CLINICAL AND EXPERIMENTAL
OPTOMETRY

Communication

Clin Exp Optom 2005; 88: 3: 181–185

CASE REPORT

Management of a post-ELLKAT keratectasia with a gas permeable contact lens

Fernando J Fernandez-Velazquez
OD FAAO
Madrid, Spain

Submitted: 9 November 2004
Revised: 14 February 2005
Accepted for publication: 10 March 2005

Key words: excimer laser, gas permeable contact lenses, keratectasia, keratoconus

ABSTRACT

Background: The Excimer laser keratoplasty of augmented thickness for keratoconus (ELLKAT) has been proposed for the refractive management of keratoconus.

Case report: A 41-year-old man with a history of bilateral keratoconus came to the clinic for a contact lens. He had undergone an ELLKAT procedure in his right eye some months earlier in an attempt to obtain acceptable unaided vision. As the result in this eye was not positive, the surgery in the fellow eye was cancelled. On examination, I diagnosed a centrally located keratectasia (KE) in his RE. After surgery, the corneal shape presented some complications in relation to contact lens fitting. The patient was able to achieve 6/9.6 acuity with adequate comfort with a Soper lens using a 'modified three-point touch' relationship.

Conclusions: The surgical procedure of ELLKAT can exhibit some advantages with regard to the penetrating keratoplasty. In this case, because a keratectasia was induced, a contact lens fitting was needed to restore vision. A gas permeable contact lens with a Soper design and with a 'modified three-point touch' fitting was a viable clinical solution. The fitting of contact lenses in cases of keratectasia can be a practical solution that may avoid the need for further surgery.

INTRODUCTION

One possible complication of lamellar surgery is iatrogenic corneal ectasia or keratectasia (KE) that might occur after an apparently successful procedure. The mean time for diagnosis has been reported to be about 13 months after the primary procedure[1] with a reported incidence of one in every 2.500 LASIK procedures.[2] Seiler, Koufala and Richter[3] were the first to provide a description of this entity based on the progressive development of a topographical central island after a photoablative procedure. Abnormal topographical findings, progressive myopic changes and non-optimal visual acuity are its diagnostic features.[4]

Excimer laser keratoplasty of augmented thickness (ELLKAT)[5] has been suggested for the refractive management of keratoconus. According to Buratto, Belloni and Valeri,[5] this is 'a modified surgical technique for the treatment of patients in the early stage of keratoconus, when it is possible to correct the astigmatic ametropia with contact lenses'. A deep plano excimer laser refractive ablation is done on the host cornea and a donor lamellar button, with or without an excimer laser refractive ablation on the posterior surface, is sutured into the recipient cornea. The authors claim that 'compared to penetrating keratoplasty, excimer laser lamellar keratoplasty of augmented thickness for keratoconus has the advantage of preserving the host endothelium and of reducing the refractive error in keratoconus'. Other refractive surgical approaches for keratoconus include epikeratophakia,[6] live-epikeratophakia[7] and the insertion of intrastromal corneal rings (ICR) or Intacs.[8]

The fitting of contact lenses to abnormal corneas as in KE is more challenging than for normal prolate corneas. The cornea may be irregular with anomalous biomechanical properties resulting in subnormal vision.

This report reviews the case of a patient with bilateral keratoconus who developed a keratectasia following an ELLKAT procedure in his right eye. The fellow eye received no further treatment. After this complication, the patient was refitted with RGP contact lenses in both eyes.

CASE REPORT

A 41-year-old man came to the clinic to be fitted with contact lenses. He said that he had been diagnosed with keratoconus about four years previously with a more advanced form in his right eye. He had worn 'firm' lenses with good tolerance over a long period. Recently, an ophthalmologist recommended an ELLKAT procedure in both eyes to improve his unaided vision. His right eye was scheduled for surgery. Preoperative data received from the surgical centre for the RE indicated a VA of 6/30 with -8.00 sph/-4.50 x 20º and a central pachymetry of 470 microns. The surgical plan was to implant a 180-micron width disc from a donor cornea, with a subsequent laser treatment to correct his ametropia. Because this procedure did not improve his vision, the specialist recommended that he return to wearing contact lenses and aborting the procedure in the fellow eye.

At the optometric examination, refraction in the RE was -11.00 sph/-4.00 x 50º (6/18). Manual keratometry was 5.90 @ 110º and 6.35 @ 20º with mires type B. Corneal topography (EyeSys) showed

simulated K readings of 6.12 @ 121°, 6.31 @ 31° with apical power of 55.30 D and a topographical pattern of a concentric area of steepening very near to the visual axis without a mirrored island of normal or flatter than normal cornea (Figure 1).

The sliplamp examination showed a corneal flap approximately 9.0 mm in diameter with a nasal hinge of pearls or intraepithelial ingrowths (Figure 2). There was a clear and circular zone of 7.0 mm of higher density that I identified as the lamellar implant.

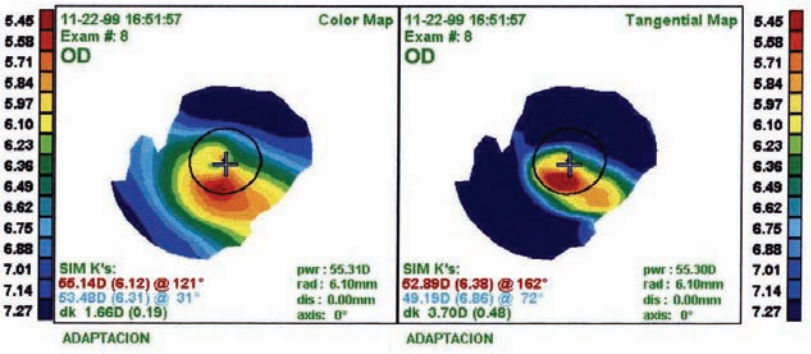

Figure 1. Corneal topography of the RE prior to the contact lens fitting

Contact lens fitting

A specific lens design for keratoconus was used because of the shape of the right cornea. The central zone was steep with an elevated apex, indicating that 'apical bearing' would be a less appropriate fitting than 'apical clearance' or 'three-point touch'.[9]

Soper Cone trial lenses (C&E GP Specialists, San Clemente, California) with a bicurve design based on a sagittal depth were fitted.[10] In this design, the 'vaulting' effect is larger when the base curve is steeper for a specific lens diameter. Apical bearing should be avoided. After the trial lens procedure, the following lens was ordered: Fluoroperm 60, (Paragon Vision Sciences) base curve 53.62 D (6.30 mm), posterior flange 45.00 D/0.25 mm, power -12.50 D, overall diameter 7.50 mm, optic zone 6.00, lenticular with peripheral curves of 40.00 D/0.1 mm, 37.00 D/0.2 mm and 26.00 D/0.2 mm.

At the dispensing visit, the fluorescein pattern showed central apical bearing of 2.5 mm, semi-central alignment with light touch and some narrow peripheral fluorescein and a VA of 6/15. The patient began wearing the lens and returned for a follow-up visit the following week. At that time, the patient was comfortable with the lens but vision was fuzzy and lights bothered him at night. Vision improved to approximately 6/20 with an over-refraction of +0.75 and to 6/9.6 with a pinhole. The assessment of the lens was similar to the dispensing visit with less bearing at the apex and a narrow peripheral zone. The lens was decentred due to the flat fit over the peak corneal area and did not give good coverage of the pupil.

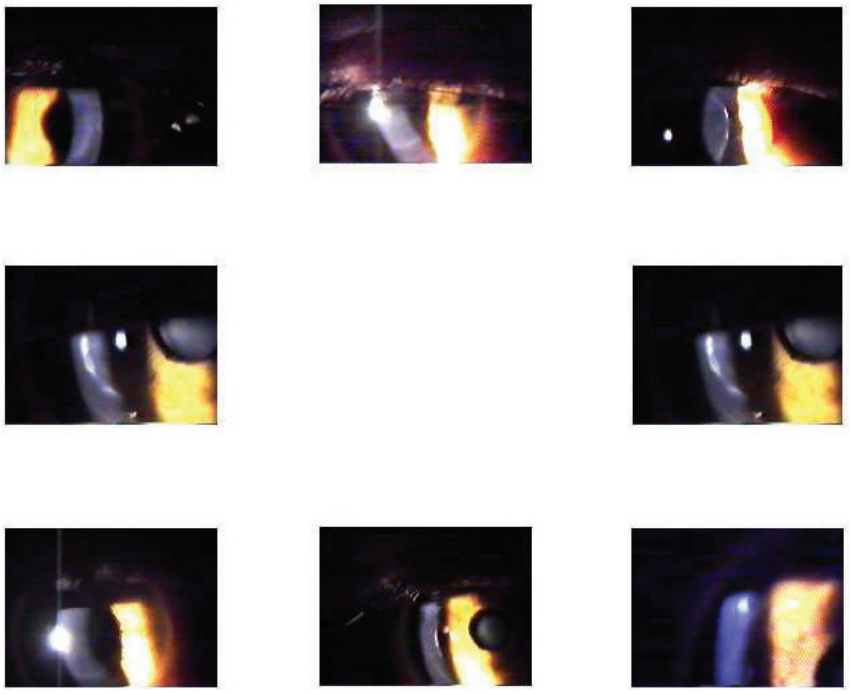

Figure 2. Biomicroscopic images of the RE

A new lens was ordered with the following parameters: Fluoroperm 60, (Paragon Vision Sciences), base curve 53.62 D (6.30 mm), posterior flange 45.00 D/0.25 mm, power -11.50 D, overall diameter 8.50 mm, optic zone 7.00, lenticular with peripheral curves of 39.00 D/0.1 mm, 36.50 D/0.2 y 26.00 D/0.2. Visual acuity improved to 6/9.6 with this lens. The fluorescein pattern indicated central apical feathered touch of 2.0 mm, semi-central alignment with light touch and an optimal peripheral system with good centration. The patient wore this lens and returned for a follow-up visit two weeks later. The patient was comfortable with the lens and achieved the same acuity. Because the fit was considered satisfactory, the patient

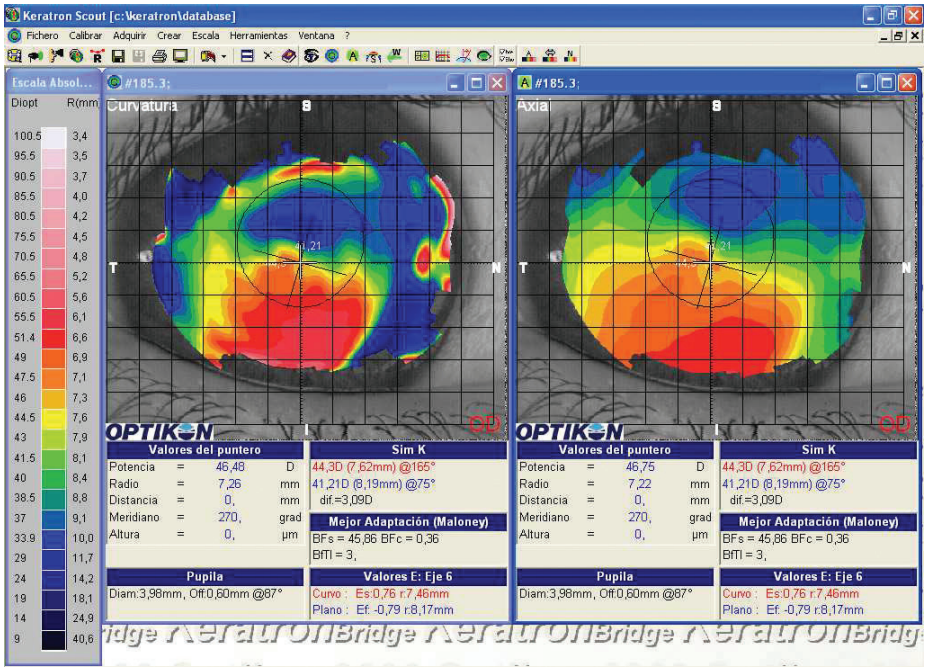

Figure 3. Inferior-located ectasia in a post-LASIK case

continued to wear the lens and returned for evaluation every six months.

In contrast, the left eye with mild keratoconus was significantly simpler to fit. A McGuire design was used with a little more apical bearing to obtain the best visual outcome. A satisfactory fit was achieved with a lens with the following parameters: Boston IV, (Polymer Technology), base curve 7.50 mm, power -4.00 D, overall diameter 8.60 mm, optic zone 6.60 and peripheral curves 8.0 mm/0.3, 9.0 mm/0.3, 10.50 mm/0.3 and 12, 50 mm/0.4. The fluorescein pattern showed a central zone with light bearing and adequate peripheral tear exchange. The patient achieved 20/15.

DISCUSSION

Theories to explain the aetiology of keratectasia include excessive corneal ablation for the treatment of high myopia, errors in the formation of the flap or the presence of keratoconus even at the forme fruste stage.[11] Seiler[3] suggested a biomechanical cause as the flap no longer contributes to the strength of the cornea. Andreasen, Simonsen and Oxlund[12] found that the tangential elastic modulus in keratoconus is altered on an average of 2.1 in comparison with the normal cornea. The size of the optical zone in the ablation is also important[13] and KE occurs even with ablations of only 14 microns.[14]

Early KE may be treated with INTACS[15] or early suturing of the flap.[16] Recently, Randleman, Thompson and Staver[17] recommended the use of Interwave aberrometry plus corneal topography for its early diagnosis. Penetrating keratoplasty may be indicated, although the majority of KE can be fitted with contact lenses.[2] Recently, LASIK has been proposed for the refractive management after penetrating keratoplasty.[18]

The fitting of contact lenses after corneal refractive procedures is considered to be more arduous than regular cases.[19] The recommended techniques for fitting contact lenses after LASIK have been revised extensively.[20,21] Practitioners can attain successful fitting with several gas permeable lens designs such as spherical and reverse geometry lenses. Nevertheless, the clinical management of KE with rigid corneal contact lenses has been reviewed rarely. Joo and Kim[22] reported one patient but gave few details. In addition, Eggink and Beekhuis[23] reported fitting a case with a multicurve gas permeable lens with 'apical clearance' and 'lid attachment'. Choi, Kim and Lee[24] used a specific design marketed in Korea for keratoconus as well as a modified reverse geometry lens.

Many factors need to be considered in the fitting of contact lenses in keratectasia.

1. Monocular or binocular correction

In monocular ectasias and in mild cases, a toric soft lens, or any of the available soft lenses designed for keratoconus and even an aspheric RGP, can be considered.

2. Amount of corneal steepening and elevation

Egging and Beekhuis[23] found steeper apices in post-LASIK ectasias than in keratoconus. In fact, the apical value was 61.90 D, which is steeper than the average apical radius in keratoconus (54.68 D) in Spain.[25] Recently, it has been claimed that central bulging is a universal phenomenon in corneas post-LASIK, even without evidence of manifest KE.[25]

3. Location of the ectasic apex

The most common location of the apex in both subclinical[26] and clinical keratoconus[27] is the inferior-temporary quadrant. There are two main topographical patterns in KE. The central KE may be induced in a previously normal cornea and an inferior protrusion (Figure 3) may occur in forme fruste keratoconus.[28] Choi, Kim and Lee[24] reported the fitting of a large modified reverse geometry lens (RGL) in cases of an inferiorly located ectasia. The author has successfully fitted large aspheric RGP lenses in KE with this eccentric pattern.

The rationale for fitting central KE is similar to that used for 'nipple' keratoconus. The 'three-point touch' or 'divided support' relationship seems to have the most popularity.[29,30] According to The Collaborative Longitudinal Evaluation of Keratoconus study,[31] 88 per cent of

keratoconic eyes are fitted in this way, with support provided for the lens in an area of central bearing and two other areas at the corneal midperiphery. Edrington and colleagues[32,33] analysed the incidence of corneal scarring based on fitting philosophy (apical bearing versus apical clearance). They reported that 25 per cent of eyes with steep fitting were scarred versus 46 per cent of apical bearing fittings.

When fitting KE, the total diameter might range from 7.80 to 8.50 mm with optical zones at least 1.5 to 2.0 mm smaller. The lens should be fitted with minimal central pressure on the apex. Therefore, a 'modified three-point touch' that tends 'towards apical clearance as the visual acuity is not compromised' should be advocated.[34] In addition, the degree of edge lift should be determined to avoid either a peripheral curve that is too steep or an excessive edge lift.

Other lenses might be useful for the management of central KE.

1. Back aspherics such as the VFL lens (Conforma Contact Lenses, Norfolk, Virginia) and the Nulife (C&E GP Specialists, San Clemente, California), which are fitted with a steeper base curve than in the spherical three-point-touch approach because of their higher eccentricity values. Central alignment or slight touch is seen with edge clearance and paracentral bearing is eliminated.[35]
2. Rose-K lenses (International Rose-K, New Zealand) have a complex computer generated peripheral curve system. They are credited with being very comfortable and subjectively are preferred by patients with keratoconus.[35] The Rose-K design is particularly useful when a topographical assessment shows that a lens is needed with a relatively small posterior optic zone and a wide flat periphery.
3. Semiscleral and scleral lenses, with commercial designs such as the Macrolens (C&H Labs, Dallas, TX), the Dyna Intralimbal lens (Lens Dynamics, Golden, CO) and the Jupiter lens (Innovations in Sight, Front Royal, Virginia) could be fitted. Caroline and André reported a successful fitting of a post-LASIK ectasia with a Macrolens.[37]

CONCLUSION

ELLKAT[5] may show advantages over penetrating keratoplasty in the management of keratoconus as there is preservation of a healthy corneal endothelium and reduction of the amount of refractive error. In this patient, keratectasia after an ELLKAT procedure was managed with a corneal RGP lens (Soper design) and a 'modified three-point touch' fitting. Fitting of contact lenses in cases of KE can be a practical solution that provides good comfort and adequate vision without the need for further surgery.

REFERENCES

1. Twa MD, Nichols JJ, Joslin CE, Kollbaum PS, Edrington TB, Bullimore MA, Mitchell GL, Cruichshank KJ, Schanzlin DJ. Characteristics of corneal ectasia after LASIK for myopia. *Cornea* 2004; 23: 447-457.
2. Randleman JB, Russel B, Ward MA, Thompson KP, Stulting RD. Risk factors and prognosis for corneal ectasia after LASIK. *Ophthalmology* 2003; 110: 267-275.
3. Seiler T, Koufala K, Richter G. Iatrogenic keratectasia after laser *in situ* keratomileusis. *J Refract Surg* 1998; 14: 312-317.
4. Choi HJ, Kim MK, Lee JL. Optimization of contact lenses fitting in keratectasia patients after laser *in situ* keratomileusis. *J Cataract Refract Surg* 2004; 30: 1057-1066.
5. Buratto L, Belloni S, Valeri R. Excimer laser lamellar keratoplasty of augmented thickness for keratoconus. *J Refract Surg* 1998; 14: 517-525.
6. McDonald MB, Kaufman HE, Durrie DS, Keates RH, Sanders DR. Epikeratophakia for keratoconus. *Arch Ophthalmol* 1986; 104: 1294-1230.
7. Krumeich JH, Daniel J, Knulle A. Live-epikeratophakia for keratoconus. *J Refract Surg* 1998; 14: 156-163.
8. Colin J, Cochener B, Savary G, Malet F, Holmes-Higgin D. INTACS inserts for treating keratoconus. *Ophthalmology* 2001; 108: 1409-1414.
9. Korb DR, Finnemore VM, Herman JP. Apical changes and scarring in keratoconus as related to contact lens fitting techniques. *J Am Optom Assoc* 1982; 53: 199-205.
10. Soper JW, Jarret JA. Results of a systemic approach to fitting keratoconus and corneal transplants. *Contact Lens Med Bull* 1972; 62: 152-157.
11. Spadea L, Palmieri G, Mosca L, Franciani R, Balestrazzi E. Iatrogenic keratectasia following laser *in situ* keratomieleusis. *J Refract Surg* 2002; 18: 475-480.
12. Andreassen T, Simonsen TH, Oxlund H. Biomechanical properties of keratoconus and normal corneas. *Exp Eye Res* 1980; 31: 435-441.
13. Gatinel D, Hoang-Xuan TR, Azar DT. Volume estimation of excimer laser tissue ablation for correction of spherical myopia and hyperopia. *Invest Ophthalmol Vis Sci* 2002; 43: 1445-1449.
14. Wang JC, Hufnagel TJ, Buxton DF. Bilateral keratectasia after unilateral laser *in situ* keratomileusis: a retrospective diagnosis of ectasic corneal disorders. *J Cataract Refract Surg* 2003; 29: 2015-2018.
15. Siganos CS, Kymionis GD, Astyrakakis N, Pallikaris IG. Management of corneal ectasia after laser *in situ* keratomileusis with INTACS. *J Refract Surg* 2002; 18: 42-46.
16. Seo Ky, Lee JH, Kim MJ, Park JW, Chung ES, Lee YS, Kim EK. Effect of suturing on iatrogenic keratectasia after laser *in situ* keratomileusis. *J Refract Surg* 2004; 20: 40-45.
17. Randleman JB, Thompson KP, Staver PR. Wavefront aberrations from corneal ectasia after laser *in situ* keratomileusis demonstrated by interwave aberrometry. *J Refract Surg* 2004; 20: 170-175.
18. Buzard K, Febbaro JL, Fundingsland BR. Laser *in situ* keratomileusis for the correction of residual ametropia after penetrating keratoplasty. *J Cataract Refract Surg* 2004; 30: 1006-1013.
19. Yeung KK, Olson MD, Weissman BA. Complexity of contact lens fitting after refractive surgery. *Am J Ophthalmol* 2002; 133: 607-612.
20. Szczotka L, Aronsky M. Contact lenses after LASIK. *J Am Optom Assoc* 1998; 69: 775-784.
21. Ward M. Visual rehabilitation with contact lenses after laser *in situ* keratomileusis. *J Refract Surg* 2001; 17: 433-440.
22. Joo CK, Kim TG. Cornal ectasia detected after laser *in situ* kertomileusis for correction of less than -12 diopters of myopia. *J Cataract Refract Surg* 2000; 26: 292-295.
23. Eggink FAGJ, Beekhuis WH. Contact lens fitting in a patient with keratectasia after laser *in situ* keratomileusis. *J Cataract Refract Surg* 2001; 27: 1119-1123.
24. Luque Valentín-Fdez ML, Balado Vázquez P, Rodríguez Ausin MP, León Cabello MJ, Al-Kathiri H, Cortes Valdés C. Características topográficas de las ectasias corneales en nuestro medio. *Arch Soc Esp Oftalmol* 1998; 11: 563-568. Available at http://www.oftalmo.com/seo/1998/11nov98/05.htm.
25. Miyata K, Tokunaga T, Nakahara M, Ohtani S, Nejima R, Kiuchu T, Kaji Y, Oshika T. Residual bed thickness and corneal forward shift after laser *in situ* keratomileusis. *J Cataract Refract Surg* 2004; 30: 1067-1072.
26. Arantz A, Duran JA, Pijoan JI. Subclinical keratoconus diagnosis by elevation topog-

raphy. *Arch Soc Esp Oftalmol* 2003; 78: 654-665. Available at http://www.oftalmo.com/seo/2003/12dic03/05.htm.
27. Demirbas NH, Pfugfelder SC. Topographic pattern and apex location of keratoconus on elevation topography maps. *Cornea* 1998; 17: 476-484.
28. Faraj HG, Gatinel D, Chastang PJ, Hoang-Xuan T. Corneal ectasia after Lasik. Letter in *J Cataract Refract Surg* 2003; 2: 220.
29. Chiquiar-Arias V, Liberatore JC, Voss EH, Chiquiar-Arias M. A new technique of fitting contact lens on keratoconus. *Contacto* 1959; 3: 393-415.
30. Moss HI. The contour principle in corneal contact lens prescribing in keratoconus. *J Am Optom Assoc* 1959; 30: 570-572.
31. Edrington TB, Barr JT, Zadnik K, Davis LJ, Gundel RE, Libassi DP, McMahon TT, Gordon MO. Standardized Rigid Contact Lens Fitting Protocol for Keratoconus. *Optom Vis Sci* 1996; 73: 369-375.
32. Edrington TB, Zadnik K, Barr JT, Gordon MO. Scarring and contact lens fit in keratoconus: Results from the CLEK (Collaborative Longitudinal Evaluation of keratoconus) screening study. *Invest Ophthalmol Vis Sci* 1991; 32(suppl): 738.
33. Leung KKY. RGP fitting philosophies for keratoconus. *Clin Exp Optom* 1999; 82: 230-235.
34. Szczotka LB. Fitting the irregular cornea. *Contact Lens Spectrum* May 2003. Available at http://www.clspectrum.com/article.aspx?article=12343.
35. Betts AM, Mitchell GL, Zadnik K. Visual performance and comfort with the Rose-K lens for keratoconus. *Optom Vis Sci* 2002; 79: 493-501.
36. Caroline PJ, André MP. An RGP solution for LASIK gone wrong. *Contact Lens Spectrum* October 2000 Available at http://www.clspectrum.com/archive_results.asp?loc=archive\2000\october\1000056.htm.

Author's address:
Fernando J Fernandez-Velazquez
Ferraz, 2
28008 Madrid
SPAIN