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Case report

Reverse geometry contact lens fitting in corneal scar caused by perforating corneal injuries

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Abstract

Purpose: To describe a reverse geometry rigid gas permeable (RGP) contact lens fitting in corneal scar caused by perforating corneal injuries with intraocular strange body.
Methods: A reverse geometry RGP lens, with large diameter, was empirically fitted in a 38-year-old male patient who had previous open globe injuries due to work accident in right eye. Corneal suture, vitrectomy and lens extraction were performed. Irregular corneal surface with corneal scar in line with the visual axis were found with low uncorrected visual acuity.
Results: Snellen visual acuity improved from counterfinger to 0.8 with high contact lens acceptance, 6–9 h per day of wear. Only three diagnostic contact lenses, in two visits, were necessary. Orbscan simulated fluorescein pattern was different to definitive fluorescein pattern.
Conclusions: Reverse geometry RGP contact lens, with large diameters, could be a good alternative in irregular corneal surface with corneal scar. Fluorescein pattern analysis could be the proper fitting technique. This fitting could involve less time and fewer visits. Computer-aided fitting was of limited value in these cases.

Keywords: Eye injuries; Contact lenses; Corneal topography; Corneal scar

1. Introduction

Corneal perforation injuries with intraocular strange body can cause significant visual reduction. Corneal scars, irregular astigmatism, iris damage, traumatic cataract, retinal detachment, etc., were frequent in these patients [1]. Most of these patients require penetrating keratoplasty for visual acuity recovery. Rigid gas permeable (RGP) contact lens, which can mask significant amounts of irregular astigmatism, can improve visual acuity in some of these patients [2–4]. Different RGP shape and design was proposed for visual acuity impairment post-traumatic scarred corneas [5–7].

This paper presents a case in which reverse geometry RGP contact lenses were prescribed to improve the vision of a patient with irregular cornea, iris damage and aphakia secondary to open globe injury.

2. Case report

A 38-year-old male patient was referred for contact lens fitting. History revealed the patient to have undergone vitrectomy (retinal detachment) and lens extraction after open globe injuries due to work accident in right eye 1 year ago. The patient never wears glasses or contact lenses. There was no significant familial ocular history. His general health was excellent and he was not taking any medication on a regular basis.

Visual acuities were counter finger at 1 m in right eye (RE) and 1.2 m in left eye (LE). RE slit lamp examination showed; inferior conjunctival scar secondary to eye surgery and corneal scar in central area that affect pupil axis (Fig. 1). Pupil was inferior and nasal decentred. Aphakia LE was normal.

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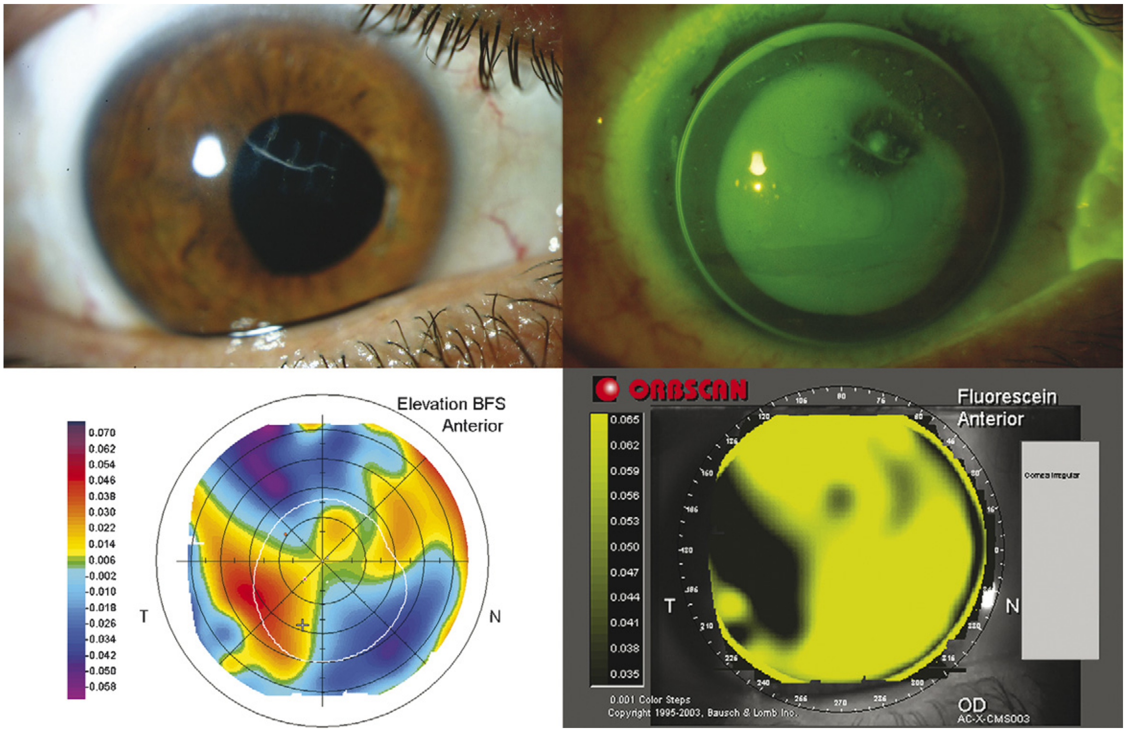

Fig. 1. Top left: biomicroscopic aspect with corneal scar in line with the visual axis and iris damage. Top right: fluorescein pattern with reverse geometry and high diameter RGP lens showed central pooling with a small apical clearance in the scar zone, a mild peripheral alignment with slightly optimal clearance under peripheral curve and good even edge clearance. Bottom left: Orbscan elevation topography shows irregular corneal surface with high astigmatism (anterior elevation best fitting surface). Bottom right: Orbscan simulated fluorescein pattern. Orbscan software does not permit simulating reverse geometry RGP fluorescein pattern. We plotted simulate fluorescein of 10.20 mm diameter RGP lens with only one back posterior radius of 8.20 mm. Several differences with real fluorescein pattern were shown.

Orbscan II (Bausch & Lomb, Inc., Software Version 3.12) revealed an irregular cornea with astigmatism of 9.50 DP approximately. The “Orbscan simulated keratometry” readings obtained were 35.50 DP (9.50 mm) @ 61° × 45.10 DP (7.50 mm) @ 151°. Manual keratometry (Oftalmometer OM-1, Topcon, Japan) was 45.30 DP (7.45 mm) @ 60° × 45.10 DP (7.50 mm) @ 150°. Mires were grossly distorted.

Reverse geometry RGP contact lenses were proposed to improve visual acuity. An empirical fitting was provided. After three diagnostic contact lenses in two visits, definitive contact lens was calculated. Table 1 resumes diagnostic lenses characteristics and Fig. 2 shows three diagnostic contact lenses. The final lens was reached with the lens that permits best visual acuity (0.8), optimum fluorescein alignment and good tolerance. The back optic zone radius (BOZR) was 8.20 mm, first peripheral curve 7.60 mm, total diameter 10.20 mm, back optic zone diameter 6.60 mm, power of +12.75 DP with anterior tangential design, material; Boston XO (Dk = 140), manufactured by Conoptica, Barcelona (Spain). Slitlamp examination revealed good lens movement and centration. Fluorescein patterns (Fig. 1) showed central pooling with a small “apical touch” (absence of visible fluorescein) in the scar zone. The peripheral alignment appears as another zone of “light touch”. Finally, the edge lift curve shows an optimal clearance to facilitate tear exchange.

At the 3-month after-care visit, the patient stated that he was wearing the lens between 6 and 9 h per day, 7 days per week, without problem. No visual acuity changes were found. Slit lamp examination revealed neither corneal nor conjunctival staining, nor any other ocular complications associated with contact lens wear. No *ortho*-k effect was

Table 1
Trial contact lenses parameters used to define definitive contact lens

Trial lens	BOZR (mm)	BPZR (mm)	Diameter (mm)	Power (DP)	Over refraction	VA	Comment
1	7.85	7.25	10.20	0.00	NA	NA	Steepest lens
2	8.20	7.90	10.20	0.00	+10.75	0.8	Good movement
3	8.30	8.00	10.20	0.00	+11.00	0.6	Double image

BOZR: back optic zone radius; BPCR: back peripheral curve radius; DP: dioptrie; VA: visual acuity with overcorrection in trial frame; NA: not applicable. Material of all diagnostic lenses: Boston XO (Dk = 140), Conoptica, Barcelona (Spain).

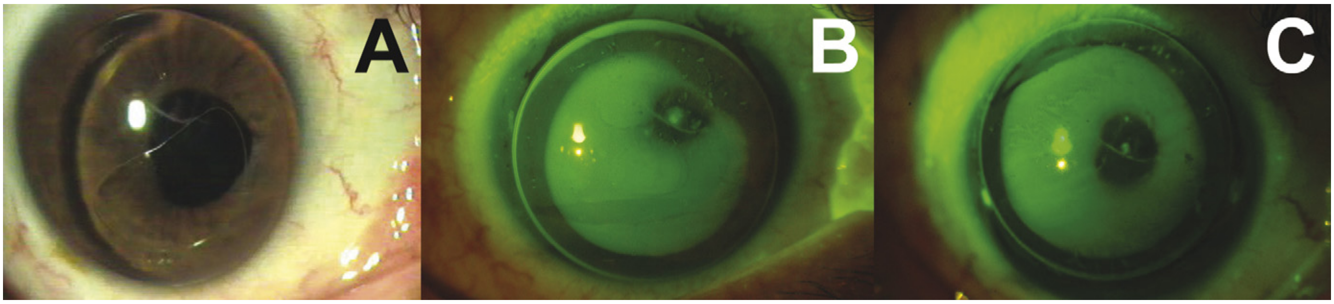

Fig. 2. Slitlamp photographs of the diagnostic lenses. (A) First lens, with BOZR of 7.85 mm and peripheral curve of 7.25 mm. It is a steeper lens with a long air bubble. Fluorescein pattern was not taken. (B) Fluorescein pattern of second lens (definitive lens) with BOZR of 8.20 mm and peripheral curve of 7.90 mm. (C) Fluorescein pattern of last lens with BOZR of 8.30 mm and peripheral curve of 8.00 mm. This lens provides lower corrected visual acuity than lens B (Table 1). All diagnostic lenses have the same geometry, power (0.00 DP), diameter (10.20 mm) and material (Boston XO).

found because we did not find any refraction change after contact lens wear.

3. Discussion

Contact lens fitting may be required after open globe injury for optical or therapeutic reasons. Optical indications for contact lens fitting include the correction of irregular astigmatism, high regular astigmatism, anisometropia and secondary aniseikonia, as well as simple ametropia where the patient desires to wear contact lenses as opposite to spectacles. Therapeutic lenses are advised in certain cases, such as when there are sutures, epithelial healing and others [8]. In this case, contact lens was fitted to improve visual acuity and maintain some degree of binocularity function.

Standard RGP contact lenses in irregular cornea could have poor centration and movement. Boghani et al. cannot successfully fit with a contact lens in cases of large peripheral lacerations; however, 92% of small corneal laceration and 85% of large laceration were successfully fitted [5]. A traditional fitting monogram designed RGP lens to be fitted with the flattest keratometric value (*K*) as the initial base curve. Lamentably in irregular corneas manual keratometry and corneal topography measurement could be inexact (mires distorted, quality of the captured image, reconstruction algorithm and others). The quality of the captured image is a crucial factor for accurate topographic results [9]. In these cases, empirical fitting was proposed aiming for the proper fluorescein image with a contact lens and cornea alignment [2,10]. A slightly flatter fit of high Dk RGP with large overall diameter (9.50–10.50 mm) to achieve superior alignment was proposed in patients with corneal perforations [2,7]. We fitted flat reverse geometry RGP with large diameter (10.20 mm) and we obtained good centration of the lens with no upper dislocation (Fig. 1).

Boghani et al. concluded that fitting these patients is challenging and time consuming [6]. However, with large diameter reverse RGP only three diagnostic lenses were used in two visits to calculate definitive contact lens. Reverse RGP could take less fitting time (visits and diagnostic contact lens) than standard or aspheric RGP lenses in these patients. Previous reports found less than two diagnostic lenses in irregular corneal after myopic refractive surgical complications with reverse RGP lenses [11].

Reverse geometry RGP design has one or more peripheral curves steeper (shorter radius) than the BOZR. These contact lenses with large diameter were proposed in irregular cornea after myopic laser refractive surgery [11] or following corneal graft surgery [8]. Their principal advantages were better corneal fit in oblate or flatter corneas, good centration and adequate movement because large diameter and reverse peripheral curve stabilize dynamic performance of the lens over irregular corneal surfaces. In this patient, reverse geometry contact lenses were fitted with good centration and movement because this lens design stabilizes it.

Orbscan corneal topography could have less accuracy in this case because we found several differences between Orbscan simulate fluorescein pattern (Fig. 1) with definitive fluorescein pattern. Kok et al. reported that keratometer readings were not measurable with corneal topography in 50% of 26 scarred eyes of 23 patients [7]. Hough and Edwards concluded that videokeratoscopic systems do not provide credible values of corneal dimensions at a level which would normally be acceptable for the specification of RGP lens back optic zone radii in normal corneas [12]. In videokeratoscopes (Placido disc-based instruments) erroneous measurements are caused by the reconstruction algorithm and by other factors, including quality of the captured image, optical and mechanical alignment, the limitations of optical hardware, reconstruction algorithms and data processing [12,13]. Orbscan II topography is based on optical analysis and it has a decreased accuracy in measuring corneal thickness when clinically significant haze was present [14]. Orbscan might be affected by a loss of transparency or a scar in the cornea and it could have diminishing accuracy in irregular corneas. Unfortunately Orbscan utility to assist in the fitting of rigid lenses was not reported. Computer-aided fitting (with conventional or Orbscan topographers) was of limited value in cases with high irregular corneal surface.

Visual acuity with RGP contact lenses was significantly improved (from counter finger to 0.8 Snellen acuity) because the tear film underneath the contact lens neutralizes corneal surface irregularities similar to previous reports [4,10]. Lamentably visual acuity corrected at its best with contact lenses (0.8 in RE) could be inferior to previous visual acuity (subject not wearing glasses before the work accident, so visual acuity could be similar in both eyes and LE visual acuity was 1.2).

In aphakes, the visual improvement with spectacles was not as good as phakic and pseudophakic eyes. The improvement with contact lenses in these eyes was significantly greater compared to spectacle correction. For unilateral aphakia, the added advantage could be the lower amount of unilateral magnification induced by contact lens in comparison to spectacles [2]. The role of contact lenses to treat unilateral aphakia is well known.

The contact lens acceptance was high with between 6 and 9 h per day of wear. However, some authors concluded that long-term success wearing contact lenses for these patients was poor [1]. An alternative to contact lens fitting for an optimal visual gain is eye surgery with different techniques (keratoplasty, topographic-linked corneal excimer ablation, guide aberration LASIK and others). Eye surgery is difficult and of limited use in cases of very high astigmatism, insufficient pachymetry, limited by the availability of donor tissues, difficulty of the technique and post-operative complications. Contact lenses are the first choice, and sometimes the only solution for optical rehabilitation in eyes with irregular corneal surface [2,10].

4. Conclusion

The fitting of contact lenses in a patient who has corneal scars caused by perforating corneal injuries is generally difficult. RGP reverse geometry contact lens fitting, with large diameters, can be a good alternative in these cases. Fluorescein pattern analysis could be the proper RGP contact lens fitting technique. This fitting could take less time and fewer visits than standard or aspheric RGP contact lenses in these patients. Computer-aided fitting was of limited value in cases with irregular corneal surface.

Conflict of interest

The authors have no propriety, financial or commercial interest in any material or method mentioned in this study.

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