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Etiology and management of vascularized limbal keratitis

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Etiology and management of vascularized limbal keratitis

Abstract
Background: Several literatures have been published on Vascular Limbal Keratitis but there is a lack of consensus on the etiology and standard of treatment. Through a literature review and a survey of contact lens diplomats, this study summarizes the most widely accepted etiology and treatment modalities for management of VLK.

Methods: 135 surveys were sent to currently practicing contact lens diplomats of the American Academy of Optometry based on the 1999 guidebook. 52 surveys were returned and evaluated. A literature review was done to supplement the results of the survey.

Results: The survey indicated that the most common possible etiologies of VLK are chronic peripheral desiccation (26.8 %), RGP lens design phenomena (24.6%), inadequate blink (16.8%) and tear film anomaly (15.1%). In early stage VLK, most practitioners chose to discontinue RGP wear temporarily, prescribe anti-inflammatory medications and refit with new or modified RGP lens parameters. For late stage VLK, the most common management responses were to discontinue RGP lens wear temporarily, prescribe anti-inflammatory medications and refit with soft contact lenses.

Conclusion: Vascularized Limbal Keratitis is a complication found in RGP lens wearers, but can be successfully treated. With early intervention and proper treatment modalities, the majority of VLK cases can be effectively managed with complete resolution.

Degree Type
Thesis

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ETIOLOGY AND MANAGEMENT

OF

VASCULARIZED LIMBAL KERATITIS

By

JOE AN

DATNHANKHUU

JOHN KWEI
A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May 2001

Authors:
Biography

Joe An:

Joe graduated from Washington State University in 1997 with a bachelor's degree in zoology. Upon graduating from Pacific University College of Optometry in 2001, he hopes to be situated in a private practice with emphasis in primary care, disease and contact lenses.

DatNhan Khuu:

DatNhan graduated from Pacific University in 1997 with a bachelor's degree in biology and minor in Spanish. Upon graduating from Pacific University College of Optometry in 2001, she plans on doing a residency in binocular vision. Eventually, she plans on practicing in a private setting with emphasis in pediatrics and vision therapy.

John Kwei:

John received a bachelor's degree in visual science in 1999 from Pacific University. Upon graduating from Pacific University College of Optometry in 2001, he looks forward to practicing in a private setting with emphasis in primary care, contact lenses, low vision, and disease.
Acknowledgments

We would like to thank all of the contact lens diplomats that took time out of their busy schedules to fill out our survey. We would also like to thank Pat Caroline and Jenny Smythe for their guidance and support throughout our research project.
Abstract

Background:
Several literatures have been published on Vascular Limbal Keratitis but there is a lack of consensus on the etiology and standard of treatment. Through a literature review and a survey of contact lens diplomats, this study summarizes the most widely accepted etiology and treatment modalities for management of VLK.

Methods:
135 surveys were sent to currently practicing contact lens diplomats of the American Academy of Optometry based on the 1999 guidebook. 52 surveys were returned and evaluated. A literature review was done to supplement the results of the survey.

Results:
The survey indicated that the most common possible etiologies of VLK are chronic peripheral desiccation (26.8 %), RGP lens design phenomena (24.6%), inadequate blink (16.8%) and tear film anomaly (15.1%).

In early stage VLK, most practitioners chose to discontinue RGP wear temporarily, prescribe anti-inflammatory medications and refit with new or modified RGP lens parameters. For late stage VLK, the most common management responses were to discontinue RGP lens wear temporarily, prescribe anti-inflammatory medications and refit with soft contact lenses.

Conclusion:
Vascularized Limbal Keratitis is a complication found in RGP lens wearers, but can be successfully treated. With early intervention and proper treatment modalities, the majority of VLK cases can be effectively managed with complete resolution.

Key Words:
Cornea, vascularized limbal keratitis, peripheral corneal desiccation, RGP
Vascularized limbal keratitis (VLK) is a peripheral corneal complication that occurs exclusively in rigid contact lens wearers. This condition is characterized by the appearance of:

- Localized conjunctival injection
- Localized neovascularization
- Peripheral corneal desiccation (PCD)
- An elevated hyperplastic nodule

VLK occurs in the intrapalpebral space at either 3 or 9 o'clock similar to 3 and 9 o'clock staining however, the hallmark of VLK is the appearance of the whitish elevated nodule. This condition was first described and differentiated from other peripheral corneal anomalies by Lebow and Grohe in 1989. Since that time, little has been written about the etiology and management of VLK. Throughout the article, we will review the signs and symptoms of VLK as well as the current management strategies obtained through a survey of currently practicing diplomats of the Cornea and Contact Lens section of the American Academy of Optometry.

Lebow and Grohe described four clinical stages of VLK. Since the management of the condition depends on the stage at the time of presentation, it is important to become familiar with the signs and symptoms present at each stage.

In the first stage, where the corneal and/or limbal epithelium becomes hyperplastic, patients are typically asymptomatic. Mild staining is often visible at this time due to SPK. As the condition progresses to stage two, corneal infiltration and conjunctival hyperemia occur, causing patients to report having a red eye with mild irritation, an increase in lens awareness, but no pain. Upon examination, coalesced peripheral SPK may be visible along with a corneal infiltrate. Eventually, a vascular leash extending from the conjunctiva surrounds the corneal infiltrate. By this third stage, patients have a moderately red eye and have often experienced a decrease in lens wearing time. In the advanced stage four VLK, erosion and ulceration of the hyperplastic epithelium may occur. Contact lens wear is intolerable at this point due to photophobia and pain as the contact lens rubs against the eroded areas. Significant corneal staining and hyperemia will be present upon observation. These signs and symptoms are summarized in Table I.
**Table I. Signs and Symptoms of VLK**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Symptoms</th>
<th>Corneal and Conjunctival Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Hyperplasia of the cornea and/or limbal epithelium</td>
<td>Asymptomatic</td>
</tr>
<tr>
<td>II.</td>
<td>Inflammatory response including corneal infiltration and conjunctival hyperemia</td>
<td>Mild irritation, red eye with no pain, increased lens awareness</td>
</tr>
<tr>
<td>III.</td>
<td>Vascularization</td>
<td>Decreased lens wearing time, moderate red eye</td>
</tr>
<tr>
<td>IV.</td>
<td>Erosion of the hyperplastic epithelium</td>
<td>Photophobia, pain, unable to wear contact lenses</td>
</tr>
</tbody>
</table>

**Etiology**

The etiology of VLK is unclear at this time and may be multi-factorial involving the peripheral corneal topography, overall lens design, and tear film.

**Corneal Topography**

The human cornea has a prolate shape that is steeper in the center and gradually flattens towards the limbus. The degree of flattening varies from patient to patient and is difficult to accurately quantify, even with modern corneal mapping techniques. When a rigid lens is placed on an eye, the lens will be in closest apposition to the cornea where it is the flattest. In the case of with-the-rule astigmatism, the lens will be tightest at 3 and 9 o’clock. Therefore, if the patient has a flatter-than-normal peripheral corneal topography, the lens may be prone to inadequate peripheral clearance.

**Overall Lens Design**

Most eye care professionals agree that lens design plays a prominent role in the formation of VLK. Lebow and Grohe suggest that the condition is frequently the result of an excessively large overall lens diameter and/or a low peripheral lens design. These features can ultimately lead to peripheral lens tightening with desiccation and.
infiltration. Poor contact lens designs, especially improper edge lifts and overall diameters, lead to undesirable lens to cornea relationships and improper positioning on the lens. Any one of the following may occur as a result:

1. excessive friction of the lens edge against the corneal-scleral junction, which may be more common in WTR astigmas
2. inadequate blinking due to excessive foreign body sensation
3. lid gaping

Numerous studies have been done to evaluate specific aspects of the lens design on peripheral corneal dessication. In a study done by Brannen in 1997, moderate to severe staining was seen more frequently in aligned (9.3mm average diameter, 1.0mm mean peripheral curve radius, fitted an average of 0.12D STK) and steep (8.2mm average diameter, 9.5mm mean peripheral curve radius, fitted an average of 0.62D STK) lens-to-cornea fitting relationships. Flat-fitting (9.3mm average diameter, 12.0mm mean peripheral curve radius, fitted an average of 1.37D FTK) relationships yielded the least amount of staining. Others such as Williams, Lebow, and Andrasko, investigated the affect of edge-lift and found that higher axial edge-lift designs produced less 3 and 9 o'clock staining. In another study by Schnider et al., the effect of lens diameter on PCD was investigated. The lenses used had an edge-curve of 0.3mm width, and axial edge lift of about 80 microns, and diameters of 9.0, 9.6, and 10.2mm. They were fitted based on an apical alignment to slight apical clearance fitting philosophy. The study identified the following four variables as contributors to 3 and 9 o'clock staining: vertical centration, edge tightness, lens movement, and lens diameter. Edge lift and overall diameter were noted as being the most significant variables. Larger lenses with greater edge clearance provide greater lid interaction, thereby leading to less erratic lens movement, better vertical centration, greater patient comfort, and decreased 3 and 9 staining.

Lens material has also been proposed as a possible etiologic factor due to its effects on the tear film and on lens designs and fits. It has been shown that fluoropolymer lenses have good surface wetting ability due to their affinity for mucin. With better surface wetting characteristics of fluorosilicone acrylate and fluoropolymer lens materials, tear film evaporation is less likely, decreasing the possibility of tear film disturbance. The
specific gravity of a lens material however, plays a critical role in maintaining a healthy cornea. Specific gravity is related to lens mass\(^1\) and a lens material with a high specific gravity yields a heavier lens, resulting in a low-riding contact lens fit. Since low riding lens inhibit normal blinking, patients would be more susceptible to developing corneal problems.

Tear Film
A tear film with too much lipid, deficient mucin, and/or an insufficient aqueous layer can increase the signs and symptoms of PCD.\(^1,12\) Also, altered and incomplete blinks may inadequately wet the corneal surface and lead to corneal desiccation. This holds true for both contact lens and non-contact lens wearers.\(^1,3,12\)

Management
Since the formation of VLK may be multifactorial, it is important to identify as many of the causative factors as possible and appropriately modify one's treatment plan. Each stage of VLK is managed slightly different than the preceding stage, with stages I and II focused primarily on ocular lubricants and modification of the existing lens design. If the condition progresses to stages III and IV, the management will involve temporary discontinuation of the lenses, topical corticosteroids, and perhaps surgical intervention.'

In order to effectively diagnose and treat VLK, it is necessary to become familiar with other raised, nodular corneal disorders that can mimic VLK. Table 2 is a list of differential diagnoses that must be considered in the assessment of VLK.
<table>
<thead>
<tr>
<th>Description</th>
<th>VLK</th>
<th>Pseudopterygium</th>
<th>Salzmann's Nodular Degeneration</th>
<th>Dellen</th>
<th>Phlyctenulosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cornea</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Limbus</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y (initially)</td>
</tr>
<tr>
<td>Conjunctiva Position</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y (often at limbus)</td>
</tr>
<tr>
<td>Location 3 &amp; 9</td>
<td></td>
<td>Typically 3 &amp; 9 but can originate anywhere along limbus</td>
<td>Peripheral or central</td>
<td>Typically 3 &amp; 9</td>
<td>Starts peripherally and migrates centrally</td>
</tr>
<tr>
<td>Laterality</td>
<td>Typically unilateral</td>
<td>Typically unilateral</td>
<td>80% bilateral</td>
<td>Typically unilateral</td>
<td>Typically unilateral</td>
</tr>
<tr>
<td>APPEARANCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vascularized</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Elevated</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Color</td>
<td>White, opaque</td>
<td>White, opaque</td>
<td>Grayish-blue</td>
<td>Clear</td>
<td>White</td>
</tr>
<tr>
<td>Staining</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y (when ulcerated)</td>
</tr>
<tr>
<td>Number of lesions</td>
<td>Typically one</td>
<td>Typically one</td>
<td>1 – 10</td>
<td>Typically one</td>
<td>Typically one</td>
</tr>
<tr>
<td>ETIOLOGY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic corneal drying, mechanical irritation</td>
<td></td>
<td>Chronic corneal dessication and SPK (secondary to mechanical irritation)</td>
<td>Previous inflammatory condition (primarily phlyctenular keratitis)</td>
<td>Corneal drying from an adjacent area of tissue elevation</td>
<td>Delayed hypersensitivity reaction (usually related to blepharitis or TB)</td>
</tr>
<tr>
<td>INFLAMMATORY</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>SYMPTOMS</td>
<td>FB sensation</td>
<td>Burning and stinging</td>
<td>Usually asymptomatic</td>
<td>Usually asymptomatic</td>
<td>Tearing, irritation, pain, photophobia, history of similar episodes</td>
</tr>
<tr>
<td></td>
<td>burning pain</td>
<td>(depending on severity)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Differential Diagnoses
Methods
A VLK survey consisting of seven questions and two photographs was mailed out to 135 currently practicing diplomats of the Cornea and Contact lens section of the American Academy of Optometry. The questions enabled the practitioners to express their expert opinions on the prevalence of VLK in their practices, the etiological factors responsible for the development of VLK, and the management of early and late stage VLK. (Figure 1 is a copy of the survey). Of the surveys distributed, 55 (40.7%) were returned.

Questions 1 and 2 of the survey were multiple choice in which only one response was allowed. Questions 3 to 6 were also multiple choice however, more than one response was permitted. The responses were tabulated for each question in the survey. Questions that were left blank were not counted as a response in our results.

Results
Incidence
Question 1: On average, how many new cases of VLK do you see a year?

Number of responses (55 total)

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Do not see any new cases</td>
</tr>
<tr>
<td>17</td>
<td>See 1-2 new cases</td>
</tr>
<tr>
<td>15</td>
<td>See 3-5 new cases</td>
</tr>
<tr>
<td>17</td>
<td>See more than 5 new cases</td>
</tr>
</tbody>
</table>
**Question 2:** In your practice, has the incidence of VLK increased, decreased, or stayed the same over the past 5 years

Number of responses (54 total)
- 30 felt the incidence stayed the same
- 21 felt the incidence decreased
- 3 felt the incidence increased

![Graph 2](image)

Etiology

Questions 3 and 4 of the survey dealt with the etiologies responsible for the development of VLK. The questions were multiple choice and the practitioners were allowed to choose more than one answer.

**Question 3:** In your experience, what do you suspect is/are the primary etiologies responsible for the formation of VLK lesions?

Number of responses (180 total)
- 48 chronic peripheral desiccation
- 44 RGP lens design phenomena
- 30 inadequate blink
- 27 tear film anomaly
- 13 peripheral corneal topography anomaly
- 9 RGP lens material phenomena
Other less common responses included:

- Upper lid related anomaly
- Lens care solution related phenomena
- Limbal vascular hypoxia
- Environmental factors

![Graph 3: Etiologies of VLK](image)
The practitioners that suspected lens design as an etiology were asked to choose which tens parameters were most responsible for the development of VLK.

**Question 4:** If one of your suspected etiologies was lens design, which parameter do you feel is most responsible for the development of VLK?

Number of responses (128 total)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral lens design</td>
<td>40</td>
</tr>
<tr>
<td>Edge contour</td>
<td>28</td>
</tr>
<tr>
<td>Peripheral lens thickness</td>
<td>24</td>
</tr>
<tr>
<td>Large overall diameter</td>
<td>19</td>
</tr>
<tr>
<td>Base curve radius</td>
<td>12</td>
</tr>
<tr>
<td>Posterior optical zone diameter</td>
<td>4</td>
</tr>
<tr>
<td>Central lens thickness</td>
<td>1</td>
</tr>
</tbody>
</table>

![Graph 4](image-url)

**Graph 4**

*Lens design responsible for VLK*
Management

Questions 5 and 6 of the survey enabled the practitioners to express their clinical expertise on the management of VLK. The questions were multiple choice and the practitioners were allowed to select more than one answer.

Question 5: The following photograph (Figure 2- stage II VLK photo) is that of a 34 year old female with symptomatic stage II VLK. The patient history includes successful RGP lens wear for the past 10 years. The patient's present contact lenses are fitted with excellent alignment with good lens movement and centration. The lens specifications are:

- B.C. 42.79 D (7.90 mm)
- Power -4.25 D
- Diameter 9.6 mm
- Optical Zone 8.0 mm
- Center Thickness 0.14 mm
- Curves 9.00 .2, 10.00 .2, 11.50 .3
- Material Boston ES

In treating this patient, your suggested plan would include:

Number of responses (123 total)

- 29 Discontinue RGP lens wear temporarily
- 24 Order new RGP lenses with different parameters
- 19 Refit with soft contact lenses
- 16 Modify the existing lens
- 14 Anti-inflammatory medications
- 8 Suggest refractive surgery

Other less common responses included:

- Artificial tears
- Change the patient's lens care regimen
- Discontinue RGP lens wear permanently
- Disposable hydrogel bandage lens
The practitioners that elected to order a new RGP lens were asked to identify which lens parameters they would change.

Number of responses (51 total)

<table>
<thead>
<tr>
<th>Response</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease overall diameter</td>
<td>18</td>
</tr>
<tr>
<td>Flatten peripheral curve</td>
<td>5</td>
</tr>
<tr>
<td>Lenticular edge design</td>
<td>5</td>
</tr>
<tr>
<td>Steepen peripheral curve</td>
<td>5</td>
</tr>
<tr>
<td>Thinner center thickness</td>
<td>5</td>
</tr>
<tr>
<td>Higher D/K lens</td>
<td>3</td>
</tr>
<tr>
<td>Decrease optic zone diameter</td>
<td>3</td>
</tr>
<tr>
<td>Flatten base curve</td>
<td>2</td>
</tr>
<tr>
<td>Blend edge design</td>
<td>2</td>
</tr>
</tbody>
</table>
Other less common responses included:
   - Steeper base curve
   - Increase overall diameter
   - Lid attach design

The practitioners that chose to modify the existing RGP lens were asked which parameters they would change.

Number of responses (21 total)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flatten peripheral curve</td>
<td>7</td>
</tr>
<tr>
<td>Decrease overall diameter</td>
<td>6</td>
</tr>
<tr>
<td>Blend peripheral curve</td>
<td>4</td>
</tr>
<tr>
<td>Lenticulate</td>
<td>2</td>
</tr>
</tbody>
</table>

Other less common responses included:
   - Flatten base curve
   - Decrease center thickness
The practitioners that chose to prescribe anti-inflammatory medications were asked to specify their medication of choice.

Number of responses (20 total)

- 6         FML
- 6         Tobradex
- 3         Lotemax
- 2         Acular

Other less common responses included:
- Alrex
- Pred Forte
- Patanol
Question 6: The following photograph (Figure 3-stage IV VLK photo) is that of a 28 year old female with symptomatic stage IV VLK. The patient history includes successful RGP lens wear for the past 12 years. The patient's present contact lenses are fitted with excellent alignment with good lens movement and centration. The lens specifications are:

- B.C. 45.00 D (7.50 mm)
- Power -5.50
- Diameter 9.2 mm
- Optical Zone 7.8 mm
- Center Thickness 0.13 mm
- Curves 8.50 .4, 11.50 .3
- Material Paragon HDS

In treating this patient your suggested plan would include:

Number of responses (151 total)

- 33 Prescribe anti-inflammatory meds
- 32 Discontinue RGP lens wear temporarily
- 23 Refit with soft contact lenses
- 18 Order new RGP lens
- 12 Discontinue RGP lens wear permanently
- 12 Modify the existing RGP lens
- 9 Suggest refractive surgery

Other less common responses included:

- Artificial tears
- Change the patient's lens care regimen
- Excise lesion
The practitioners that chose to prescribe anti-inflammatory medications were asked to specify their medication of choice.

Number of responses (31 total)

<table>
<thead>
<tr>
<th>Number</th>
<th>Medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Tobradex</td>
</tr>
<tr>
<td>8</td>
<td>FML</td>
</tr>
<tr>
<td>4</td>
<td>Pred Forte</td>
</tr>
<tr>
<td>4</td>
<td>Lotemax</td>
</tr>
</tbody>
</table>
Other less common responses included:
- Alrex
- Acular

The practitioners that chose to order a new RGP lens were asked to identify what lens parameters they would change.

Number of responses (39 total)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease overall diameter</td>
<td>18</td>
</tr>
<tr>
<td>Flatter base curve</td>
<td>5</td>
</tr>
<tr>
<td>Steeper peripheral curve</td>
<td>3</td>
</tr>
<tr>
<td>Thinner edge design</td>
<td>2</td>
</tr>
<tr>
<td>Smaller optic zone</td>
<td>2</td>
</tr>
<tr>
<td>New material</td>
<td>2</td>
</tr>
<tr>
<td>Decrease center thickness</td>
<td>2</td>
</tr>
<tr>
<td>Flatter peripheral curve</td>
<td>2</td>
</tr>
</tbody>
</table>

Other less common responses included:
- Wider peripheral curve
- Steeper base curve
- Larger overall diameter
The practitioners that elected to modify the existing RGP lens were asked what lens parameters they would change.

Number of responses (8 total)

<table>
<thead>
<tr>
<th>Number</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Flatten peripheral curve</td>
</tr>
<tr>
<td>2</td>
<td>Blend peripheral curve</td>
</tr>
<tr>
<td>2</td>
<td>Decrease optic zone</td>
</tr>
<tr>
<td>1</td>
<td>Decrease overall diameter</td>
</tr>
<tr>
<td>1</td>
<td>Decrease edge thickness</td>
</tr>
</tbody>
</table>

Graph 11

Graph 12
Question 7: Following your treatment of VLK, what percent of your patients have complete resolution of the lesions with no recurrence?

Number of responses (45 total)

<table>
<thead>
<tr>
<th>Percentage Range</th>
<th>Number of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20% complete resolution</td>
<td>3</td>
</tr>
<tr>
<td>21-40% complete resolution</td>
<td>6</td>
</tr>
<tr>
<td>41-60% complete resolution</td>
<td>11</td>
</tr>
<tr>
<td>61-80% complete resolution</td>
<td>9</td>
</tr>
<tr>
<td>81-100% complete resolution</td>
<td>16</td>
</tr>
</tbody>
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Discussion

Although VLK is a relatively rare corneal complication, it can lead to corneal erosion and permanent lens intolerance if left untreated. Successful management of VLK requires intervention during the early stages, while successful diagnosis requires familiarity with the etiology, and clinical signs and symptoms. Our survey of diplomats of the Cornea and Contact Lens section of the American Academy of Optometry reveals the primary etiological factors responsible for the formation of a VLK lesion and the current treatment modalities. The primary etiology is related to rigid gas permeable lens design and lens-cornea fitting relationship. Given that the etiology is lens related, treatment modalities for early stage VLK revolve around conservative methods such as temporary discontinuation of lens wear, modifying existing lens parameters, and refitting with soft contact lenses. Late stage VLK management is identical to the early stage, but incorporates the use of anti-inflammatory medications.
Figure 1.

**VLK Questionnaire**

1. On average, how many new cases of VLK do you see a year?
   - A. 0
   - B. 1-2
   - C. 3-5
   - D. More than 5
   - E. Other (please comment)

2. In your practice, over the past five years, has the incidence of VLK:
   - A. Increased
   - B. Stayed the same
   - C. Decreased

3. In your experience, what do you suspect is/are the primary etiologies responsible for the formation of VLK lesions? (circle all that apply)
   - A. RGP lens design phenomena
   - B. RGP lens material phenomena
   - C. Lens care solution related phenomena
   - D. Chronic peripheral desiccation
   - E. Tear film anomaly
   - F. Inadequate blink
   - G. Upper lid related anomaly
   - H. Peripheral corneal topography anomaly
   - I. Other (please comment)

4. If one of your suspected etiologies was lens design, which parameter(s) do you feel is (are) most responsible for the development of VLK? (circle all that apply)
   - A. Base curve radius
   - B. Posterior optical zone diameter
   - C. Large overall diameter
   - D. Edge contour
   - E. Peripheral lens design
   - F. Central lens thickness
   - G. Peripheral lens thickness
   - H. Other (please comment)

5. The following photograph (refer to stage I VLK photo) is that of a 34-year-old female with symptomatic stage 1 VLK. The patient history includes successful RGP lens wear for the past 10 years. The patient's present contact lenses are fitted with excellent alignment with good lens movement and centration. The lens specifications are:
   - **Base Curve:** 42.75 D (7.90 mm)
   - **Power:** -4.25
   - **Diameter:** 9.6 mm
   - **Optical Zone:** 8.0 mm
   - **Center Thickness:** .14
   - **Curves:** 9.00.2, 10.00.2, 11.50.3
   - **Material:** Boston ES

   In treating this patient your suggested plan would include: (circle all that apply)
   - A. Discontinue rigid lens wear temporarily
   - B. Discontinue rigid lens wear permanently
   - C. Modify the existing lens (please describe what modifications you would suggest)
   - D. Order a new RGP lens (please describe what changes you would make from the patient's existing lenses)
   - E. Prescribe an anti-inflammatory medication (please describe your medication(s) of choice and length of treatment)
   - F. Change the patient's lens care regimen
   - G. Refit with soft contact lenses
   - H. Suggest refractive surgery
   - I. Excise lesion
   - J. Other (please comment)
6. The following photograph (refer to stage IV VLK photo) is that of a 28-year-old female with symptomatic stage IV VLK. The patient history includes successful RGP lens wear for the past 12 years. The patient’s present contact lenses are fitted with excellent alignment with good lens movement and centration. The lens specifications are:

- Base Curve: 45.00 D (7.50 mm)
- Power: -5.50
- Diameter: 9.2 mm
- Optical Zone: 7.8 mm
- Center Thickness: .13
- Curves: 8.50 .4, 11.50 .3
- Material: Paragon HDS

In treating this patient, your suggested plan would include: (circle all that apply)

A. Discontinue rigid lens wear temporarily
B. Discontinue rigid lens wear permanently
C. Modify the existing lens (please describe what modifications you would suggest)
D. Order a new RGP lens (please describe what changes you would make from the patient’s existing lenses)
E. Prescribe an anti-inflammatory medication (please describe your medication(s) of choice and length of treatment)
F. Change the patient’s lens care regimen
G. Refit with soft contact lenses
H. Suggest refractive surgery
I. Excise lesion
J. Other

7. Following your treatment of VLK, what percent of your patients have complete resolution of the lesions with no recurrence?

8. Additional Comments:
Figure 2.

Figure 3.
References