The Evaluation of Lid Wiper Epitheliopathy in Contact Lens Wearers in a Controlled Low Humidity Environmental Exposure Chamber

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Introduction

- Lid Wiper Epitheliopathy (LWE) is a clinical sign of ocular irritation that is believed to be caused by increased friction and shear forces between the palpebral lid margin region and the ocular surface. It may result from decreased lubrication caused by alterations in the tear-film and its mucous component and the apposing bulbar conjunctiva and cornea and/or contact lens surface in lens wearers and may be detected by vital staining of the upper (UL) and lower lid (LL) margin surfaces.[1-3]
- Lid wiper epitheliopathy is considered an early sign of dry eye disease[4] and has been observed with a greater prevalence in symptomatic dry eye patients[5] who exhibit tear film deficiencies. Such deficiencies may alter both the tear film and ocular surface especially under adverse environmental conditions including temperature, airflow and low relative humidity (RH).[6]
- In daily disposable lens wearers the causation of LWE due the effect of wind and humidity over a period of time and it's recovery with pharmacological intervention have not been investigated.

Purpose

- To measure the clinical grades of LWE in contact lens (CL) wearers before and after exposure to a low humidity environmental exposure chamber (LH-EEC) with controlled conditions of temperature and air flow velocity.

Materials and Methods

- This was a double-masked feasibility study consisting of two visits:
  - Visit 1 (Screening Visit): Subjects wore habitual CLs for at least four hours prior to this initial visit. To be included in the study, subjects with healthy eyes had to demonstrate an OSDI score >15 and a LWE grade ≥2.
  - Upon inclusion into study, subjects were asked to discontinue CL wear and instill Refresh Tears® (ATs) t.i.d. for 48 hrs. in both eyes prior to Visit 2.
  - Visit 2 (LH-EEC exposure Visit): Subjects performed visual screen tasking in the LH-EEC for 180 minutes and upon exit, remained in the clinic office setting for 120 minutes.
- 10 symptomatic CL wearers were randomized to contralateral lens wear with narafilcon A and etafilcon A lenses.
- To detect and measure LWE in the UL and LL, the eyes were stained with sodium fluorescein (NaFl) and lissamine green (LG) dyes using an optimized technique.
- Following baseline ocular assessments including the evaluation of LWE, time was allotted to allow dyes to dissipate & CL's to be worn and settled on-eye, prior to entry into the LH-EEC.
- In the LH-EEC, subjects were exposed to a controlled temperature of 22±3°C, RH of 10±3% and an airflow velocity of approx. 5ft/sec for 180 mins. Upon exit into the clinic setting, CLs were removed and ATs were instilled in both eyes every 15 mins. for 120 mins.
- LWE was graded at baseline prior to CL insertion, after 180 mins. of chamber exposure (PC) and at PC+30 mins., PC+90 mins. and PC+120 mins, on a 0-3 scale using the classification: 0=None, 0.25-1.00=Mild, 1.25-2.00=Moderate, and 2.25-3.00=Severe.[2]
- Statistical analyses were conducted with Statistica.[7]

Methods (continued)

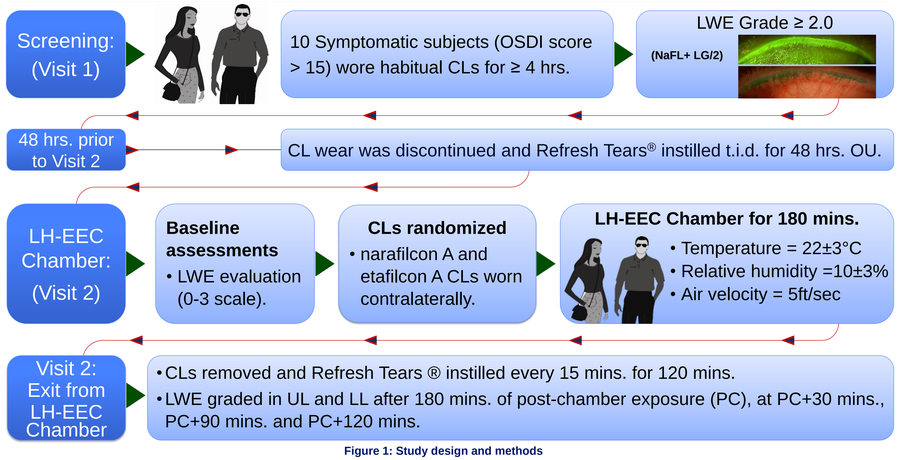

Figure 1: Study design and methods

Results

- After exposure to LH-EEC, more subjects showed moderate and severe UL and LL LWE than at baseline with both lenses, Figures 2 and 3.

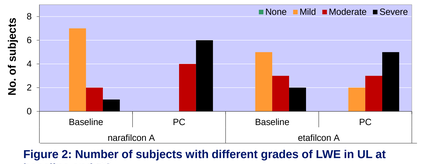

Figure 2: Number of subjects with different grades of LWE in UL at baseline and PC.

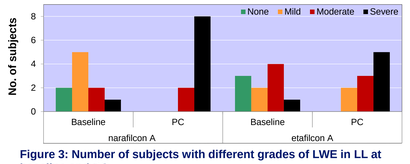

Figure 3: Number of subjects with different grades of LWE in LL at baseline and PC.

- After 180 mins. in the LH-EEC, mean UL LWE grades increased from Baseline to PC: 1.25 to 2.23 for narafilcon A, and 1.18 to 1.93 for etafilcon A (all $p<0.05$), Figure 4.
- The mean UL LWE grades at PC+120 were 2.47 and 2.42 for narafilcon A and etafilcon A, respectively (all $p<0.05$), Figure 4.

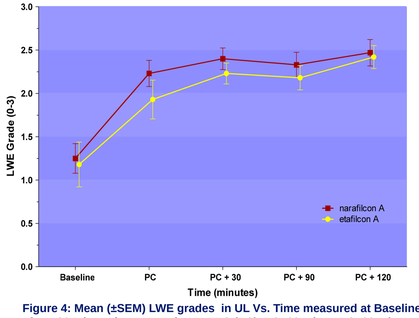

Figure 4: Mean (±SEM) LWE grades in UL Vs. Time measured at Baseline, after 180 mins. of exposure in LH-EEC (PC), PC+30 mins., PC+90 mins., and PC+120 mins.

- After 180 mins. in the LH-EEC, mean LL LWE grades changed from Baseline to PC: 1.00 to 2.48 for narafilcon A and 0.90 to 2.03 for etafilcon A (all $p<0.05$), Figure 5.
- The mean LL LWE grades at PC+120 were 2.11 and 1.89 for narafilcon A and etafilcon A, respectively (all $p<0.05$), Figure 5.

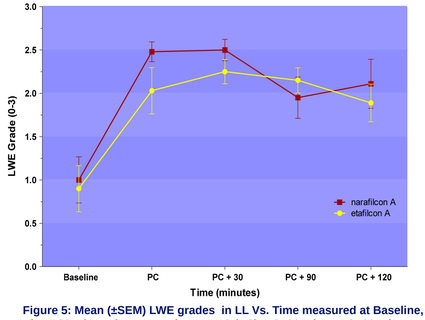

Figure 5: Mean (±SEM) LWE grades in LL Vs. Time measured at Baseline, after 180 mins. of exposure in LH-EEC (PC), PC+30 mins., PC+90 mins., and PC+120 mins.

Results (examples of UL and LL staining)

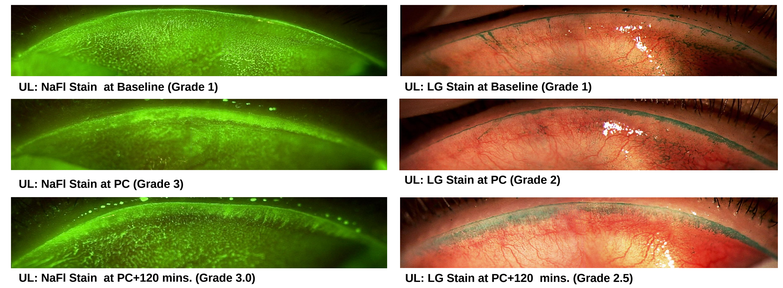

Figure 6: Examples of UL staining with NaFl (top left panel) and LG (top right panel) dye at different sequential assessment times.

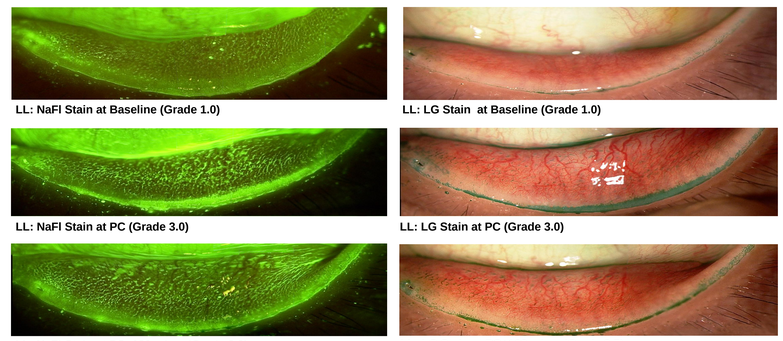

Figure 7: Example of LL staining with NaFl dye (left panel) and LG dye (right panel) at different sequential assessment times.

Conclusions

- LWE grades increased significantly with CL wear in both the UL and LL after 180 mins. of exposure to environmental conditions with low humidity and moderate airflow velocity.
- The use of ATs had no effect in LWE reduction during the 120 mins. following exit from the controlled conditions of the Low Humidity Environmental Exposure Chamber.
- The LH-EEC model may prove a valuable tool to study conditions that result in alterations in Lid Wiper Epitheliopathy.

References

1. Korb DR, et al., Lid-wiper epitheliopathy and dry-eye symptoms in contact lens wearers. CLAO J 2002;28:211-6.
2. Korb DR, et al. Lid wiper epitheliopathy and dry eye symptoms. Eye Contact Lens 2005;31:2-8.
3. Berry M, et al., Mucins and ocular signs in symptomatic and asymptomatic contact lens wear. Optom Vis Sci 2008;85:E930-8.
4. Knop E, et al. The lid wiper and muco-cutaneous junction anatomy of the human eyelid margins: an in vivo confocal and histological study. J Anat 2011;218:449-61.
5. Korb DR,, et al., Prevalence of lid wiper epitheliopathy in subjects with dry eye signs and symptoms. Cornea 2010;29:377-83.
6. Ousler GW, Gomes PJ, Welch D, Abelson MB. Methodologies for the study of ocular surface disease. Ocul Surf 2005;3:143-54.
7. Statsoft, Inc. (2011). Statistica (data analysis software system), version 10.

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This study was conducted in collaboration with: INFLAMAX RESEARCH INC. Scientific Excellence in Clinical Research