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Case series: Extended wear of rigid gas permeable scleral contact lenses for the treatment of persistent corneal epithelial defects

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ABSTRACT

Objectives: To report the successful treatment of persistent corneal epithelial defects that failed to respond to alternative treatment methods using extended wear of three different rigid gas-permeable scleral lenses.
Methods: Eight eyes of eight patients with persistent corneal epithelial defects were treated with Blanchard Onefit 2.0 Scleral lens, BostonSight Scleral lens, and BostonSight PROSE device and were observed for defect resolution and improvement in best-corrected visual acuity over the duration of treatment.
Results: All eyes observed complete re-epithelialization with a mean time of 11.1 ± 5.5 days. At the conclusion of the treatment, visual acuity improved in all but one patient. No complications were observed during treatment.
Conclusions: Scleral lenses provide the corneal epithelium with hydration, oxygen permeation, and protection from mechanical forces; thereby facilitating healing of persistent corneal epithelial defects. This case series demonstrates the successful use of continuous wear scleral lenses in a number of patients for the treatment of persistent epithelial defects refractory to other interventions.

1. Introduction

Proper corneal healing mechanisms are paramount to maintaining a healthy corneal epithelium against structural damage and infections. A persistent epithelial defect (PED) occurs when there is a failure in the normal healing mechanism of the corneal epithelium for greater than two weeks after therapeutic initiation in the setting of mechanical trauma, dryness, neurotrophic cornea, ultraviolet light exposure, limbal stem cell deficiency, and inflammatory conditions [1].

After a corneal insult, a series of events characterized by changes in tear composition and cellular remodeling initiate the process of epithelial wound healing, which typically occurs in 7–10 days [2]. The cascade of events in corneal epithelial wound healing consists of the latent, migration, proliferation, and epithelial reattachment phases [2]. If the corneal stroma is damaged, healing may take 8 weeks or more as epithelial cells adhere to its basement membrane, which itself is anchored to the underlying connective tissue [3,4]. Without proper treatment, a corneal epithelial defect may persist, causing discomfort and predispose patients to increased risks of infection, corneal thinning, and in severe cases perforation [5]. Common management options include lubrication, punctual plugs, bandage soft contact lenses (BCL), and tarsorrhaphy. In refractory and severe cases, amniotic membrane grafts (AMG), serum tears, gas-permeable scleral lenses, keratoplasty, and cyanoacrylate glue are utilized [6].

Prosthetic Replacement for the Ocular Surface Ecosystem (PROSE) devices and gas-permeable scleral lenses protect and aid in re-epithelialization of the corneal epithelium by establishing an environment that provides continuous hydration in the absence of mechanical shearing forces from eyelid movement by means of a tear filled scleral lens vault [7]. An early study by Rosenthal et al. reported that extended wear of BostonSight Scleral lenses in 13 patients was effective in promoting the healing of persistent epithelial defects in eyes that failed to respond to other treatment measures. With the exception of one patient who wore the lens continuously, extended wear in this study was interrupted by brief periods of removal once or twice during each 24 h period for cleaning [8]. A recent case series by He et al. of three patients who were treated with a combination of day and night-time wear of PROSE observed expedited defect resolution and improvement in vision after 2–4 weeks of treatment [5]. Patients were treated with night time wear only or continuous wear with the lens removed and cleaned every 12 h. Other devices such as the Blanchard Onefit 2.0 Scleral lens and BostonSight Scleral lens are similar in structure and are used in treating

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persistent epithelial defects.

The purpose of this review is to demonstrate the successful use of extended wear (both day and night) of three different scleral lenses in combination with amniotic membranes or serum tears in a number of patients with persistent epithelial defects that failed to respond to other therapeutic interventions. Furthermore, by reporting the treatment of persistent epithelial defects with Blanchard Onefit 2.0 lenses, another aim of this case series is to expand the types of scleral lenses as treatment options available to physicians and optometrists in treating this condition.

2. Patients and methods

This retrospective case series examined 8 eyes of 8 patients with persistent corneal epithelial defects refractory to other therapeutic measures or who developed epithelial defects after penetrating keratoplasty for persistent epithelial defects. All patients were referred and treated at the Cullen Eye Institute in the Department of Ophthalmology at Baylor College of Medicine from August 2017 to March 2018. Access and use of patient records was HIPAA compliant.

Patients 1–3 and 5–7 were fit with a Blanchard Onefit 2.0 Scleral Lens (Blanchard Contact Lens Inc., Manchester, USA). Patient 4 was fit with a BostonSight Scleral Lens (BostonSight, Needham, USA) and patient 8 was fit with a BostonSight Prosthetic Replacement of Ocular Surface Ecosystem (PROSE) (BostonSight, Needham, USA), Table 1. Extended wear of scleral lenses was classified as periods of continuous wear for 48 h or more without removing the lens. During treatment in this case series, all patients wore scleral lenses continuously for a minimum of 72 h. Lenses were inserted and removed by licensed optometrists and patients were examined daily for the first 48 h immediately following placement. Patient 1 and 4 wore the scleral lens continuously for 14 and 10 days, respectively. Lenses were removed in clinic at selected follow-up visits and corneas were examined under slit-lamp examination in combination with fluorescein staining for resolving epithelial defects.

After removal in clinic, the scleral lenses were thoroughly cleaned with Optimum (Lobob Laboratories, San Jose, USA) and rinsed with PuriLens Plus (The Lifestyle Company, Freehold, USA) preservative free sterile saline. Some patients received one drop of Vigamox 0.5% (Alcon Laboratories, Fort Worth, USA), autologous serum tears, Ambio2 amniotic membrane allograft (IOP Ophthalmics, Costa Mesa, USA), Refresh Celluvisc (Allergan, Dublin, Republic of Ireland) or a combination of the four in the scleral reservoir, which was topped-off with PuriLens Plus (The Lifestyle Company, Freehold, USA) or AddiPak (Teleflex, Wayne, USA) preservative free saline immediately before insertion of the lens, Table 2. During placement, it was ensured that no air was present underneath the scleral lens. The size of the fluorescein-stained persistent corneal epithelial defect was measured by slit-lamp examination during each visit. The central vault was measured by slit-lamp estimation and by ocular coherence tomography (OCT) (Optovue, Freemont, USA).

Table 2
Additions to Scleral Lens Reservoir.

Patient	Vigamox 0.5%	Celluvisc	Serum tears	Amniotic membrane graft
1	—	—	—	2
2	—	—	—	1
3	—	—	—	2
4	1 gt	2 gtt[a]	1 gt	1
5	1 gt	2 gtt	—	—
6	1 gt	2 gtt	—	1
7	—	—	—	1
8	—	—	—	—

[a] Drops.

3. Results

Patient specific information on diagnoses, prior outcomes, and defect size are listed in Table 3. Patients with persistent epithelial defects were previously treated with amniotic membrane grafts (7 eyes), tarsorrhaphy (2 eyes), bandage soft contact lenses (3 eyes), penetrating keratoplasty (4 eyes), limbal stem cell transplants (2 eyes), and artificial lubrication (all eyes). The mean duration of persistent epithelial defects prior to initiation of scleral lens treatment was 79.5 ± 27.7 days. The persistent epithelial defects of all 8 patients in this study re-epithelialized after extended wear of rigid gas-permeable scleral lenses.

The two youngest patients in this case series developed persistent corneal epithelial defects secondary to neurotrophic corneas from Beçhet's syndrome and trauma. The mean age of patients treated was 65.6 ± 6.9 years. Patient 2 developed a 3.0 x 7.0 mm persistent corneal epithelial defect from a neurotrophic cornea secondary to herpes simplex keratitis and observed 21 days to re-epithelialization after which the patient was switched to day time lens wear with serum tears at night-time. Patient 2 also experienced the greatest improvement in uncorrected vision from 20/400 to 20/25 after scleral lens treatment. Conversely, patient 3 developed a 4.0 x 5.0 mm defect secondary to a neurotrophic cornea that healed in 9 days. Patient 7 developed corneal thinning and an epithelial bullae and patient 8 developed corneal scarring as post-treatment complications. After initial successful treatment with extended scleral lens wear in this series, patient 4 re-developed a persistent epithelial defect. The re-development of patient 4's persistent epithelial defect was attributed to ceasing scleral lens use at the conclusion of his treatment and not continuing with day-time lens wear. There were no reported cases of microbial keratitis or corneal perforations as complications. The range of time to resolution was 5–21 days, and mean days to resolution was 11.1 ± 5.5 days, Table 4. Healing times for patient 4, 5, and 6 are represented in Fig. 1.

4. Selected case reports

PATIENT 2: This 80-year-old man underwent cataract extraction in his right eye and developed a corneal epithelial defect after medication toxicity superimposed with ocular surface disease. The epithelial defect

Table 1
Scleral Lens Specifications After Fitting.

Patient	Brand	Lens Material	Dk	Central Thickness (mm)	Base curve (mm)	Diameter (mm)	Central Clearance (μm)
1	Onefit 2.0[a]	Contamac Optimum Extra	100	0.2	7.6	14.9	~572
2	Onefit 2.0	Contamac Optimum Extra	100	0.24	8.2	14.9	~100
3	Onefit 2.0	Contamac Optimum Extra	100	0.25	8.4	15.2	~300
4	BostonSight Scleral	Contamac Optimum	100	0.22	2.8[b]	18.5	~250
5	Onefit 2.0	Contamac Optimum Extra	100	0.23	7.7	15.2	~300
6	Onefit 2.0	Contamac Optimum Extra	100	0.25	7.5	15.2	~300
7	Onefit 2.0	Contamac Optimum Extra	100	0.25	7.7	15.2	~250
8	BostonSight PROSE	Boston Equalens II	85	0.22	8.0	18.5	~250

[a] Blanchard Onefit 2.0 Scleral lens.
[b] SAG – sagittal depth.

Table 3
Patient Profiles Prior to Extended Scleral Lens Fitting for Persistent Epithelial Defect.

Patient	Age (years)	Sex	Eye	Primary Diagnosis	PED Duration (days)	PED Dimensions (mm)	PKP	Prior Treatment(s)[a]
1	61	M	OD	Fungal Keratitis	57	4.5 × 3.5	No	1(2),2,7,8
2	80	M	OD	Herpes Simplex Drop Toxicity	47	3.0 × 7.0	No	1,3,7,8
3	34	M	OS	Beçhet's Disease Neurotrophic Keratitis	140	4.0 × 5.0	Yes	1(2),3,4,7,8
4	72	M	OS	Herpes Simplex Neurotrophic Keratitis	84	2.5 × 2.5	Yes	1,4(2),5,6,7
5	76	F	OS	Sjogren's Syndrome, Cataract Extraction Sequela	14	1.7 × 2.6	Yes	4(2),7,8
6	87	F	OS	Cataract Extraction Sequela Neurotrophic Keratitis	20	1.5 × 3.1	No	1,7,8
7	38	M	OD	Trauma	245[b]	2.0 × 2.0	Yes	1(2),2,3,4(4),5,6,7,8
8	77	F	OD	Cataract Extraction Sequela	29	1.0 × 3.5	No	7,8

PED – persistent epithelial defect, PKP – penetrating keratoplasty.
[a] (1) amniotic membrane graft, (2) tarsorrhaphy, (3) bandage contact lens, (4) penetrating keratoplasty, (5) limbal stem cell transplant, (6) autologous serum tears, (7) copious lubrication, (8) topical antibiotics.
[b] Patient 7 was treated extensively outside of the United States with autologous serum eye drops, lubricant eye drops, bandage contact lenses, multiple PKPs, and keratolimbal allograft transplantation (KLAT) prior to treatment at the Cullen Eye Institute at Baylor College of Medicine.

Table 4
Patient Outcomes After Extended Scleral Lens Wear.

Patient	Defect Healed	Days to Epithelial Defect Resolution	Post Treatment Complications	Pre-treatment Visual acuity[b]	Post-treatment Visual acuity[b]
1	Yes	16	—	HM	20/200 (20/80[a])
2	Yes	21	—	20/400	20/25
3	Yes	9	—	HM	20/70
4	Yes	15	PED Recurrence	CF at 2'	CF at 2'
5	Yes	12	Corneal Scarring	20/400	20/50
6	Yes	7	—	20/200	20/50
7	Yes	4	Severe Corneal Thinning	20/400 (20/200[a])	20/200
8	Yes	5	Corneal Scarring	20/100[a]	20/50[a]

CF – counts fingers.
[a] CC – corrected, HM – hand motion.
[b] Uncorrected visual acuity using Snellen's Chart.

was 3.0 x 7.0 mm and uncorrected visual acuity in the right eye was 20/400 + 2. He was placed in a bandage soft contact lens for 6 days with no resolution of symptoms and transitioned to a rigid gas-permeable scleral lens. After one week of continuous wear, the epithelial defect was still present (3.8 x 2.3 mm) and an Ambio2 amniotic membrane allograft was placed under the scleral lens. The amniotic membrane graft is visualized on an OCT taken on day 15 of treatment, Fig. 3 (C). Twenty-one days after initiation of extended scleral lens wear, the epithelial defect resolved and the patient was transitioned to day time scleral lens use. Uncorrected visual acuity was 20/40 in the right eye. Resolution of the persistent epithelial defect with a Blanchard Onefit 2.0 lens is shown in Fig. 2.

PATIENT 4: This is a 72-year-old male who developed a non-healing epithelial defect in 2012 secondary to a neurotrophic cornea as a result of herpes simplex keratitis. Past history was notable for penetrating keratoplasty in 2004 for corneal scarring that was complicated by pseudomonas keratitis and resulting re-scarring. Subsequently, the patient underwent a second penetrating keratoplasty in 2013. The patient experienced several corneal epithelial defects that resolved with amniotic membrane grafts, bandage soft contact lenses, and serum tears over the following years. However, in 2017 the patient developed a 2.5 x 2.5 mm persistent epithelial defect in the left eye that was refractory to a 50% tarsorrhaphy, limbal stem cell transplant, and amniotic membrane graft placement. The patient was placed in a BostonSight Scleral lens with an Ambio2 amniotic membrane allograft, 1 drop of Vigamox 0.5%, 1 drop of autologous-serum tears, and topped off with Refresh Celluvisc in the reservoir. The longest time of continuous wear was for 10 days. Following the resolution of the defect, the patient did not continue day time wear of the lens. One month after the conclusion of treatment, the patient re-developed a persistent corneal epithelial defect. Fig. 1 illustrates healing time in relation to epithelial defect size.

PATIENT 7: This man suffered a fireworks injury in 1999, severely injuring both eyes. The patient underwent a series of bilateral retinal detachment repairs, right eye tube-shunt placement for glaucoma, and was affected by persistent corneal epithelial defects since the initial injury. Prior to his referral, the patient was extensively treated outside of the United States. The patient underwent four penetrating keratoplasties in the right eye and after his most recent transplant, developed a 2.0 x 2.0 mm persistent epithelial defect that was refractory to autologous-serum eye drops, lubricant eye drops, bandage contact lenses, two amniotic membrane grafts, as well as a limbal stem cell transplant. Prior to initiating treatment, vision in the right eye was 20/400 uncorrected, and 20/200 corrected. The patient was placed in a Blanchard Onefit 2.0 scleral lens with an Ambio2 amniotic membrane allograft placed in the reservoir and topped off with PuriLens Plus preservative free solution. After continuous wear for 4 days, the epithelial defect resolved and uncorrected visual acuity was 20/200. Given his neurotrophic corneas and corneal thinning, he was fit in an EyePrintPRO device for long term daily wear and did not have a recurrence of the epithelial defect.

5. Discussion

Previous retrospective case series have demonstrated accelerated healing of persistent epithelial defects in patients that previously failed to respond to other treatment methods while using scleral lenses [5,8]. This case series further reports that extended wear of three different types of rigid gas-permeable scleral lenses with additives such as amniotic membranes and serum tears can potentially enhance the healing of persistent epithelial defects. In this study, no patient was on systemic medications during the duration of treatment and the decision to use topical antibiotics, celluvisc, and amniotic membrane was a decision made by the ophthalmologist and optometrist on a patient by patient basis. Furthermore, the selection of lenses and brands was at the discretion of the treating ophthalmologist and optometrist.

Favorable results after initiating extended wear of scleral lenses can be attributed to the unique design and features that scleral lenses provide to the cornea, Table 5. The scleral lens design offers an

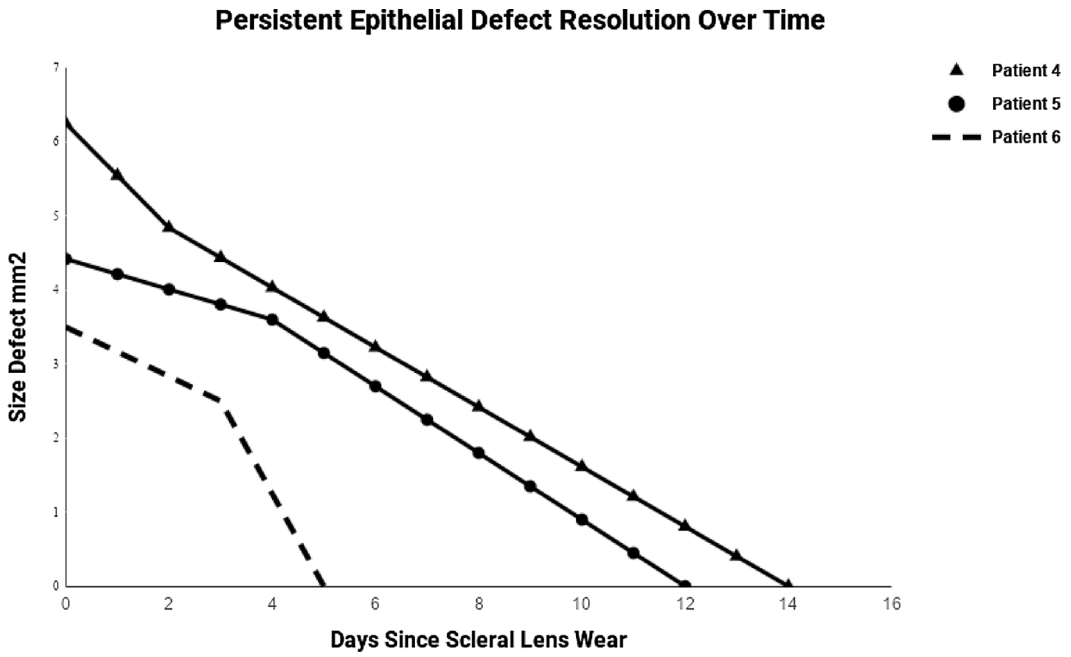

Fig. 1. Each line represents a patient in the case series and shows the resolution of epithelial defects after initiating extended wear of scleral contact lenses. Patients with larger defects, patient 4 and 5, observed longer healing times as compared to Patient 6. All three patients were treated with Vigamox 0.5%. In addition, patient 4 received serum tears and an AMG, and patient 6 received an AMG in the scleral lens reservoir.

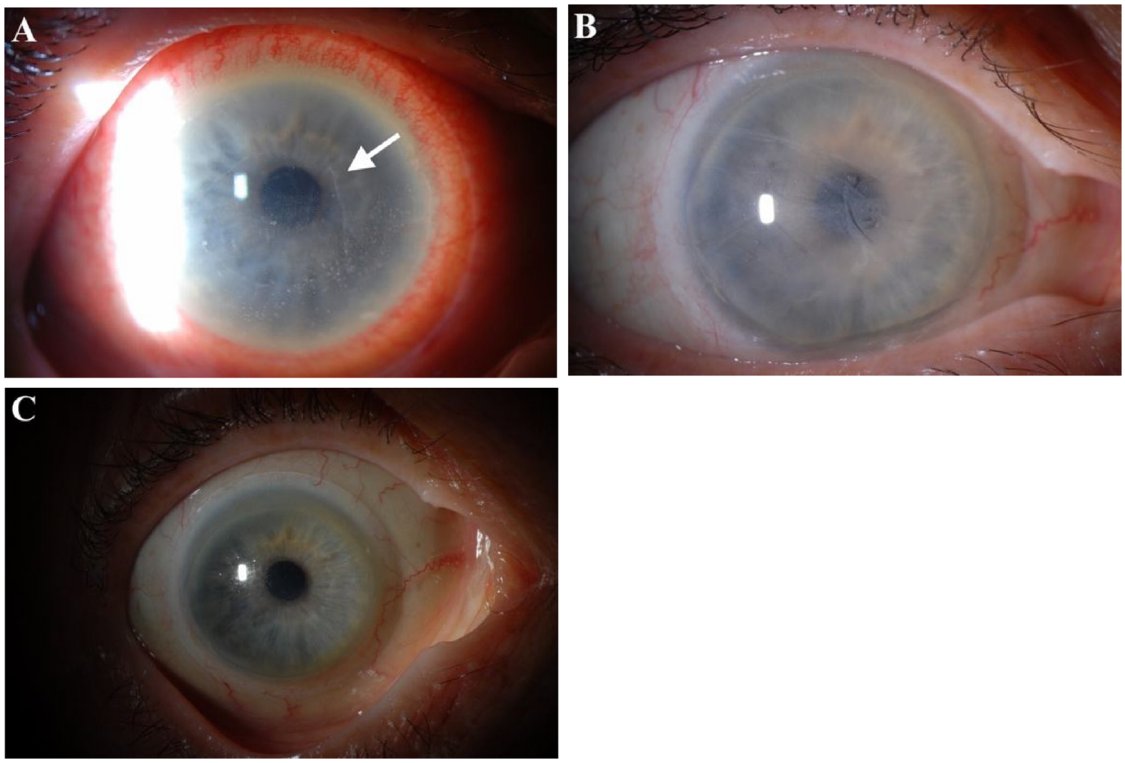

Fig. 2. Right eye, anterior view of the persistent epithelial defect with a Blanchard Onefit 2.0 lens from the patient 2, in which PuriLens Plus was used in the reservoir. Patient was followed on (A) day 1 (baseline) with the arrow indicating the leading edge of the persistent epithelial defect, (B) day 9 with amniotic graft in place and achieved complete re-epithelialization by (C) day 21.

advantage that closely mimics that of a physiologically normal corneal surface, providing an environment with minimal abrasion and a constant tear film over the cornea. By creating a vault over the cornea, scleral lenses are able to provide the cornea with an abrasion-free environment, a constant aqueous interface, and an oxygen permeable micro-environment [8]. The combination of these three factors allow for the corneal epithelium to successfully migrate, adhere, and proliferate over the persistent epithelial defect. However, factors such as increased central thickness and low permeability (Dk) of the lens combined with increased central clearance of the scleral lens vault can prevent adequate oxygenation of the cornea [9,10]. Michaud et al. calculated that scleral lenses with Dk values greater than 150, a

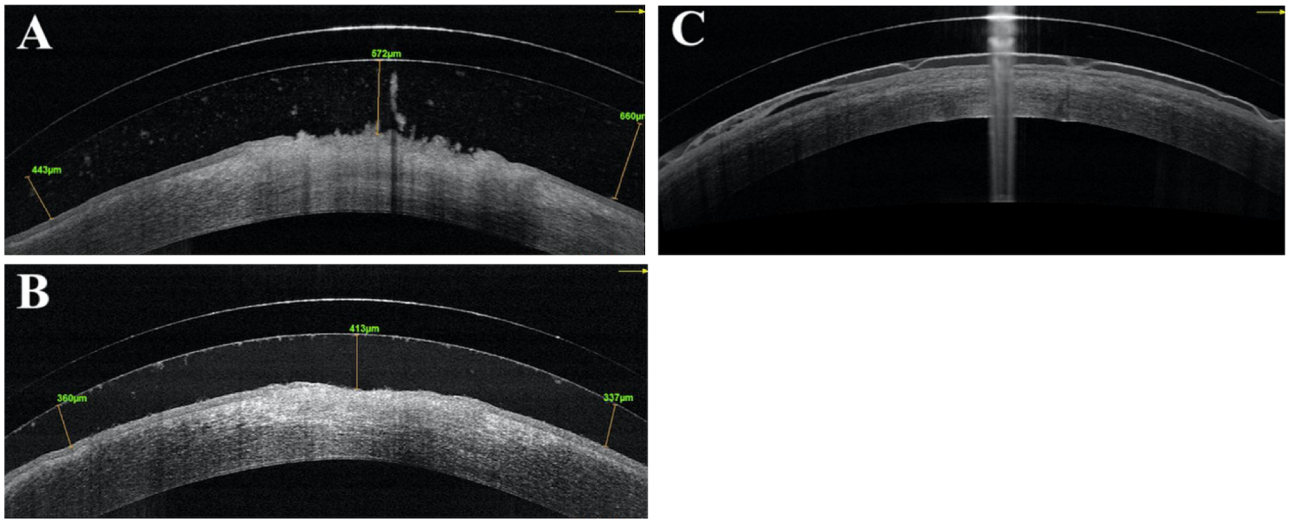

Fig. 3. Ocular coherence tomography (OCT) of patient 1 on day 1 (A) showing the persistent epithelial defect immediately after placement of the Blanchard Onefit 2.0 scleral lens and after complete re-epithelialization day 16 (B). The Ambio2 amniotic membrane allograft is clearly seen in the scleral lens vault of patient 2 on (C) day 15, one day before complete re-epithelialization.

Table 5
Characteristics of Therapeutic Interventions for Persistent Epithelial Defects[a].

	Fluid reservoir	Hydration of corneal epithelium	Friction to corneal epithelium	O_2 exposure to corneal epithelium
Gas permeable scleral contact lens	Yes	Yes	No	[b]
Bandage soft contact lens	No	Reduced	Lens	Reduced
Eyelid patching	No	Reduced	Eyelid	Reduced
Tarsorrhaphy	No	Yes	Eyelid	Reduced[c]
Amniotic membrane grafting	No	Reduced	No	[b]

[a] Adopted from Rosenthal et al. [8].
[b] Slight reduction in oxygen delivery.
[c] Increased oxygen partial pressures with partial tarsorrhaphy.

maximal central thickness of 250 µm, and a central vault clearance that does not exceed 200 µm would allow for the greatest permeability of oxygen. Furthermore, any medications or grafts introduced in the scleral lens vault that increase the viscosity of the reservoir can decrease oxygen permeation to the corneal surface. Lastly, another consideration is that during night-time wear the partial pressure of oxygen is reduced secondary to eye lid closure during sleep, thereby reducing the oxygenation of the fluid reservoir [11]. In this study, an attempt was made to optimize the fit of the lenses and devices; however, given the urgency of the conditions being treated, adjusting Dk values, central vault clearance, and central lens thickness in the clinic setting was not possible.

In this case series patients 1–3 and 5–7 were placed in a Blanchard Onefit 2.0 scleral lens, patient 4 in a BostonSight Scleral lens, and patient 8 in a BostonSight PROSE device. Patients were examined daily for the first 48 h to monitor the size of the defect. Though different brands, these lenses achieve the same therapeutic effect by utilizing a rigid gas-permeable scleral lens that provides the cornea with an aqueous reservoir devoid of mechanical shearing forces. Factors that influence the volume and height of the scleral lens vault include the base and peripheral curve, sagittal depth, lens diameter, lens design, and settling [12]. Preservative-free medications and amniotic membrane grafts can be also introduced into the scleral lens vault.

Mean time to complete re-epithelialization in this case series was 11.1 ± 5.5 days, faster than other studies reported in the literature [5,7,8]. This improved healing time may be attributable to the placement of amniotic membranes in the lens reservoir. Further comprehensive prospective randomized studies will be needed to adequately determine the efficacy of placing amniotic membranes in scleral lens reservoirs in comparison to extended scleral wear without amniotic membranes. Time to healing was also thought to be associated with the size of the initial epithelial defect. Patients 6 presented with a 4.65 mm^2, patient 7 with a 4.0 mm^2, and patient 8 with a 3.5 mm^2 persistent epithelial defect. These three patients observed healing times of 7, 4, and 5 days, respectively. Conversely, patient 2 presented with a defect size of 21.0 mm^2 and underwent treatment for 21 days before resolution of his defect. It was hypothesised that larger defects result in defective corneal epithelium and exposed stroma that may be more sensitive to the inflammatory cytokines and the hypoxic stress of scleral lens wear, lengthening the time to recovery. Additional factors such as limbal stem cell deficiency, reduced endothelial cell density, and exposed stroma retard centripetal migration and subsequent adherence of the corneal epithelial cells to the defective areas [13,14].

Patient 1 was treated continuously for 14 days with an Ambio2 amniotic membrane allograft in the scleral lens vault after which the corneal epithelium had healed. It was hypothesised that extended wear may offer an advantage over day- or night-time wear since intermittent removal and repetitive eye lid closure may prematurely shear the newly re-epithelialized corneal epithelium, thereby lengthening the time to recovery. Furthermore, immediate removal of scleral lenses at re-epithelialization may prematurely shear off the corneal epithelium prior to its firm adherence to the corneal stroma. Therefore, there may be an advantage to lengthening treatment by 24 h to prolong re-epithelialization time and reduce the risk of epithelial shearing. Risks of potential complications, as seen in other studies, such as microbial keratitis can be decreased by the placement of topical antibiotics in the scleral lens reservoir and converting patients to daily wear 24 h after re-epithelialization occurs [8]. Placement of an amniotic membrane may facilitate the formation of a gel plug within the scleral lens reservoir; thereby decreasing the amount of fluid turnover and allowing for maximum interaction of pro-healing agents such as epithelial growth factor (EGF) and transforming growth factor β-1 (TFG-β1) with the defective corneal tissue [15].

The optimal time for extended wear in patients with persistent epithelial defects lacks a collective consensus. This case series observed

a mean time of 11.1 ± 5.5 days to complete re-epithelialization suggesting that extended wear beyond 24 h without daily lens removal for cleaning may be required to achieve rapid corneal re-epithelialization. All patients in this case series achieved full re-epithelialization and 7 of the 8 patients in this series observed a significant improvement in their visual acuity. Patient 4 did not observe an improvement in visual acuity after treatment, likely due to the persistent epithelial defect being present for 84 days prior to treatment and the resultant scarring. Following treatment, patient 4 re-developed a persistent epithelial defect. In this patient with underlying neurotrophic keratitis, re-formation of the epithelial defect likely developed in the post-treatment period because the patient did not continue with day- or night-time scleral lens wear. Following treatment, continuing daily scleral lens wear is often advised to maintain the newly formed corneal epithelium in the setting of chronic conditions that would otherwise break it down, often resulting in the re-formation of a persistent epithelial defect. In certain circumstances, patients are unable to continue post-treatment lens wear because of insurance and cost related reasons. Despite wearing the BostonSight Scleral lens continuously for 10 days with Vigamox 0.5%, serum tears, and an Ambio2 amniotic membrane allograft in the lens reservoir, re-formation of the persistent epithelial defect in patient 4 occurred after cessation of extended lens wear. This case illustrates that in severe neurotrophic corneal diseases, although use of extended wear gas-permeable scleral lenses might treat the persistent epithelial defect, long term therapy with the contact lens is still needed to prevent recurrence of the defect.

Composition of the fluid in the scleral lens reservoir during periods of extended wear warrants further studies to characterize and optimize the make-up of the aqueous fluid to better promote healing. The incorporation of autologous serum drops and experimental factors such as fibronectin, thymosin-β-4 (Tβ4), and Nexagon (CoDa Therapeutics, San Diego, USA) may augment the healing effects provided by scleral lenses. Autologous serum tears contain growth factors, vitamins, immunoglobulins and neuropeptides that help regulate the proliferation, migration, and differentiation of cells to the corneal epithelium [16]. Thymosin-β-4, an active peptide in all cells, can promote the migration of cells, cause angiogenesis, maturation of stem cells and increase the survival of various cell types by down regulating pro-inflammatory cytokines [17,18]. Dunn et al. observed that 6 out of 9 patients diagnosed with neurotrophic corneal defects showed dramatic healing without significant neovascularization when treated with sterile Tβ4 eye drops [19]. Nexagon, a natural anti-sense oligonucleotide gel that will soon begin phase 3 clinical trials, decreases connexin43 expression levels and dampens the propagation of inflammatory signals through a mechanism called gap junction channel modulation. Agents that can expedite the re-epithelialization of the corneal epithelium in conjunction with scleral lens wear may offer advantages by potentially reducing wear time and lower the risks associated with prolonged wear, such as microbial keratitis. Long-term, prospective, randomized-control studies will be required to determine the efficacy and safety profile of these agents in the treatment of persistent corneal epithelial defects.

The development and persistence of corneal epithelial defects can present with unique challenges and can affect the patients' quality of life. Patients with anatomic defects, underlying chronic inflammatory conditions and inherited diseases require that the underlying cause be treated in conjunction with the initial treatment of persistent epithelial defects to maintain a healthy corneal epithelium and prevent recurrence of the PED. Scleral lenses provide a treatment alternative for new and refractory cases of persistent epithelial defects through the establishment of a corneal vault, allowing for addition of medications and amniotic membranes to aid in healing. In this case series, patients wearing extended wear scleral lenses observed expedited healing times and no complications during treatment. Further long-term studies are needed to better evaluate the optimal rigid gas-permeable scleral lenses, length of treatments, and the continuation of scleral lens wear after the healing of persistent epithelial defects.

Declarations of interest

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