

Visual Rehabilitation with New-Age Rigid Gas-Permeable Scleral Contact Lenses—A Case Series

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Abstract

Introduction: Primary ectatic corneal diseases usually require rigid gas-permeable (RGP) corneal contact lens wear for visual rehabilitation. As the disease progresses, it becomes increasingly difficult to fit these lenses. RGP scleral contact lenses now provide another treatment option before resorting to surgery. **Clinical Picture:** Two patients with pellucid marginal degeneration and one with advanced keratoconus had failed treatment with conventional lenses. **Treatment:** They were fitted with RGP scleral lenses. **Outcome:** Good vision was obtained together with satisfactory fit and comfort. **Conclusion:** RGP scleral lenses are a viable alternative to surgery in the visual rehabilitation of patients with advanced ectatic corneal disorders.

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Key words: Keratoconus, Optic zone projection, Pellucid marginal degeneration, Rigid gas-permeable material, Scleral zone radius

Introduction

Advanced primary corneal ectasia presents a difficult problem in terms of visual rehabilitation. Soft contact lenses do not address the astigmatic aberrations in these conditions and conventional rigid gas-permeable (RGP) corneal contact lenses though useful in less severe disease, are poorly tolerated by those with progressively worsening keratoconus and peripheral ectasia such as pellucid marginal degeneration. Rigid gas-permeable scleral lenses, which cover the entire corneal surface including the adjacent sclera (Fig. 1), now enable restoration of vision for this group of patients who would otherwise require corneal transplantation. Tan et al^{1,2} who conducted comprehensive retrospective analyses of scleral lens applications showed that these scleral lenses can also be used to improve vision in aphakia, irregular astigmatism due to a variety of causes, post-keratoplasty, high myopia as well as therapeutically in ocular surface disorders such as Steven Johnson syndrome, ocular cicatricial pemphigoid and neurotrophic keratitis. A larger series by Pullum et al³ 2 years later showed similar indications for scleral lens wear. We review the successful use of scleral contact lenses in the visual rehabilitation of 2 patients with pellucid marginal degeneration and 1 patient with keratoconus.

Clinical Picture

Case 1

A 40-year-old Malay woman was diagnosed to have bilateral pellucid marginal degeneration worse in the right eye (Figs. 2a to 2c). Unaided vision in the right eye was counting fingers at 1 m. Fitting of a rigid corneal lens for the right eye was difficult in view of the inferior protrusion of the cornea causing centration and stability problems and was thus unsuccessful.

Case 2

A 29-year-old Indian woman with bilateral keratoconus was previously wearing Softperm lenses (Bausch & Lomb) in both eyes. These were hybrid lenses with a RGP material in the centre and a soft hydrogel material in the periphery to increase comfort during lens wear. The Softperm lenses were due for replacement but unfortunately was no longer in production.

Case 3

A 41-year-old man from Seychelles had worn RGP lenses for bilateral keratoconus for many years. He was referred to the centre when he subsequently became

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Fig. 1. 1: soft contact lens; 2: rigid gas-permeable corneal contact lens; 3: gas-permeable scleral contact lens.

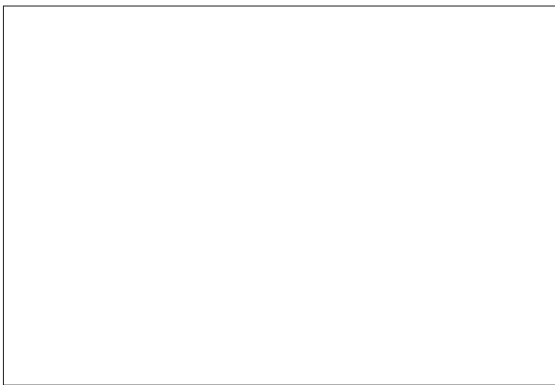


Fig. 2a. Pellucid marginal degeneration – slit view.

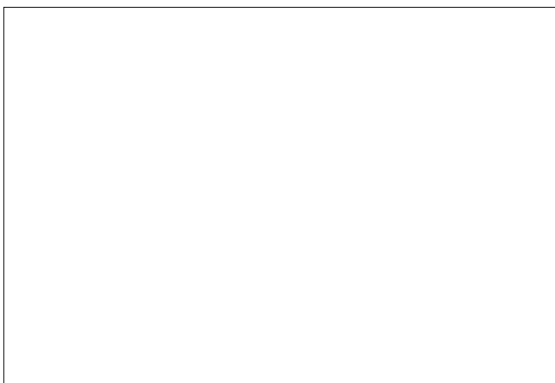


Fig. 2b. Pellucid marginal degeneration – side view.

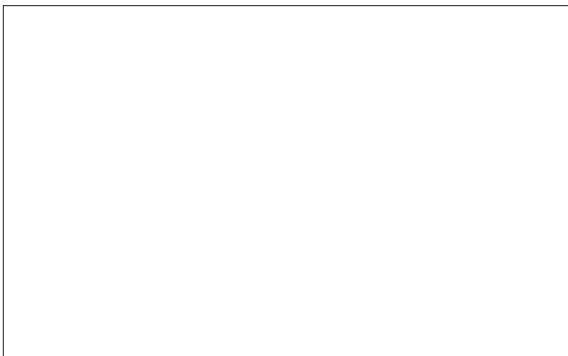


Fig. 2c. Corneal topography (case 1).



Fig. 3a. Good scleral lens fit.



Fig. 3b. Fit checked with fluorescein and cobalt blue light showing corneal and limbal clearance.

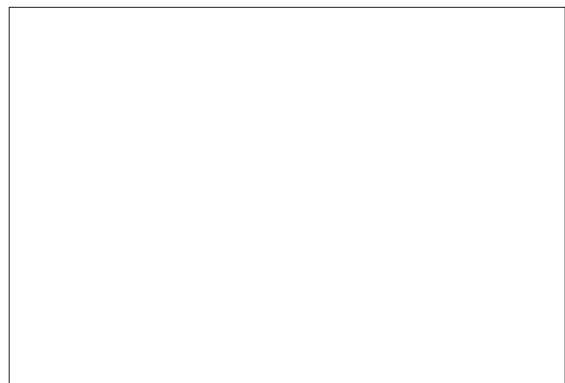


Fig. 3c. Scleral zone alignment with absence of scleral blanching.

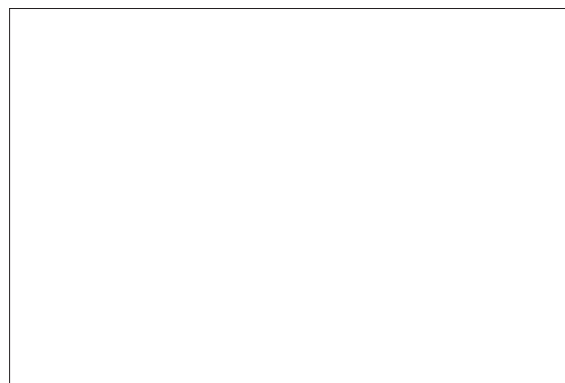


Fig. 3d. Corneal topography – left eye (case 2).

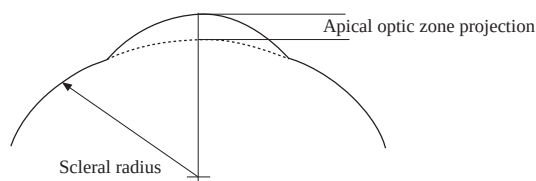


Fig. 4. Defining parameters of scleral lenses.

intolerant of contact lens wear. Examination showed that the corneal ectasia was more consistent with the diagnosis of pellucid marginal degeneration. Unaided right visual acuity was counting fingers at 4 m and in the left eye visual acuity was 6/30. His current right RGP contact lens resulted in significant inferior edge lift and bearing on the inferior cornea causing staining defects on the cornea. The left contact lens also showed some inferior edge lift.

Treatment and Outcome

Case 1

The right eye was subsequently fitted with a gas-permeable scleral lens (N5, 7.85 base curve, -1.25 sphere, 13.50 mm scleral radius). The over-refraction was plano/-1.75DC x 145°:6/7.5. Without the cylindrical correction, visual acuity was 6/12. The fit was good and no scleral blanching was observed. She was able to tolerate the lens for the entire day.

Case 2

As the patient was intolerant to the discomfort associated with rigid corneal lens wear, she was fitted with gas-permeable scleral lenses. Success was achieved with an N4 (8.04 base curve, -0.25 sphere, 13.50 mm scleral radius) scleral lens in the left eye which gave a high level of comfort as well as good visual acuity of 6/12 (Figs. 3a to 3d). With additional -2.25 DC x 60°, visual acuity was 6/6. She could wear the lens for the entire day without discomfort. The right eye was fitted with a F4 (8.27 base curve, -0.25 sphere, 14.50 mm scleral radius) scleral lens which gave 6/9 vision. Over-refraction was +0.50DS/-0.50 DC x 140°:6/6. She was able to wear the lens comfortably for the whole day.

Case 3

The patient was fitted with an F7 (7.51 base curve, -3.75 sphere, 14.50 mm scleral radius) scleral lens in the right eye and a N2 (8.92 base curve, -1.75 sphere, 13.50 mm scleral radius) lens in the left eye. This allowed 6/9 vision in both eyes. The fit was good and he was able to wear the contact lens comfortably for the entire day.

Discussion

Scleral contact lenses have been around for over a century.⁴ The first-generation scleral lenses were made of non-gas permeable materials such as glass and later,

polymethylmethacrylate.¹ Severe corneal hypoxia resulted from prolonged wear and paved the way for fenestrated designs. However, other problems associated with such a design such as bubbles forming under the lens surfaced soon after. With the advent of RGP corneal contact lenses in the 1950s, scleral lenses soon declined in popularity. The introduction of RGP material in the manufacture of these lenses, however, has enabled a comeback of these scleral lenses. Various authors have also reported success with the use of gas-permeable scleral lenses in the treatment of diseased corneas as well as ocular surface disorders.⁵⁻⁷

In our experience with pellucid marginal degeneration, we find that corneal transplantation is often not the best solution as the ectatic deformity tends to be peripheral as in cases 1 and 3. This makes the surgery technically difficult and also increases the risk of graft rejection. The situation is similar in patients with keratoconus when their ectasia is more peripheral (case 2). The more centrally-located cones have a much higher chance of success with corneal transplantation. Our results confirm that scleral lenses can provide an alternative route for those patients who may not do well with surgical management. All 3 patients in our study had little difficulty putting on these lenses, achieved clear vision (6/12 or better), a high level of comfort and were able to wear the lenses for the entire day.

The good results were, in large part, due to the excellent design of these scleral lenses. Because of the gas-permeable lens material which allows greater corneal oxygenation, a sealed design is made possible and this has the advantage of removing air bubbles and the settling back of the lens that occurs with fenestrated polymethylmethacrylate lenses.⁸ This translates into less visual disturbances, corneal dehydration and occlusion of limbal vessels. In the same vein, by retaining a pre-corneal fluid reservoir, the sealed design also allows the lens to be fitted clear of the cornea regardless of the corneal distortion. Additionally, greater comfort is achieved as the lid does not encounter the lens edge. The lids also help to keep the lenses in place. The disadvantage of these lenses is that with the gas-permeable material, corneal contact, which gives better vision, is not as well-tolerated as with polymethylmethacrylate. The material is also not sufficiently thermoplastic for impression moulding to produce customised lenses. Cases 1 and 2, for example, could not achieve their best-corrected visual acuity because the additional cylindrical power cannot be incorporated into the scleral lens. Complications with gas-permeable scleral lens wear have been reported and include corneal neovascularisation, corneal oedema/abrasion and giant papillary conjunctivitis. In our short series with a follow-up period of 1 month to 8 months, no complications were encountered.

The fitting of scleral contact lenses is performed in our centre using preformed RGP scleral lenses (Innovative

Sclerals). Figure 4 shows the scleral zone radius and the optic zone projection—the two parameters that define scleral lenses. Keratometry readings, which are indispensable in corneal contact lens fitting, are not a prerequisite here. Instead, the first trial lens used is based much on the clinical estimate of the optic zone projection and further fitting is done by assessing corneal clearance with fluorescein. The ideal fit shows an increasing depth of the pre-corneal tear film towards the periphery with the fluorescein extending 2 to 3 mm beyond the limbus. There should be no conjunctival blanching.

Conclusion

In conclusion, we have successfully employed gas-permeable scleral contact lenses in the visual rehabilitation of patients with ectatic corneal disorders. 6/12 or better visual acuity and a high level of comfort with long periods of lenswear were achieved. We look forward to the application of these lenses in the management of other refractive disorders which present visual rehabilitative problems.

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