

# Corneal Staining

What is the Clinical Relevance?

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# Dr. J. James Thimons

- 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

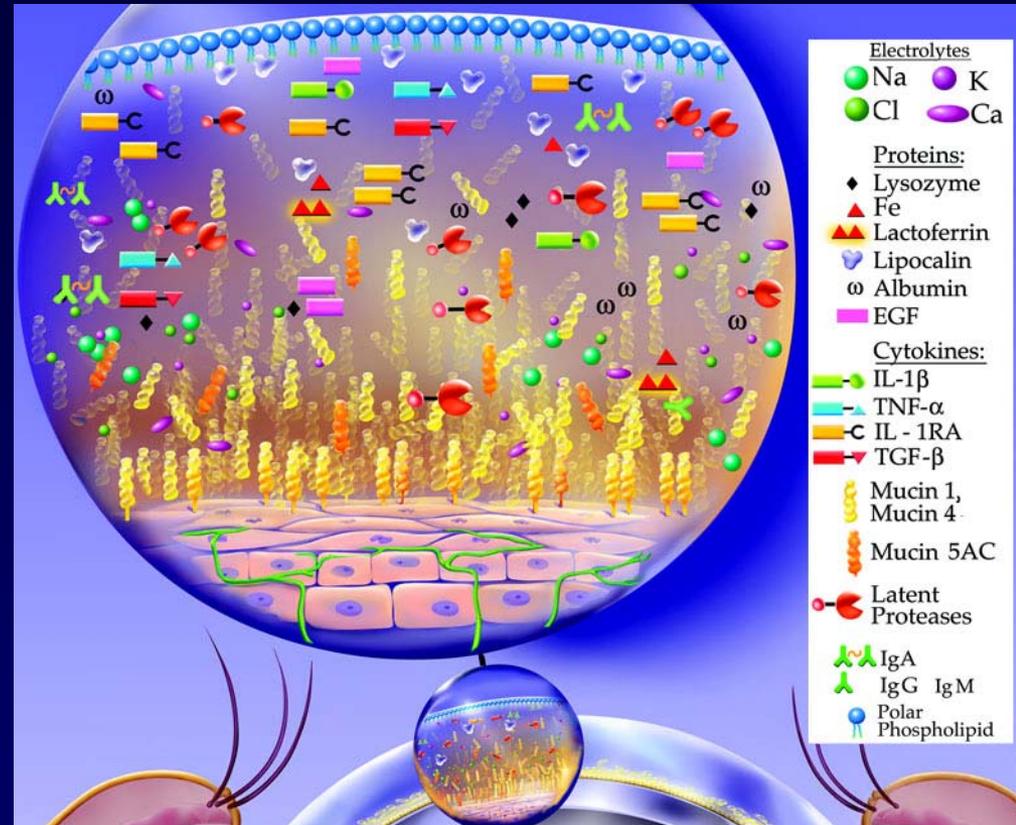
# Staining: Factors for Consideration

- 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



# Signs of Dry Eye

Dry Eye Severity Level	1	2	3	4
General Symptoms	Mild Symptoms	Moderate Symptoms	Severe Symptoms	Severe Symptoms
Diagnosis Conjunctival Staining	Mild	Moderate	Marked	Scarring
Corneal Staining		Mild punctate	Marked punctate central	Severe punctate erosions
Tear Film		Visual signs	Visual signs	Visual signs
Other			Filamentary keratitis	Filamentary keratitis
Tear Film Breakup Time	< 7	> 2 < 7	< 0	< 0
Shirmer Score	> 10	> 5 < 10	< 5	< 2

**What's the standard for  
assessing biocompatibility?**

CONTROL (L)

CONTROL, 600x, no drops

AMO Data on file

Junctions	Cell Appearance
Intact	No peeling or sloughing

Rabbit corneas dosed 2 drops QID for 7 days. Corneal surfaces imaged with scanning electron microscopy.

70245 (R)

COMPLETE MoisturePLUS™  
MPS, 600x

AMO Data on file

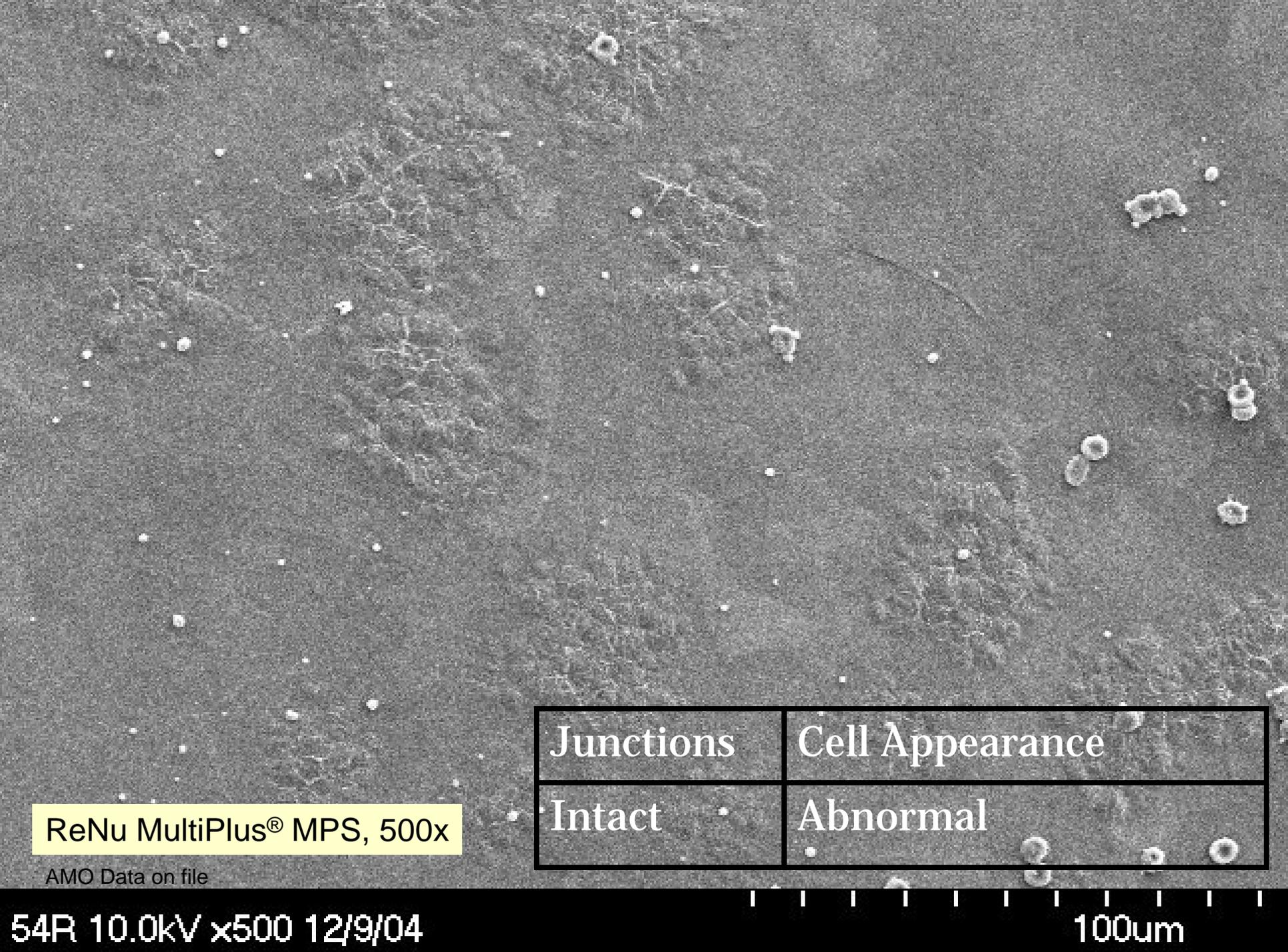
Junctions

Cell Appearance

Intact

No peeling or sloughing

3.0KV 0.60KX 16.7μ 0020



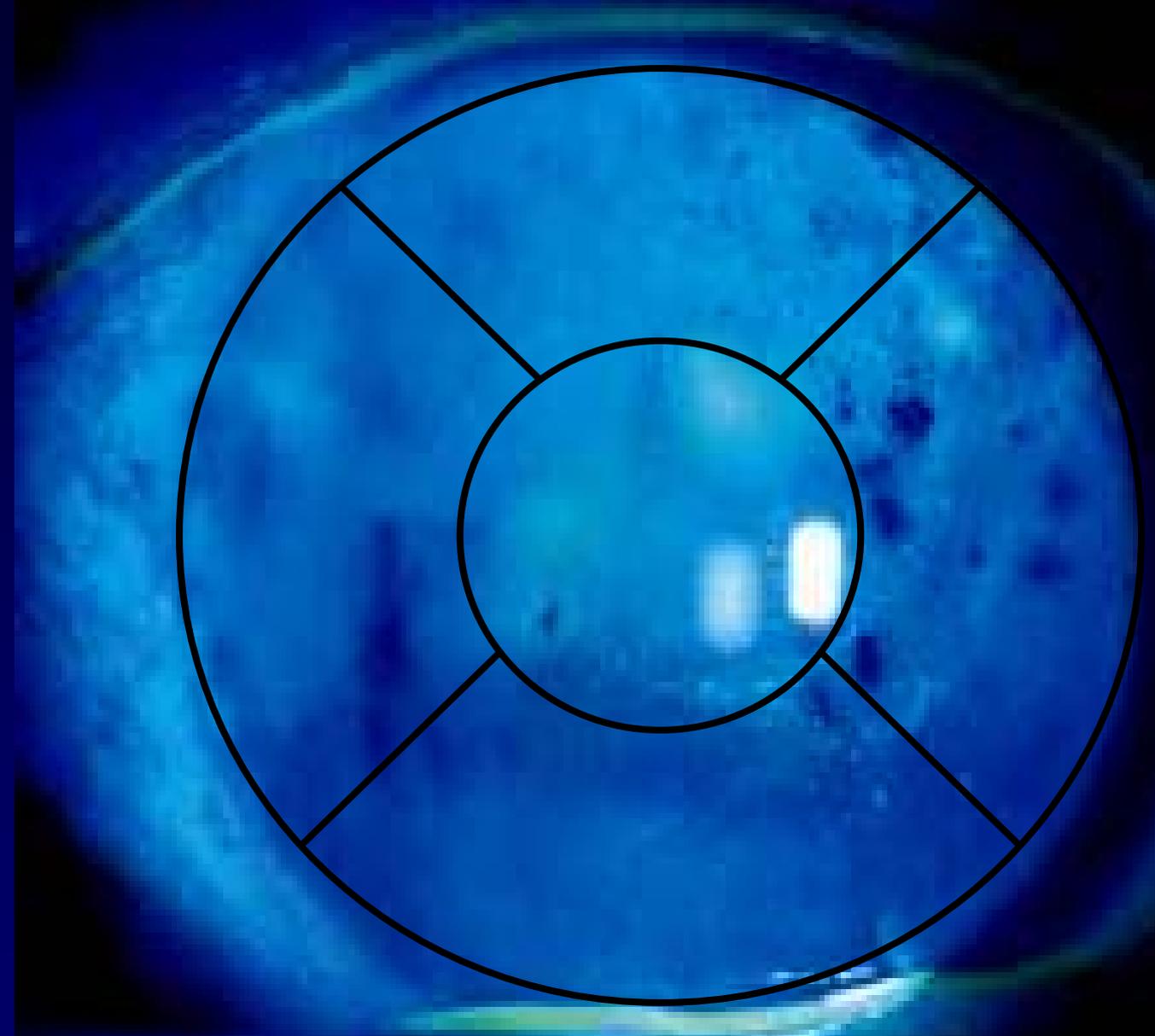
ReNu MultiPlus® MPS, 500x

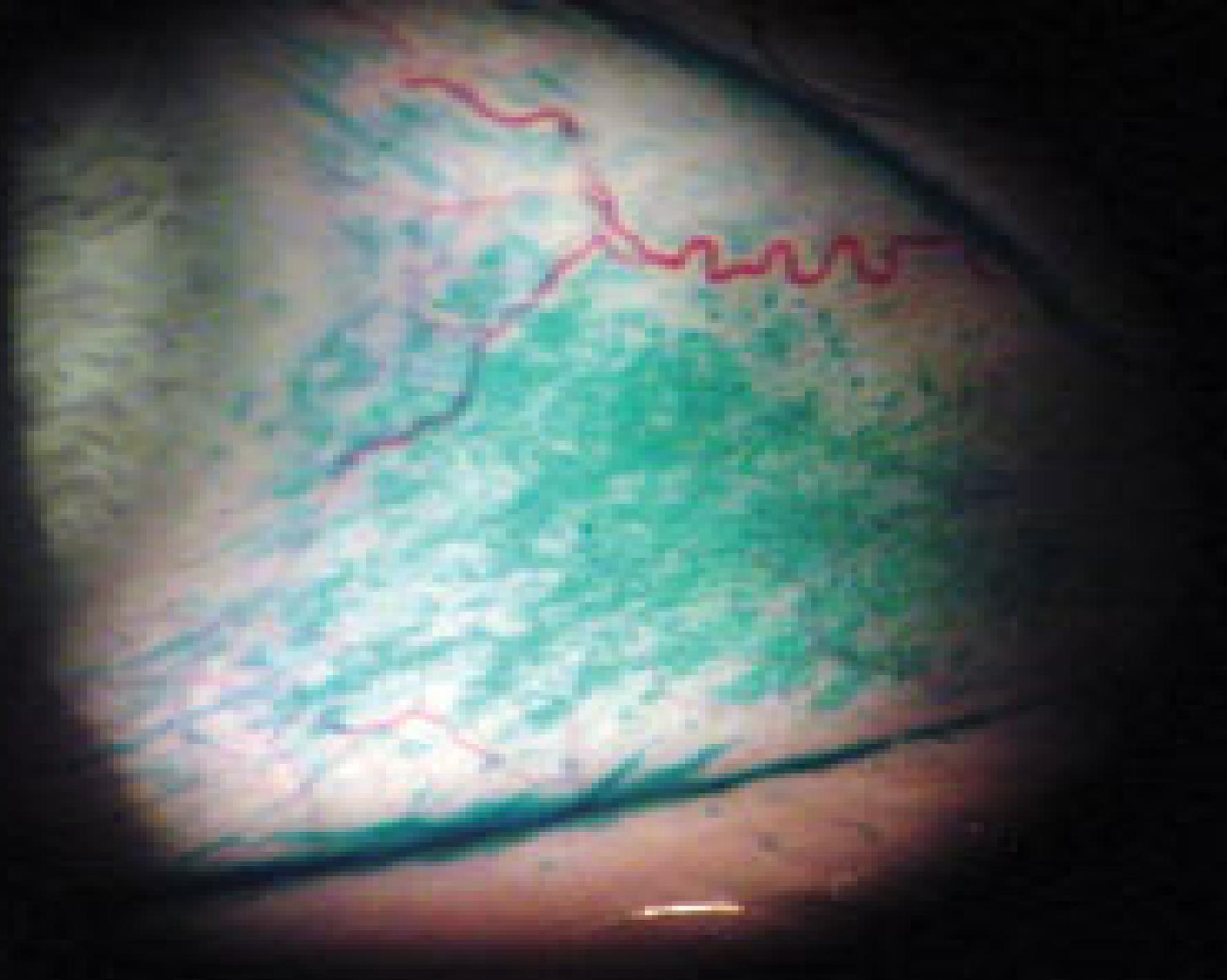
AMO Data on file

Junctions	Cell Appearance
Intact	Abnormal

54R 10.0kV x500 12/9/04

100um





# 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

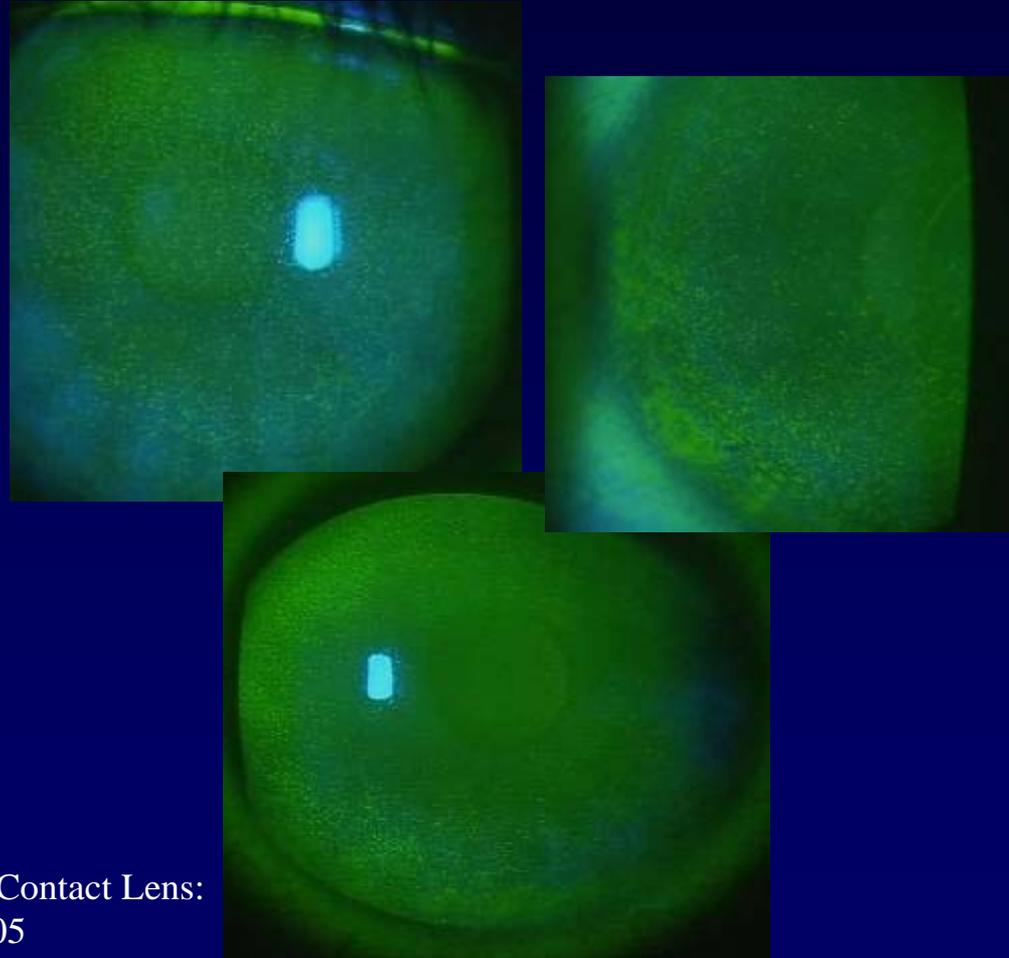
# Corneal Staining with Contact Lens Use

- **Staining TYPE (severity)**
  1. Micropunctate
  2. Macropunctate
  3. Coalesced
  4. Patch
- **Staining AREA**
  - Divided cornea into 5 sectors
  - 0% to 100% in 10% increments



# 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 Staining Grid

Contact Lens  
Research  
Services

The Place for Contact Lens Biocompatibility Research



## The Staining Grid Center

Total Site Hits: 97048

Staining Grid

Comfort Analysis

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## 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 insertion. 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

### The Grid at a Glance ...

- New Solutions Added to Grid *New!*
- Blog: Setting Record Straight *New!*

Lens and Solution Combinations  
Percentage of Average Corneal Staining Area at 2 Hours

		Branded Solutions						Private Label Solutions				
		Hydrot® Salin®	Clear Care®	Optiline Express®	Optiline Rejuvenate®	Revo Multipurpose®	Complete MP®/Revo Risk®	Agility®	Waterfall MP® (Revo MP®)	Target MP® (Revo MP®)	CVT MP® (Revo MP®)	Waterfall MP® (Revo MP®)
Hydrogel	Acuvue® 2	1%	1%	2%	5%	1%	1%	1%	1%	1%	1%	1%
	Proclear®	1%	1%	1%	2%	57%	6%	12%	61%	64%	63%	42%
	Soflens® 66	1%	1%	1%	1%	73%	17%	8%	66%	62%	Testing Ongoing	Testing Ongoing
Silicone Hydrogel	Acuvue® Advance®	1%	1%	1%	1%	13%	12%	2%	16%	13%	12%	12%
	Acuvue® Oasys®	2%	1%	3%	5%	9%	4%	3%	12%	8%	13%	10%
	Acuvue® Moist®	2%	2%	3%	2%	4%	2%	2%	4%	3%	3%	2%
Hydrogel	Paracomb®	2%	1%	4%	7%	73%	15%	21%	71%	76%	Testing Ongoing	Testing Ongoing
	Optix®	2%	1%	2%	5%	24%	3%	3%	41%	28%	28%	24%
	Night & Day®	2%	1%	2%	3%	24%	1%	3%	36%	24%	26%	22%

Updated April 16, 2008

Staining Zone Color Codes:  
■ under 5% ■ 5% to 20% ■ over 20% ■ over 30% ■ Explanation of color coding

# Staining Grid Comparisons

## IER\* / Andrasko Comparison

Lens/Solution	CLEAR CARE*		Aquify* MPS		OPTI-FREE® EXPRESS®		OPTI-FREE® RepleniSH® MPDS	
	IER	Andrasko	IER	Andrasko	IER	Andrasko	IER	Andrasko
ACUVUE* ADVANCE	0.0%	1.0%	0.9%	2.0%	0.0%	1.0%	0.0%	1.0%
ACUVUE* OASYS*	0.9%	1.0%	2.5%	3.0%	6.2%	3.0%	7.1%	5.0%
O <sub>2</sub> OPTIX*	0.5%	1.0%	3.2%	3.0%	5.9%	2.0%	6.7%	5.0%
PureVision*	0.9%	1.0%	23.2%	21.0%	11.3%	4.0%	14.2%	7.0%

IER = % of subjects at 30 days  
Andrasko = % of staining at 2 hours

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

# Results Comparison

		Opti-Free Express		Opti-Free RepleniSH	
		Bucci/Kislan*	Andrasko**	Bucci/Kislan*	Andrasko**
Hydrogel	Acuvue 2	29%	2%	27%	5%
	Proclear	30%	1%	27%	2%
Silicone Hydrogel	Acuvue Oasys	30%	3%	33%	5%
	Purevision	46%	4%	16%	7%
	O2 Optix	28%	2%	14%	5%

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