Corneal Staining

What is the Clinical Relevance?

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• Ohio State University 1978
• Residency Veterans Administration Medical Center 1979
• Chief, Optometry Service VAMC 1980
• Center Director, OMNI Eye Services 1985
• Chairman, Department Clinical Sciences & Director Glaucoma Institute 1989
• Optometric Medical Director, Ophthalmic Consultants of Connecticut 2000
• Adjunct Clinical Professor, Pennsylvania College of Optometry
• Chairman, National Cornea & Anterior Segment Society
Staining: Factors for Consideration

- Multi-purpose solution (MPS)
- Contact lens selection
- Combination of lens and solution
- Dry eye
- Patient-dependent factors:
  - Frequency of changing lenses
  - Lens hygiene
The Healthy Tear Film
A Delicate Balance

- Lipid, aqueous & mucin components
- Outer lipid layer prevents aqueous evaporation
  - Secreted by meibomian glands
- Aqueous component – a complex mixture of proteins, mucins, electrolytes
  - Secreted by main & accessory lacrimal glands
- Mucins provide viscosity and stability during the blink cycle
  - Mucin gel decreases in density toward tear film surface

Image from *Dry Eye and Ocular Surface Disorders*, 2004
## Signs of Dry Eye

<table>
<thead>
<tr>
<th>Dry Eye Severity Level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Symptoms</td>
<td>Mild Symptoms</td>
<td>Moderate Symptoms</td>
<td>Severe Symptoms</td>
<td>Severe Symptoms</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Mild</td>
<td>Moderate</td>
<td>Marked</td>
<td>Scarring</td>
</tr>
<tr>
<td>Conjunctival Staining</td>
<td>Mild</td>
<td>Moderate</td>
<td>Marked punctate central</td>
<td>Severe punctate erosions</td>
</tr>
<tr>
<td>Corneal Staining</td>
<td>Mild</td>
<td>Mild punctate</td>
<td>Marked punctate central</td>
<td>Severe punctate erosions</td>
</tr>
<tr>
<td>Tear Film</td>
<td>Visual signs</td>
<td>Visual signs</td>
<td>Visual signs</td>
<td>Visual signs</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>Filamentary keratitis</td>
<td>Filamentary keratitis</td>
<td>Filamentary keratitis</td>
</tr>
<tr>
<td>Tear Film Breakup Time</td>
<td>&lt; 7</td>
<td>&gt; 2 &lt; 7</td>
<td>&lt; 0</td>
<td>&lt; 0</td>
</tr>
<tr>
<td>Shirmer Score</td>
<td>&gt; 10</td>
<td>&gt; 5 &lt; 10</td>
<td>&lt; 5</td>
<td>&lt; 2</td>
</tr>
</tbody>
</table>

What’s the standard for assessing biocompatibility?
Rabbit corneas dosed 2 drops QID for 7 days. Corneal surfaces imaged with scanning electron microscopy.
COMPLETE MoisturePLUS™ MPS, 600x

Junctions | Cell Appearance
---|---
Intact | No peeling or sloughing

AMO Data on file
ReNu MultiPlus® MPS, 500x

AMO Data on file

Junctions | Cell Appearance
---|---
Intact | Abnormal
Corneal Staining with Contact Lens Use

- Observed with some lens-solution combinations
- Can be a form of chemical keratitis or chemical trauma, possibly from the preservatives, to the epithelium
Corneal Staining with Contact Lens Use

- **Staining TYPE (severity)**
  1. Micropunctate
  2. Macropunctate
  3. Coalesced
  4. Patch

- **Staining AREA**
  - Divided cornea into 5 sectors
  - 0% to 100% in 10% increments

Andrasko, Ryen Garofalo and Lemp, 2006
Corneal Staining with Contact Lens Use

- Typically asymptomatic
- Observed most intensely at 2 hours after insertion of the lens
- Resolves by 6 hours
- Clinical significance is to be determined

Andrasko Corneal Staining Grid

The Staining Grid is an easy-to-use reference tool informing the eye care practitioner as to the level of biocompatibility of various contact lens/multipurpose solutions. It appears as a "grid" with the solutions listed across the top and the lens materials in the first column. The percentages which appear in each cell represent the average percentage of the cornea which was stained 2 hours after lens/solution contact. For information on our testing procedures please see the methodology question in the Frequently Asked Questions section of this site. Also, read the section explaining staining scales and how to cut through the staining scale confusion.

To choose a biocompatible multipurpose solution for a particular lens brand:

1) Find the lens material (if it has been tested) in the first column of the grid
2) Follow across that row and select a solution which results in minimal corneal staining (i.e., green zone).

Easy-to-use reference tool informing eye care practitioner as to the level of biocompatibility
There seems to be variability of findings between methodologies in certain combinations.
Staining Study

- Study evaluating 48 patients randomized to either Opti-Free Express or Opti-Free RepleniSH using:
  - Acuvue 2
  - Acuvue Oasys
  - Proclear
  - Purevision
  - O2 Optix

- Staining at 1 day post-soak, evaluated 30 minutes after lens insertion

- Utilized Andrasko methods of grading staining

Kislan and Bucci,
AOA Poster Presentation 2008
## Results Comparison

<table>
<thead>
<tr>
<th></th>
<th>Opti-Free Express</th>
<th>Opti-Free RepleniSH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bucci/Kislan*</td>
<td>Andrasko**</td>
</tr>
<tr>
<td>Acuvue 2</td>
<td>29%</td>
<td>2%</td>
</tr>
<tr>
<td>Proclear</td>
<td>30%</td>
<td>1%</td>
</tr>
<tr>
<td>Acuvue Oasys</td>
<td>30%</td>
<td>3%</td>
</tr>
<tr>
<td>Purevision</td>
<td>46%</td>
<td>4%</td>
</tr>
<tr>
<td>O2 Optix</td>
<td>28%</td>
<td>2%</td>
</tr>
</tbody>
</table>

**Staining Zone Color Zones**

- **< 10%**
- **10 - 20%**
- **> 20%**

* *Bucci/Kislan % at 30 minutes*

**Andrasko % at 2 hours**
In Summary

• Depending on observation time and other variables, every lens and care solution pair exhibit some staining

• Due to differences in formulations and contact lens materials:
  – Each product may exhibit different windows of staining
  – Products with the same preservative may show different ocular toxicity profiles

• Current data suggest no correlation between short-term, transient staining and damage to the eye due to multipurpose solutions

• Studies demonstrating staining using different time points must be validated for the specific solution and lens material