The Great Debate: Silicone Hydrogels vs Hydrogels

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Over the past three years, members of CORE have received research funding and/or honoraria from the following 15 companies & 3 funding agencies:

- Alcon
- Allergan
- Contamac
- CooperVision
- GL Chemtec
- Inflamax Research
- Johnson & Johnson Vision
- Menicon
- Nature’s Way
- Novartis
- Safelens
- Santen
- Shire
- SightGlass
- Visioneering

Biggest Challenge for CL Practitioners?


Reasons for Lapsed Wear

Reasons for Lapsed Wear

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

Worldwide SiHy Fits: 2000 - 2017
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

Worldwide SCL Fits: 2018
new fits & refits


How Have Hydrogels Survived?

What drives better comfort?

Three Factors...

Material Factors...
Contact Lens & Tear Film

Consider the relative thickness of the tear film and the CL it supports.

- Pre-lens tear film 2-3 μm
- Contact lens 10-20x thicker than tear film
- Post-lens tear film 1-3 μm


Contact Lens in the Tear Film

Image courtesy of Jay Wang

Reduced PLNIBUT vs NIBUT: Impact of Contact Lens


Blinking & Tear Film Breakup


Development of Surface Aberrations

No Lens  vs  SCL in Place


Aberrations & Dry Eye

Question

• Which lens material has been shown to provide the longest PLNIBUT in eye?
  a) Hydrogels
  b) Silicone hydrogels
  c) No difference

Reduced PLNIBUT vs NIBUT: Impact of Material


Wettability: Hydrogels vs SiHy


Modulus

Modulus Over Time

Water Content vs Modulus
Soft Lens Fit

- Excessive movement results in reduced comfort [1,2,3]
- Be wary of fitting excessively mobile SiHy
  - fit may be different to hydrogels due to
    - modulus
    - thickness/design
    - edge shape
  - may need a steeper base curve [4]

1. Hoekel et al.: An evaluation of the 8.4mm and the 8.8 mm base curve radii in the CIBA Newvue vs. the Vistakon Acuvue. ICLC 1994; 21; 1/2: 14-17.

Deposition

Deposit Summary for SiHy

- Very low levels of protein
  - but often denatured and surface located
- 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
  - may be that hydrogels "integrate" better with the tear film?

Visible Deposits

Allergy

- 1/3rd population suffer from an allergy [1]
  - incidence of allergies is increasing
- Significant and growing problem eye care practitioners will encounter in everyday practice
- Sufferers likely to visit eye care practitioner [2]
  - 13% attending an optometric practice in UK [3]

Patient Factors...

**DD Hydrogels are Protective**

- Daily disposable contact lenses offer a protective barrier to airborne antigens
  - Symptoms of burning and stinging were significantly reduced in severity
  - Symptoms were significantly reduced in duration
  - Bulbar hyperaemia, corneal and conjunctival staining, palpebral conjunctival roughness, limbal and palpebral conjunctival redness reduced


**Tear Film Quality & Lid Abnormalities**

- MGD and blepharitis associated with
  - Reduced tear film quality
  - Reduced CL surface wettability
  - Increased gram positive toxins in the tear film
  - Increased risk of infiltrative keratitis
- Best managed with DD lens materials


**Oxygen Transmissibility (Dk/t)**

- SiHy values from manufacturers quoted values.

<table>
<thead>
<tr>
<th>Lens Material</th>
<th>Dk/t (at -3.00D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AO Night &amp; Day</td>
<td>175</td>
</tr>
<tr>
<td>Ultra Biofinity</td>
<td>163</td>
</tr>
<tr>
<td>Dailies TOTAL1</td>
<td>160</td>
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<tr>
<td>Acuvue OASYS/VITA</td>
<td>156</td>
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<tr>
<td>Air OPTIX Aqua</td>
<td>147</td>
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<tr>
<td>PureVision 2</td>
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<tr>
<td>1-Day AV TruEye</td>
<td>121</td>
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<tr>
<td>Sapphire/Avaira Vitality</td>
<td>118</td>
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<tr>
<td>MyDay</td>
<td>110</td>
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<tr>
<td>Acuvue Advance</td>
<td>86</td>
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<tr>
<td>Clariti 1 day</td>
<td>86</td>
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<tr>
<td>Biotrue 1 Day</td>
<td>37</td>
</tr>
<tr>
<td>Proclear</td>
<td>28</td>
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<tr>
<td>Proclear 1 Day</td>
<td>26</td>
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<tr>
<td>1 Day AV Moist</td>
<td>21</td>
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<tr>
<td>Acuvue 2</td>
<td>20</td>
</tr>
<tr>
<td>Proclear 1 Day</td>
<td>18</td>
</tr>
<tr>
<td>SofLens 38</td>
<td>18</td>
</tr>
</tbody>
</table>

**Patients vary in their oxygen needs...**

Same patient wearing DD hydrogel in their right eye and DD SiHy in their left eye for an eight hour period, with a noticeable difference in limbal hyperaemia

**Corneal Swelling for DW?**


**Hydrogel Wear vs No Lens Wear (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/limbus hyperaemia
Infiltrative Keratitis: Risk Factors

- **Age**: 15-29
- **Sleeping overnight in CL**
- **Hygiene**
  - showering in CL
  - neglected hand-washing
  - poor case hygiene
  - poor compliance with care system
- **Stretching use of CL past replacement frequency**
- **Smoking**
- **Previous history of an inflammatory event**


Question

- Which lens material has been shown to provide the lowest risk of corneal infiltrates?
  - a) Hydrogels
  - b) Silicone hydrogels
  - c) No difference

Infiltrative Keratitis: Reusable CL

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


Infiltrative Keratitis & DD Contact Lenses

- Age and other risk factors for corneal infiltrative and inflammatory events in young soft contact lens wearers
- Multicenter case-control study of the role of lens materials and care products on the development of corneal infiltrates

“12x lower risk of IK with DD lenses”

Solution Factors
Biocide Uptake/Release?

Lipophilic versus hydrophilic modes of uptake and release by contact lenses of active entities used in multipurpose solutions. Cont Lens Anterior Eye 2010; 33: 9-18.


Corneal Staining

Clinically Relevant?

Question

• Which lens material has been shown to be the most comfortable in extensive reviews of the literature?

   a) Hydrogels
   b) Silicone hydrogels
   c) No difference

Comfort: Hydrogels vs SiHy?

Other Pictures…

Biomechanical Stresses and Strains

Comfort: Reusable Hydrogel vs SiHy?


“Neither material types showed superiority in comfort, and adverse event rates were low with both material types. These findings suggest that choice of material is a patient and practitioner preference; however, for patients at risk of hypoxia-related complications, SiHy materials should be considered.”

Comfort: DD Hydrogel vs SiHy?

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Summary

Hydrogels vs SiHy

- SiHy materials have provided much-needed improved oxygen transport to the eye
  - hypoxic signs disappeared
- but many subjects show no hypoxia with hydrogels on a DW basis
- No differences between hydrogels and SiHy for
  - wettability
  - comfort
  - wearing time
- Infiltrates reduced with reusable hydrogels compared with SiHy
- Hydrogels remain a viable option for CL wearers

THANK YOU