Controversies in contact lens care
A clinical perspective to define the best system

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Professor - Université de Montréal

Disclosure - Dr Michaud

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- Genzyme Canada - Canadian Opto. Ass.
- AMO /Abbott - Alcon / Ciba

Introduction

Contact lens care systems have evolved with 3 new products launched in the market in 2011-2012.

BUT

We are still seeing problems related with comfort and ocular health

What defines the best care system to avoid negative impacts on contact lens wear and ocular health?
Contact lens care US market

Source: Contact Lens Spectrum annual report, January 2012.

Canadian Market

2013-2014 Canadian Lens Care Market

Canadian Market - by Manufacturer
New players in town

- New formulations
  - AMO Revitalens Ocutec
  - B&L Biotrue
  - Others are evolved from former platforms
    - Alcon Opti-Free Moist

B&L Biotrue

Specific Features

- Matches pH of healthy tears
  - to promote comfort upon insertion
  - pH level provides optimal activation of the dual disinfectants in Biotrue (antimicrobial efficacy)
- Based on a lubricant found in eyes
  - Hyaluronan (HA)
  - Long lasting effect which improves comfort
- Company claims that it keeps certain beneficial tear proteins active¹
  - Lysozymes and Lactoferrin
  - Objective data non conclusive ²

AMO Revitalens Ocutec

- Enhanced disinfection with the combination of Alexidine (biguanide family) and PQ-1
  - In addition: EDTA
- Kill rate equal or superior to hydrogen peroxide
  - With the convenience of MPS
  - Combined action of Alexidine and PQ-1
- Boric acid, sodium borate
- Available only through professional offices in Canada
Disinfection – comparable to peroxide

<table>
<thead>
<tr>
<th>Product Type</th>
<th>Zone Color: Extent Observed Fluorescence</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>&lt;10%</td>
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<tr>
<td></td>
<td>10–20%</td>
</tr>
<tr>
<td></td>
<td>&gt;20%</td>
</tr>
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</table>

Peroxide-quality disinfection with the convenience of a Multi-Purpose Disinfecting Solution

A second look: hyperfluorescence vs time

- Similar testing to Andrasko

<table>
<thead>
<tr>
<th>Product Type</th>
<th>30 mins</th>
<th>2 hrs</th>
<th>30 mins</th>
<th>2 hrs</th>
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</thead>
<tbody>
<tr>
<td>Acuvue® 2™</td>
<td>29%</td>
<td>2%</td>
<td>27%</td>
<td>5%</td>
</tr>
<tr>
<td>Proclear®†</td>
<td>30%</td>
<td>1%</td>
<td>27%</td>
<td>2%</td>
</tr>
<tr>
<td>Acuvue® Oasys®</td>
<td>30%</td>
<td>3%</td>
<td>33%</td>
<td>5%</td>
</tr>
<tr>
<td>PureVision®‡</td>
<td>46%</td>
<td>4%</td>
<td>16%</td>
<td>7%</td>
</tr>
<tr>
<td>O2 Optix®§</td>
<td>28%</td>
<td>2%</td>
<td>14%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Proven efficacy against pathogens, fungi and acanthamoeba
- Widely used in the last 20 years by many companies
- Alexidine is part of the biguanides family
- 2/3 of the newest solutions incorporate such elements
- Modes of action similar to PQ-1
  - Action on cell membrane
  - Larger molecular size: reduced % of biocide needed for clinical action

PHMB: the reality

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PHMB

- Performance influenced by pH
  - Tears pH: 7.10 – 8.06
  - Contact lens solutions: 7.23 – 7.88
  - Revitalens 7.8, Biotrue 7.5
    - PHMB is more active at 7.8

- Heavily adsorbed during soaking
  - Disinfection in the case is reduced
  - Addition of PQ-1 to PHMB or Alexidine helps to increase pathogens disinfection in the case

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Alcon’s Pure Moist

- Alcon’s Pure Moist
- Improved contact lens wetting technology (Hydraglyde®)
  - EO–polyoxyethylene attracts moisture
  - BO–polyoxybutylene targets silicone
  - In theory, helps comfort.
    - No published data support this claim
    - Reduces lipid deposition
  - Higher disinfection profile
    - Addition of a chelating agent (EDTA)
    - Enhances anti-microbial activity

1- Curr Eye Research 1997 16(5):482-6
Dreams vs reality

Clinical requirements

| 1. Disinfection  | 90% ODs recommend solutions based on: |
| 2. Cleaning       | 1. Material-solution compatibility (34%) |
| 3. Eye-solution biocompatibility | 2. Potential impact on comfort (25%) |
| 4. Material-solution compatibility | 3. Disinfectant efficacy (23%) |
| 5. Help to restore lens surface/comfort | 4. Cleaning efficacy (12%) |
| 6. Compliance (easy to use) | 5. Convenience (6%) |
| 7. Affordable     | 6. Cost: not an issue |

Factors to consider

- Impacts of contact lens wear
  - Mechanical
  - Immunological
- Deposits
  - Bioburden
- Chemicals of the care regimen
  - Uptake and release
  - Efficacy
- Corneal Staining

Looking at evidence-based science for clinical recommendations

Impacts of lens wear and lens care on the ocular health
Impacts of the lens on the tear film

- Reduces tear film thickness in front of the lens in the first 30 minutes of wear, more with particular care regimen.
- This leads to tear film instability.
  - Vision reduced
  - Discomfort felt at the end of the day
  - TBUT is reduced by 5 sec compared to non wearers
- Increases tear film osmolarity
  - Linked with increased ocular dryness
  - Increases likelihood of deposits on the surface of the lens


Related to tear film composition and environmental conditions.
- Proteins, carbohydrates, lipids, mucin
- Bacteria and trapped exotoxins
- Nature and quantity of deposits vary from wearer to wearer, based on individual factors
- Deposits trigger mechanical and immune responses and increase patient discomfort.


Contact lens deposits

- Related to tear film composition and environmental conditions.
  - Proteins, carbohydrates, lipids, mucin
  - Bacteria and trapped exotoxins
- Nature and quantity of deposits vary from wearer to wearer, based on individual factors
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Mechanical response

- Giant Papillary Conjunctivitis (GPC)
- Seen with all types of contact lenses
- Hydrogel, Silly, RGPs, Hybrid
- Associated with lens discomfort
- Treatment according to algorithms
Deposits modify the immune composition of the tear film
- Increased potential for ocular infection to develop

Deposits favour the development of a biofilm on the lens
- Bacterial endotoxins on c.l. are hypothesized to be the principle causes of sterile infiltrates
- Microbial keratitis develop if there is
  - Enough pathogens
  - Sufficient time exposure to the cornea
  - An epithelial break


CL and microbiota
- The bacterial populations that colonize the lids and conjunctiva during long-term asymptomatic soft lens wear have been hypothesized to change based on the wear schedule.
  - More pathogenic species in EW
  - Increased load with SiHy
  - Lids > conjunctiva
    - Lids = major route of lens contamination

Contact lens wear and contamination
- It appears that soft CL wearers establish a baseline level of bioburden on their lenses at the first day of lens wear, which remains fairly consistent over time.
  - Exposure to normal flora
  - Ready from handling (lids)

- Substantial lid and conjunctival bioburden
  - associated with a 2.5 X and 4 X greater risk of substantial lens bioburden, respectively
Pathogen exposure

- Pathogens exposure
  - Exposure to other pathogens
    - Over 200 species
    - Gram + and Gram -
  - Pathogens migrating from lens cases and contaminated solution bottles
    - Positive microbial bioburden within storage cases: 24% to 81% including hydrogen peroxide systems

- Pathogens mutation
  - Phenotypic and genotypic shift occurs, and pathogens develop a biofilm (polysaccharide matrix) which protects them against natural defense mechanisms and biocides
  - Most common pathogenic species (P. aeruginosa, S. marcescens, and S. aureus) are known to form biofilms

Understanding the pathogenicity

- Pathogens transfer
  - Lens biomaterial acts as a vendor for adherence of microorganisms with subsequent transfer to the ocular surface
  - The pathway between bacterial contamination of CLs and corneal inflammatory events is not as straightforward as the link between CL bioburden and microbial keratitis
  - Other factors to consider:
    - Lens deposits or defects
    - Hypoxia
    - Cytotoxicity of care solutions
    - Changes in pH, oxygen and CO2 concentration
    - Corneal surface disruption

Associated micro-organisms

<table>
<thead>
<tr>
<th>CLARE</th>
<th>CLPU</th>
</tr>
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<tbody>
<tr>
<td>Haemophilus influenzae</td>
<td>Staphylococcus aureus</td>
</tr>
<tr>
<td>Acinetobacter sp</td>
<td>Streptococcus pneumoniae</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>Abiotrophia defectiva</td>
</tr>
<tr>
<td>Aeromonas hydrophila</td>
<td>Acinetobacter sp</td>
</tr>
<tr>
<td>Serratia liquefaciens</td>
<td></td>
</tr>
<tr>
<td>Serratia marcescens</td>
<td></td>
</tr>
<tr>
<td>Pseudomonas putida</td>
<td></td>
</tr>
</tbody>
</table>
Lens case: the weakest link

- Contamination of the case occurs within 7-10 days
- Mainly from gram + bacteria transferred from hands and gram - from water sources
- Some bacteria are quicker to develop biofilm
- Disinfection is then ineffective against them
- Transfer to the lens surface
- Contaminate the eye
  - Exotoxins
  - Corneal invasion

Bioburden

- On the back surface of the lens, deposits and pathogens are not exposed to the blinking process
- A tight lens on the eye, with reduced movement upon blinking, allow the pathogen to be exposed enoughly long to invade the cornea
- Pathogens endotoxins are released and remain trapped under a tight lens.
  - Immune system reacts. This leads to sterile infiltrative keratitis. Bioburden = risk factor #1

Pathogens

- Contamination comes from water sources and through airborne transportation
- Bathroom is the worst location to store cases and lenses
  - Pseudomonase, Achromobacter, Stenotrophomonase et Deltila
- Non compliance help to grow pathogens and to develop biofilm
  - Some elements, such as PG, can serve as a carbon source of nutrition for pathogens
  - Top-off reduces the concentration of biocide, making it ineffective
Pathogenic Microbes

- *Acanthamoeba*
- "Real-world" *Fusarium* strains
- MRSA, MRSE, MDR pathogens
- *Stenotrophomonas maltophilia* 1
- Variety of *Acanthamoeba*
- Reported with increasing frequency
- Supports the growth and replication of *Acanthamoeba*
- Commonly found in contact lens cases3

![Trophozoite containing food vacuoles with phagocytised *S. maltophilia* (arrows)](image)

**Factors associated with increased risk of ocular infection**

**Related to the lens**

- Contact lens materials
  - Hydrogels vs. SiHy
- Mode of wear
  - Conventional > disposable
  - 3 months > 1 month
- Contact lens fitting
  - Tight lens, reduced movement on the eye
- Power of the lens
  - High ametropia
- Care system
  - MPS vs Peroxyde
  - Extended wear
  - Hygiene / Compliance
  - Contact lens experience (>6 months)
  - Age (< 25 y.o.)
  - Smoking
  - Sex (M > F)
  - Internet purchase

**Clinical implications**

- Deposits occur a few minutes after lens insertion. Their accumulation leads to immune reactions
- Pathogens should be eliminated
  - Solutions can be inefficient to eradicate pathogens trapped into deposits or adsorbed on the lens surface
  - Lens case is the weakest link to look at
- Lens should be replaced often to minimize risk factors to develop infections
  - Daily disposable lenses represent the safest option
Uptake and release

**ALL MPS Solutions Contain Preservative Agents...**

<table>
<thead>
<tr>
<th>MPS</th>
<th>Preservative</th>
</tr>
</thead>
<tbody>
<tr>
<td>AQuity*</td>
<td>PHMB</td>
</tr>
<tr>
<td>Biotrue†</td>
<td>PHMB, PQ-1</td>
</tr>
<tr>
<td>Complete Easy Rub‡</td>
<td>PHMB</td>
</tr>
<tr>
<td>Opti-Free Evermoist (UK)/ Panosoft (USA)**</td>
<td>PQ-1, MAPD</td>
</tr>
<tr>
<td>Opti-Free Express†</td>
<td>PQ-1, MAPD</td>
</tr>
<tr>
<td>Opti-Free RepleniSH‡</td>
<td>PQ-1, MAPD</td>
</tr>
<tr>
<td>Pure Fresh§</td>
<td>PHMB</td>
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<tr>
<td>Pure sensitive†</td>
<td>PHMB</td>
</tr>
<tr>
<td>ReNu sensitive†</td>
<td>PHMB</td>
</tr>
<tr>
<td>ReNu Sensitive§</td>
<td>PHMB</td>
</tr>
<tr>
<td>RevitaLens OcuTec‡</td>
<td>Alexidine, PQ-1</td>
</tr>
</tbody>
</table>

MAPD = myristamidopropyl dimethylamine; PHMB = poly hexamethylene biguanide; PQ-1 = polyquaternium-1.

Trademark of *Ciba Vision, †Bausch & Lomb, Inc., ‡AMO, and §Alcon.


Amount and Rate of Preservative Uptake Is Influenced by Several Factors

Lens Material\(^1,2\)  Preservative Type\(^1,2\)  MPS Formulation\(^2\)

The Alexidine- and PHMB-based multipurpose solutions tested showed significant uptake of preservative into group IV lenses, decrease in the residual activity of the storage solution. MAPD uptake and release produces corneal staining. OFX and OFR MPS maintained fungicidal efficacy after storage of lenses. PQ-1 properly formulated does not bind to contact lenses.

Biocide uptake

- Higher adsorption by ionic and non-SiHy lenses.
- Slower desorption (t(1/2) = 120 min.)
- Uptake capacity much higher with all SiHy lenses. Faster desorption (t(1/2) = 20 min.).
- This difference can trigger clinical signs seen after 30 min vs 2h00 post-insertion.

Uptake vs material

- PHMB
- Higher adsorption by ionic and non-SiHy lenses.
- Slower desorption (t(1/2) = 120 min.)

- Aldox
- Uptake capacity much higher with all SiHy lenses.
- Faster desorption (t(1/2) = 20 min.)

- Adsorbed MPS Preservatives Are Released by the Lens Into the Tear Film Upon Application Onto the Eye

- The release rate is dependent on the preservative and lens material combination.
- Released preservatives are dissipated by normal tear flow.

References:
Uptake and release of biocides

- There are differences in the preferential adsorption/release profile of certain compounds.

- Can lead to clinical side effects:
  - Expected increase in cytotoxicity with borate-based MPS (ex: OFR, Biotrue, Revitalens) solutions in vitro when compared with both phosphate-buffered saline (ex: Renu Fresh, Sauflon, Complete MPS) and borate-exposed lenses
  - Some exceptions can apply

Biocide release and discomfort

- Lens care products can change corneal staining and comfort responses during wear.

- These changes may be associated with release of material soaked into lenses or changes to the lens surface composition.

- Could be related to time of desorption

Staining: is this for real?
Andrasko, IER and others
- Lens/solution interaction theory
- Had been linked to increased discomfort
- Had been described as
  - An alteration of the epithelial membrane permeability
  - A sign of cytotoxicity
  - A triggering factor for inflammation and infection

Epithelial barrier function
- Its disruption is a known risk factor to develop MK
- Could be altered by hypoxia and mechanical impact of the lens on the eye
- Antimicrobial agents in the lens care solutions are intended to breach the cell walls of microbes and have the potential for cell membrane toxicity in the corneal epithelial cells
- Cell damage results in a loss of metabolic function and cell viability.

Epithelial barrier function
- The current marketed contact lens MPS may have negative effects on human corneal epithelial viability and barrier function.
- Among 4 MPS studied, MPS A (AMO –Complete) maintains the cell viability and barrier function significantly better than other 3 marketed products (Alcon OFX, OFR and B&L Renu)\(^1\)

Staining or cytotoxicity

- Cytotoxicity = alteration of the cell viability
- Translates an attack to cell membrane integrity
- Agents known with cytotoxic potential effects:
  - benzalkonium chloride, berberine chloride, and chlorhexidine
- Solutions potential to induce cytotoxicity
  - SoloCare = Complete Comfort Plus < ReNu < OFX with Aldox
  - Does not match with Andrasko and IER results
- CORNEAL COLORATION SHOULD BE DIFFERENTIATED FROM CELL TOXICITY

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Cytotoxicity

Figure 1. Effect of MPS-cycled Silly Contact Lenses on Cell Viability by direct contact assay

<table>
<thead>
<tr>
<th>Solution</th>
<th>Cameo®</th>
<th>Gyro® MPS</th>
<th>Alcon® MPS</th>
<th>Axon® MPS</th>
<th>Alcon® MPS</th>
<th>Alcon® MPS</th>
<th>Alcon® MPS</th>
<th>Alcon® MPS</th>
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<tbody>
<tr>
<td>Lens</td>
<td></td>
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</tr>
</tbody>
</table>

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PATH = Preservative associated transient hyperfluorescence

When fluorescein dye is applied to the eye, it interacts with MPS preservatives released from soft contact lenses.

Fluorescein (negative charge) and MPS preservatives (positive charge) are attracted to one another.

The level of attraction depends on MPS preservatives.

Fluorescein is attracted to PHMB up to 50x more strongly than to PQ.
The Binding of PHMB and Fluorescein Results in a Benign, Transient Hyperfluorescence

*This phenomenon is preservative-associated transient hyperfluorescence*

Fluorescein testing during the period of peak PHMB release produces the most intense hyperfluorescence

1. Bright PR et al. Poster presented at: The 9th Biennial Scientific Symposium of the Contact Lens Association of Ophthalmologists Education & Research Foundation; September 23-25, 2010; Las Vegas, NV.

Hyperfluorescence theory cannot explain why staining observed is not uniform across the corneal surface

Does not explain why we can see altered epithelial cells without fluoresceine

Does not take in account the reduced tear flow under most of the lenses fitted.
Summary

- Andrasko grid /IER matrix observations are real but the significance and the meaning are still research questions
- Not a true validation of lens/solution interaction
- Staining observed is not a sign of toxicity
- Staining observed is not hyperfluorescence
- Staining observed is not associated with mechanical causes neither hypoxia

What are we seeing on the cornea?

- Pooling of fluoresceine visible under slit lamp
- Associated with a lack of surface integrity / break in the cell structure
- Potential causes in contact lens wear:
  - Hypoxia
  - Trauma /Injury
  - Ocular Dryness
  - Infectious process (ex: viruses, bacterial ulcers)
  - Chronic Inflammation
  - Toxicity from preservative agents exposure

Corneal staining: a definition
Recent studies show that corneal staining associated with contact lens solution is, in fact, penetration of fluoresceine within the epithelial cells membrane. Associated with an epithelial cells apoptosis, NOT an epithelial loss, break or alterations of their tight junctions. Its nature translates a challenge of the epithelial cells secondary to chronic exposure to chemicals.

Solution induced corneal staining (SICS)¹

1- Bendamwar, K. Garrett Q, Papas E.B. BCLA 2011-poster session

Staining significance at cellular level: a new thinking¹

- Moderate fluoresceine intensity
  - Identified healthy cells

- Hyperfluorescence
  - Only level visible under slit lamp
  - Visualized apoptotic cells that could have been damaged after exposure to toxic stimuli

- Minimal fluoresceine
  - Seen as dark areas on the cornea
  - Indicates dead cells

SICS

- Corneal staining may facilitate endotoxin-tissue interactions and cytokine transportation through the tissue
- This mechanism amplifies endotoxin response leading to infiltrates
- SICS alone, in the absence of bacteria and endotoxins, is NOT associated with the development of sterile infiltrates
SICS

- Its presence is not considered a risk factor for the development of further infections (MK) \(^1\)
- Contact lens comfort IS linked with SICS presence \(^2\)
  - For certain combinations, not all.
  - PHMB-induced SICS does not produce high discomfort


Corneal staining: where are we?

- Lens wear with reusable lenses
- Impact on tear film stability
  - Deposits + to
  - Soaking in chemicals
  - Dirty case
  - Discomfort, visual symptoms
  - Contact lens drop-out
  - Pathogens trapped within deposits
  - Tight lens on the eye

- Stress stimuli (epithelial apoptosis)
- Toxic soup = immune reaction
- Endotoxins and chemicals released
- Bioburden = presumed risk factor #1 to develop infiltrative events (CEI) / MK

Clinical implications

- To reduce SICS severity or its transient presence
  - Reduce exposure to contact lens solutions
    - Switch to daily disposable
  - OR
    - Rub and rinse the lens before soaking \(^1\)
  - OR
    - Switch solutions for hydrogen peroxide
  - AND
    - Educate patient to increase compliance \(^2\)

\(^1\) Peterson RC, Fonn D, Woods CA, Jones L. Optom Vis Sci. 2010 Dec;87(12):1030-6
Understanding non optimal lens/solutions interactions

Infiltrative outbreak

Contact Lens-Associated Infiltrative Keratitis (CLAIK) and Multipurpose Solutions

- Association between SiHy lens materials and infiltrates
- Other adverse events

CLAIK presents as sterile with small, superficial, granular infiltrates, may or may not be accompanied by symptoms


OPTI-FREE® Replenish MPDS users had an average a 6% incidence per patient-month of CIEs. A hydrogen-peroxide-based solution, CLEAR CARE® Contact Lens Cleaning and Disinfecting Solution, had the lowest incidence of CIEs.
CLAIIK

- Found with many lens/solution combinations
- Senofilcon A / OFR
  - (Sacco, 2011; Carnt, 2009; Wolfe, 2009; Kohler, 2005; Reeder, 2011)
- Balafilcon A, Lotrafilcon B, Comfilcon A / OFR
  - Anecdotal cases implying OFX, Renu, private labels (Sacco, 2011)
- Not known before 2007
  - Cases increased with a wider use of SiHy
  - 2007 coincides with the launch of OFR
  - Market share of products do not explain association with SiHy
- Not related to staining nor hypoxia

### DDX

<table>
<thead>
<tr>
<th>DDX</th>
<th>Ocular Involvement with Contact Lenses (OIL/CLE)</th>
<th>Traditional Cases of Bilateral Corneal Melanoma</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye involvement</td>
<td>&gt;50% bilateral</td>
<td>0% to 15% bilateral</td>
<td>Wells, 1999; Burian, 2000; Boeing, 1995; (Owen, 2010)</td>
</tr>
<tr>
<td>Number of lesions</td>
<td>50% multiply, diffuse keratitis (eyes with single keratitis)</td>
<td>30% to 45% with multiply keratitis</td>
<td>Wells, 1999; Burian, 1999; Owen, 2010; Gordon, 1995</td>
</tr>
<tr>
<td>Appearance of lesions</td>
<td>Coarse, gray, granular, and gray patches</td>
<td>Raised, hypopigmented, gray, and hypopigmented patches</td>
<td>Gordon, 1995; Hongen, 1993; Bouzas, 1995</td>
</tr>
<tr>
<td>Location of lesions</td>
<td>&gt;50% ventral perilemmal cornea</td>
<td>&gt;50% ventral perilemmal cornea and edematous posterior pole</td>
<td>Wells, 1999; Burian, 1999; Gordon, 1995; Horn, 1993; Bouzas, 1995</td>
</tr>
<tr>
<td>Symmetry with regard to curvature</td>
<td>Symmetry independent of location</td>
<td>Leucoma symmetrically located</td>
<td>Bhaskar, 2005</td>
</tr>
<tr>
<td>Symptom</td>
<td>Mild to moderate (may be asymptomatic in some cases)</td>
<td>Marked to moderate</td>
<td>Bhaskar, 2005; Boeing, 1995</td>
</tr>
<tr>
<td>Symptoms</td>
<td>Absent</td>
<td>Commonly present</td>
<td>Gordon, 1995; Hongen, 1993; Bhaskar, 2005</td>
</tr>
<tr>
<td>SLN involvement</td>
<td>Absent in ~70% of cases</td>
<td>Absent in about 50%</td>
<td>Bhaskar, 1999; Boeing, 1995</td>
</tr>
<tr>
<td>Modality</td>
<td>Early stage in all but a rare cases</td>
<td>More common in extensive cases but also observed in daily wear</td>
<td>Wells, 1999; Burian, 1999; Boeing, 1995; Bhaskar, 2005</td>
</tr>
<tr>
<td>Lens material</td>
<td>Silicone hydrogel (very few cases in hydrogel lenses)</td>
<td>Hydrogel</td>
<td>Bhaskar, 2005; Izeaud, 2005; Gasparri, 1997</td>
</tr>
<tr>
<td>Lens care system</td>
<td>with daily wear</td>
<td>Moderate with high-risk Replacements</td>
<td>Carnt, 2005</td>
</tr>
<tr>
<td>Lens care system</td>
<td>with monthly wear</td>
<td>Moderate with high-risk Replacements</td>
<td>Carnt, 2005</td>
</tr>
</tbody>
</table>

Source: Sacco, A.J. CL SPECTRUM, Jan 20.
Defining ultimate lens wear and care regimen

Essential elements
- To fit a lens that moves
- To eliminate bioburdens
- To minimize chemical exposure
- To allow oxygen permeability
- To favour user friendly products and a better compliance

Daily disposable as the ultimate solution for contact lens wear
- Easiest and more convenient way to wear contact lenses
- Less associated with adverse effects or infections
  - No bacterial colonization
  - No deposits
  - No chemicals released in the eye every day
  - Associated with higher compliance
  - High DK (Si Hy, omafilconA, new hypergel- nesofilcon A ) and UV protection available
Conclusion

- The best solution is probably... no solution!
  - At least for more susceptible and at risk wearers
  - If the cost is not an issue

- For others:
  - High profile of disinfection and efficacy
  - With a reduced level of uptake/release to maintain in case disinfection efficacy
  - Favours compliance (lens + case)
- Lenses fitted have to move on the eye.