**Current Research Topics in Cornea & CLs**

Lyndon Jones PhD FCOptom FAAO
Professor and University Research Chair
School of Optometry & Depts of Physics, Biology, Chemical Engineering & Chemistry
Director, Centre for Contact Lens Research,
University of Waterloo, Ontario, Canada

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- Advanced Vision Research
- Alcon
- Allergan
- Contamac
- CooperVision
- Essilor
- GL Chemtec
- Inflamax Research
- Johnson & Johnson Vision
- Nature’s Way
- Novartis
- Ocular Dynamics
- Oculus
- Santen
- Shire
- TearLab
- TearScience

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**Discomfort**


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**% of Wearers Dropping out of Lens Wear for a Period of Time**

![Graph showing percentage of wearers dropping out of lens wear by country and year.]

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**Reasons for Dropout**

![Bar chart showing reasons for dropout, such as discomfort, vision, handling, and compliance.]

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Reasons for Lapsed Wear

Dumbleton et al. (2013) investigated the impact of contemporary contact lenses on contact lens discontinuation. Eye Contact Lens 2013; 39;1: 93-9.

Factors impacting CLD

• Contact Lens Discomfort
• 9 subcommittees
• 90 experts
• Academic and industry representatives
• Oct 2013: publication in IOVS
• 10 reports
  - All free to download

Many factors influence comfort in CL wearers

Patient factors:
- Demographics
- Age
- Gender
- Environment
- Humidity
- Temperature
- General Health
- Allergies
- Medications
- Systemic conditions
- Ocular Physiology
- Lid margin disease
- Other

Lens factors:
- Design and fit
- Deposition
- Material
- DEK
- Lubricity
- Astigmatism
- Wettability
- Surface properties
- Modification
- Wearing agents
- Wearing schedule
- Mobility
- Replacement frequency
- Wearing time

Care regimen factors:
- Disinfecting solutions
- Rewetting drops

TFOS Reports on CLD


Materials

Oxygen Permeability (Dk)

Tighe, 2000

Conventional vs Sil Hydrogel
Centre for Contact Lens Research

Oxygen Transmissibility (Dk/t)

1. SiHy values from manufacturers quoted values.

- Centre of a -3.00D lens
  - what about the periphery?
- What about impact of thickness?
  - BVP
    - +4.00 vs -4.00D
  - torics
  - bifocals

**Characteristics of Reusable SiHy Materials**

**SiHy Daily Disposable**

**Characteristics of DD SiHy Materials**

- Unique water gradient technology
  - “ultra-soft” surface gel
- Low friction surface
What have SiHy bought us?

Silicone Hydrogel Benefits

- Hypoxia related complications - problem solved!
- overnight oedema ~3% 1,2
- no increase in microcysts 2,3
- min limbal hyperaemia 2,4
- min vascularisation 5
- no myopic creep 6

1. Fonn D et al.: IOVS 1999; 40;13
3. Covey M et al.: OVS 2001; 78;2
5. Dumbleton KA et al. OVS 2001; 78;3
6. Dumbleton KA et al. OVS 1999; 76;12

Corneal Swelling for DW?

Hydrogel Wear vs NLW

- N = 24
- DW of etafilcon A for 8 hrs (tinted and clear)
- Central and peripheral corneal swelling by optical pachymetry or OCT was negligible
- No significant differences between lenses and NLW for
  - corneal staining
  - limbal/bulbar hyperemia

Comfort Benefits?

K Dumbleton et al.: Compliance with contact lens replacement in Canada and the United States. Optom Vis Sci 2010; 87(2): 131-139
N=2232
**Comfort: Hydrogel vs SiHy?**

Are Silicone-Hydrogel Contact Lenses More Comfortable Than Hydrogel Contact Lenses?


*there is no evidence that for daily wear they have significantly improved comfort compared with the comfort achieved with hydrogel contact lenses*

**Material Factors NOT Associated with Comfort**

- Higher Dk/t
- Ionicity/charge
- Modulus/stiffness
- Dehydration
- In vitro wettability
- Tear exchange
- Deposits
  - denatured lysozyme?


**Material Factors PROBABLY Associated with Comfort**

- Good fit
  - avoid excessive movement
  - avoid excessive thickness
- Lower water content
- Shorter frequency of replacement
- Shorter periods of wear
  - comfort worse at end of day
- Low friction


**Friction & Lubricity**

- Emerging importance to CL field
  - varied testing protocols
  - unknown which best simulates in-eye performance
- Recent evidence does exist for an association between CL friction and comfort 1,2


**What are some unique challenges with SiHy?**
1. Modulus

![Modulus Graph]

**Water Content vs Modulus**

![Water Content vs Modulus Graph]

2. Deposits

**Deposit Summary for SiHy**

- Very low levels of protein
  - but often denatured
- Lipid deposits higher than conventional materials
  - in some patients
  - lower in surface treated materials
- Clinical relevance
  - not all deposits may be bad?
  - denatured protein and lipid is hard to remove without physical rub/rinse

3. Interactions With Solutions
Biocide Uptake/Release?

Lipophilic versus hydrophilic modes of uptake and release of active entities used in multipurpose solutions


Corneal Staining

Clinically Relevant?

Review Papers on “Staining”

When fluorescein dye is applied to the eye, it interacts with MPS preservatives released from soft contact lenses 1, 2. Fluorescein (negative charge) and MPS preservatives (positive charge) are attracted to one another 4. The level of attraction depends on MPS preservative.

Fluorescein Interacts With MPS Preservatives

Fluorescein Preservative

MPS = multipurpose solution; PHMB = polyhexamethyl biguanide; PQ-1 = polyquaternium-1.


Case Hygiene

Latest Findings

• Replace case regularly
  – every 1/12 ideal
  – max after 3/12
• Rubbing with a tissue reduces biofilm
• Don’t air dry face-up
  – aerosol effect
• Air dry face-down on a clean tissue

4. Microbial Keratitis

EW SiHy & Microbial Keratitis

- No reduced incidence compared with conventional polyHEMA-based materials
- Lower morbidity
- Swifter recovery – role of oxygen?
- Related to eye/lens contamination with pathogenic organisms


5. Infiltrative Keratitis

Infiltrates?

- Difficult to accurately report incidence rates
  - results depend on:
    - study design
    - criteria used for reporting infiltrates
- Consistently 2X higher rate with reusable SiHy 1-5

Hydrogels vs SiHy

- SiHy materials have provided much-needed improved oxygen transport to the eye
  - but little improvement in comfort for many patients
- Hydrogels remain a viable option for many wearers

Impact of Solutions on CLD

- There are conflicting studies regarding the impact of solutions on CLD \(^1,^2\)
- No statistically significant association for solutions in self-reported DE among CL wearers \(^3\)


Comfort: Lens & Solution Choice?

- "Ocular comfort and symptoms in symptomatic CL wearers can be perceptibly improved by switching to an alternative CL-LCP combination".
- "This finding provides justification for the efforts of both eye care practitioners and researchers to improve the comfort of CL wearers".


Comfort: Avoiding Solutions...

- "Senofilcon A clinical response is modulated by the lens care products".
- "All lens care products tested reduced subjective responses relative to DD modality...
- "Senofilcon A performs best when used on a DD basis."


Potential Patient Factors?

- Age
- Environment
- Medication
- Allergies
- Blink rate
- Tear film quality
- Lid disease

I'M CONFUSED
**Patient Factors Associated with CLD**

- **Potential factors** include:
  - Female sex
  - Younger age
  - Poor TF quality and quantity
  - Seasonal allergies
  - Some systemic medications
    - oral contraceptives
    - isotretinoin
  - Diet, hydration & alcohol
  - Smoking
  - Compliance

**Potential factors** include:
  - Staining
    - bulbar conjunctival staining
    - corneal staining
  - Lid abnormalities
    - meibomian gland disease
    - lid wiper epitheliopathy
  - Tear film abnormalities
    - reduced tear film stability
    - increased tear film evaporation
    - tear film biochemical changes
      - mainly to lipids


**Ocular Surface Factors Associated with CLD**

- **Potential factors** include:
  - Staining
    - bulbar conjunctival staining
    - corneal staining
  - Lid abnormalities
    - meibomian gland disease
    - lid wiper epitheliopathy
  - Tear film abnormalities
    - reduced tear film stability
    - increased tear film evaporation
    - tear film biochemical changes
      - mainly to lipids

**Meibomian Gland Dysfunction**

- Bubbles in the tear film

**Impact of MGD on CL Discomfort?**

- **Equivocal results**
- **CL wear** reduces # of functional MG
  - decrease is proportional to duration of CL wear
- **No association** between CL wear and MG atrophy
- **CL wear results in MG changes**
  - Onset during first 2 yrs of wear
  - 6 months cessation of wear no impact on recovery

**Association of MGD with CL Wear?**

Managing MGD

- Ocular lubricants containing lipids
- Warm compresses
- Physical treatments
  - Forceful expression without heat
  - Intense pulsed light (IPL)
  - Intraductal (Maskin) probing
  - Lid debridement
  - LipiFlow
    - Lid heated and physically expressed

Demodex

CL Wear and Demodex

- N=62
  - 28 ex-CL wearers; ceased wear due to discomfort
  - 34 asymptomatic CL wearers
  - Mean age 29
- Significant difference in % exhibiting demodex infestation

Impact of Demodex on CL Discomfort?

Tea Tree Oil (TTO) Treatment

- Tea tree oil (TTO)
  - Essential oil derived mainly from the Australian native plant Melaleuca alternifolia
- TTO is incorporated as the active ingredient in many topical formulations used to treat cutaneous infections
  - Wide-ranging antimicrobial, antifungal and anti-inflammatory properties
- TTO kills Demodex mites dose-dependently
  - TTO in its pure form can be extremely irritating to the skin around the eye
Essential Fatty Acids & Dry Eye Reviews

2. Rosenberg & Asbell. The Ocular Surface 2010; 8; 1 (18-28).

Optics & Optical Correction

Reviews on Myopia Control


Ortho-K vs Atropine/SCL MF for Myopia Control

1. Scleral lenses
2. Corneal Cross Linking
3. Refractive Surgery

Thanks for your attention