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

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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. 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 with a reported incidence of one in every 2,500 LASIK procedures. Seiler, Koufala and Richter 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.

Excimer laser keratoplasty of augmented thickness (ELLKAT) has been suggested for the refractive management of keratoconus. According to Buratto, Belloni and Valeri, 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, live-epikeratophakia and the insertion of intrastromal corneal rings (ICR) or Intacs.

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.
simulated K readings of 6.12 @ 121º, 6.31 @ 31º 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 slitlamp 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 7.9 mm of higher density that I identified as the lamellar implant.

**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.

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...
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. Seiler suggested a biomechanical cause as the flap no longer contributes to the strength of the cornea. Andreasen, Simonsen and Oxlund 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 and KE occurs even with ablations of only 14 microns.

Early KE may be treated with INTACS or early suturing of the flap. Recently, Randleman, Thompson and Staver 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. Recently, LASIK has been proposed for the refractive management after penetrating keratoplasty.

The fitting of contact lenses after corneal refractive procedures is considered to be more arduous than regular cases. 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 reported one patient but gave few details. In addition, Eggink and Beckhuis reported fitting a case with a multicurve gas permeable lens with ‘apical clearance’ and ‘lid attachment’. Choi, Kim and Lee 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 Beckhuis 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. Recently, it has been claimed that central bulging is a universal phenomenon in corneas post-LASIK, even without evidence of manifest KE.

3. **Location of the ectasic apex**
   The most common location of the apex in both subclinical and clinical keratoconus 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. Choi, Kim and Lee 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.

**Figure 3. Inferior-located ectasia in a post-LASIK case**
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\textsuperscript{23,25} 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.\textsuperscript{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&I 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.\textsuperscript{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.\textsuperscript{26} 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.\textsuperscript{27}

CONCLUSION

ELKAT\textsuperscript{4} 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, keratectomy 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.

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Fernandez-Velazquez

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