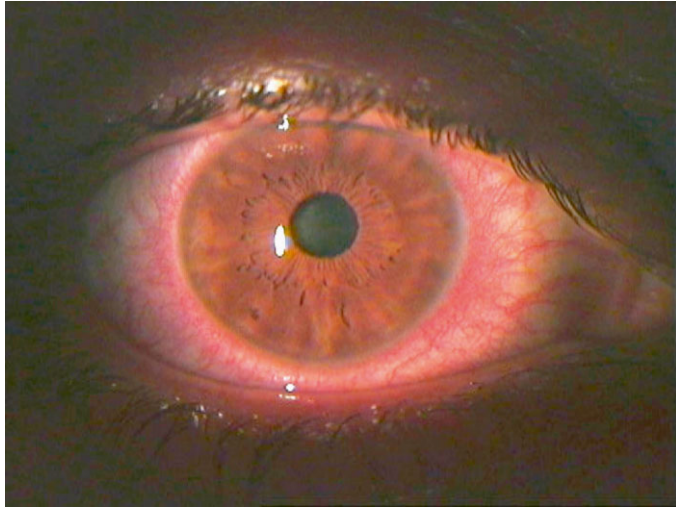


Figure 1. Acute red eye (non-ulcerative keratitis) associated with mini-scleral contact lens wear for keratoconus. The cornea showed trace diffuse infiltrates at about the 2 o'clock position in the mid-periphery but no significant corneal fluorescein staining.

was not considered necessary. The red eye resolved within two days and the patient was able to resume right contact lens wear. Vision at the next visit was 6/9.5 in the right eye, the same as before the event.

Once the acute red eye had resolved, an evaluation of the contact lenses was made to minimise the risk of recurrence. The patient was wearing Eyecon mini-scleral lenses (Capricornia Contact Lens, Brisbane, Qld, Australia) with the following parameters: R 7.2/16.0/-4.00 and L 6.8/16.0/-6.25 with a standard proprietary design for the periphery. She was using Boston Simplus multipurpose solution (Bausch & Lomb, Rochester, NY, USA) for disinfection and each morning one vial of Refresh Celluvisc was placed into each lens at insertion. The affected lens was two months old.

The fluorescein pattern fitting analysis showed light central touch in the right eye and corneal clearance in the left eye with the lens periphery resting over the sclera. Visante anterior optical coherence tomography (OCT) confirmed the light corneal touch and inadequate clearance in the right eye (Figure 2A). Corneal topography showed the bilateral keratoconus with a central nipple cone appearance, slightly greater in the left eye. The simulated keratometric readings were right: 5.95 mm @106, 6.40 mm @016 and left: 5.62 mm @098, 6.09 mm @008.

The right mini-scleral lens was refitted to increase the corneal clearance, to be similar to the left (unaffected) eye, by steepening the back optic zone radius. The parameters of the new right lens were 6.9/16.0/-6.00 with a standard periphery. The new steeper lens showed improved clearance and an increased tear film reservoir (Figure 2B), which was expected to help avoid recurrence by diluting any build-up of antigens or exotoxins. Proper lens maintenance was emphasised, including rubbing the lens for cleaning followed by saline rinsing of the lens.

At aftercare the new lens performed well, vision was 6/9.5 and the patient showed acceptable compliance with cleaning and rubbing her lenses with the Boston Simplus solution. In the meantime, the patient had consulted with an ophthalmologist, who confirmed that the eye had cleared satisfactorily and who agreed with the management.

There was a recurrence of the right acute red eye almost five months later. The patient presented with the same signs and symptoms as for the first episode. There was conjunctival hyperaemia, mild inferior corneal punctate staining and four small (less than 0.5 mm) infiltrates positioned in the 4 o'clock to 6 o'clock area of the cornea, about 1.0 to 2.0 mm from the limbus. There was no discharge, ulceration or anterior chamber reaction and intraocular pressures

were normal. Vision was 6/19 with a -6.50 D sphere (DS) spectacle lens. Management consisted of fluoromethalone 0.1 per cent four times daily (FML, Allergan) prescribed for one week, with cessation of contact lens wear, cold compresses four times daily and topical lubricants also four times daily (Systane, Alcon, Fort Worth, TX, USA).¹⁰ The steroid was prescribed as the keratitis was a recurrence. At the next aftercare visit, vision with the contact lens was R 6/9.5, the same as baseline.

Other risk factors were examined. The patient had been using Boston Simplus multipurpose solution but reported rubbing her lenses only every one to two weeks, rather than the recommended daily surface cleaning. The lens case was 'not clean and looking old' and replacement was advised. Solution hypersensitivity was considered unlikely, as the ocular reaction would be expected to be bilateral and every day rather than episodic. The risk of a hypersensitivity or toxicity reaction may be further minimised by ensuring the soaking solution is rinsed off the lens with saline and the lens is then filled with a fresh non-preserved unitdose solution prior to insertion.

An issue for the patient was that she felt highly dependent on her contact lenses due to the keratoconus. Average contact lens wearing time was 14 to 15 hours per day, as vision with her glasses did not meet her requirements.

Contact lens maintenance was identified as the most likely factor contributing to the recurrent acute red eye. A two-step system was prescribed for daily use, with Boston Advance Cleaner and Boston Advance Comfort Formula conditioning solution (Bausch & Lomb). Boston One Step Liquid Enzymatic Cleaner (Bausch & Lomb) was recommended for weekly protein removal. The patient was also directed to replace her contact lens case every month.

The patient was followed for a further 12 months, at six-month intervals. The infiltrative keratitis was not observed to recur at aftercare, although the patient did report two instances of milder hyperaemia that she was able to self-manage by ceasing lens wear and using cold compresses and lubricants. She also sometimes found her eyes were more comfortable, if the Celluvisc was replenished every four hours. Toward the end of the 12-month period, replacement of the left contact lens was recommended, as it was two years old and had started to cause irritation.

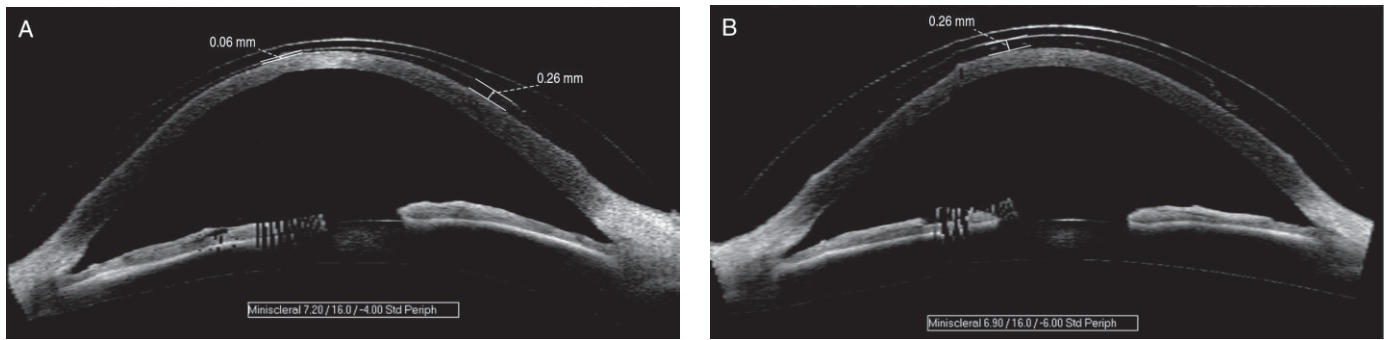


Figure 2. (A) Anterior-segment optical coherence tomography (OCT) scan showing the fitting relationship for the initial mini-scleral lens on the right eye. There is a relatively small degree of clearance between the lens and cornea. (B) Anterior-segment OCT scan showing the fitting relationship for the refitted mini-scleral lens on the right eye. The contact lens shows greater clearance from the cornea, compared to the original lens fitting.

DISCUSSION

There has been a resurgence of interest in recent years with larger diameter gas-permeable lenses for keratoconus and other causes of corneal irregularity.¹ Improvements in manufacturing of mini-scleral lenses, as well as advances in the fitting process using anterior-segment OCT¹¹ have combined to make fitting simpler and more predictable. While the corneal gas-permeable lenses remain the most common lens design for keratoconus, mini-scleral lenses appear to have progressed and are being prescribed more widely.

While mini-scleral lenses differ in lens design from standard corneal gas-permeable lenses, the same gas-permeable maintenance solutions are used in lens care. Boost, Cho and Lai¹² found current gas-permeable maintenance solutions, including Boston Simplus, to be effective disinfectants when evaluated against Food and Drug Administration criteria; however, there was a gradual reduction in efficacy over a 12-week period and storing of solutions in the refrigerator was not recommended. For *Acanthamoeba*, there have been conflicting reports on the efficacy of Boston Advance and Boston Simplus.^{13,14}

Patients may prefer a multipurpose gas-permeable solution like Boston Simplus compared to a two-step system with a separate surfactant cleaner, as the multipurpose solution is simpler to use.¹⁵ When Boston Simplus is used in accordance with manufacturer directions, it usually achieves adequate lens cleaning and maintains eye health.¹⁶ Nevertheless, if the patient is at risk for non-

compliance with lens maintenance, then the multipurpose system may have less margin for error. Conversely, it may be argued that a multipurpose system is easier to comply with, giving greater patient satisfaction. In any event, good clinical follow-up remains important.¹⁶

Whether the results on gas-permeable maintenance solutions are applicable to mini-scleral gas-permeable lenses with a sealed fitting is not yet established. With the sealed fitting, by design there is little or no tear film replenishment behind the lens. If there is any contamination of the lens case or lens prior to lens insertion, then the eye may be exposed for a considerable time. Holden and colleagues¹⁷ showed an acute red eye reaction may occur for soft lenses in less than eight hours of closed eye lens wear, if the lens is heavily contaminated with bacteria. This mechanism may help explain how an acute infiltrative keratitis could potentially occur with a sealed mini-scleral lens fitting if the lens is not clean.

The acute red eye is most often associated with soft contact lens extended wear.¹⁸ An acute non-ulcerative keratitis is a rare complication of gas-permeable lens daily wear¹⁹ and gas-permeable lens extended wear²⁰ and does not appear to have been reported previously in association with mini-scleral lenses.

Bacteria that cause an acute red eye reaction are adherent to the contact lens rather than colonising the ocular surface or eyelids, which is consistent with the observation that symptoms rapidly subside once the lens is removed.¹⁰ Both Gram-negative *Haemophilus influenzae* bacteria and Gram-positive *Strepto-*

coccus pneumoniae organisms have been isolated from the lenses of patients with acute red eye in extended wear.^{21,22} Other Gram-negative bacteria identified in lenses and solutions of patients with acute red eye are *Serratia marcescens* and *Pseudomonas aeruginosa*.¹⁷ The contact lens case is frequently contaminated and is also known to be associated with contamination of the lens itself.²³

In conclusion, we have reported the occurrence of an acute red eye (non-ulcerative keratitis) in association with mini-scleral contact lens wear. We found that having an adequate corneal clearance vault was not in itself sufficient to avoid recurrence of the keratitis. For this patient with keratoconus wearing mini-scleral contact lenses, improved compliance with lens cleaning, disinfection and lens case procedures proved more successful in avoiding recurrence of the acute red eye. Lens hygiene may be particularly important for mini-scleral lenses with a sealed fitting.

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