The Effect of Freezing on Senofilcon A Contact Lenses

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Introduction

With an increase in contact lenses being purchased online and shipped to your front door, more contacts lenses are exposed to harsh environments. Research has shown that soft contacts that were exposed to heat decreased in overall diameter by a clinically significant amount.[1] There are no studies on the effects of cold temperatures on soft contacts. There are no laws or regulations on the shipment of prescription contact lenses.

Purpose

To determine if there should be more precautions taken when directly shipping soft contact lenses. This study seeks to better understand the effects of freezing temperatures on the optics and parameters of Senofilcon A soft contact lenses. This study aims to determine if there should be laws to protect patients from any faulty lenses affected by the shipping and handling process.

Methods

- Senofilcon A (38% water content), -3.00D, 14.0mm diameter, and 8.4mm base curve lenses were used.
- Lenses were frozen for 24 hours to either -80°C or -23°C
- Lenses were then thawed at 23°C (fast thaw) or in a Styrofoam container at 23°C for five hours before exposure to 23°C (slow thaw).
- This resulted in four conditions as follows:
    - 26 lenses in the -80 Fast group
    - 24 lenses in the -80 Slow group
    - 21 lenses in the -23 Fast group
    - 21 lenses in the -23 Slow group
- 21 control lenses were kept at 23°C and never frozen.
- After thawing, lens power was measured three times for each lens in solution in a wet cell using a lensometer and the results were averaged.
- Overall diameter was measured once with a reticle magnifier.

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Power Changes in Various Conditions

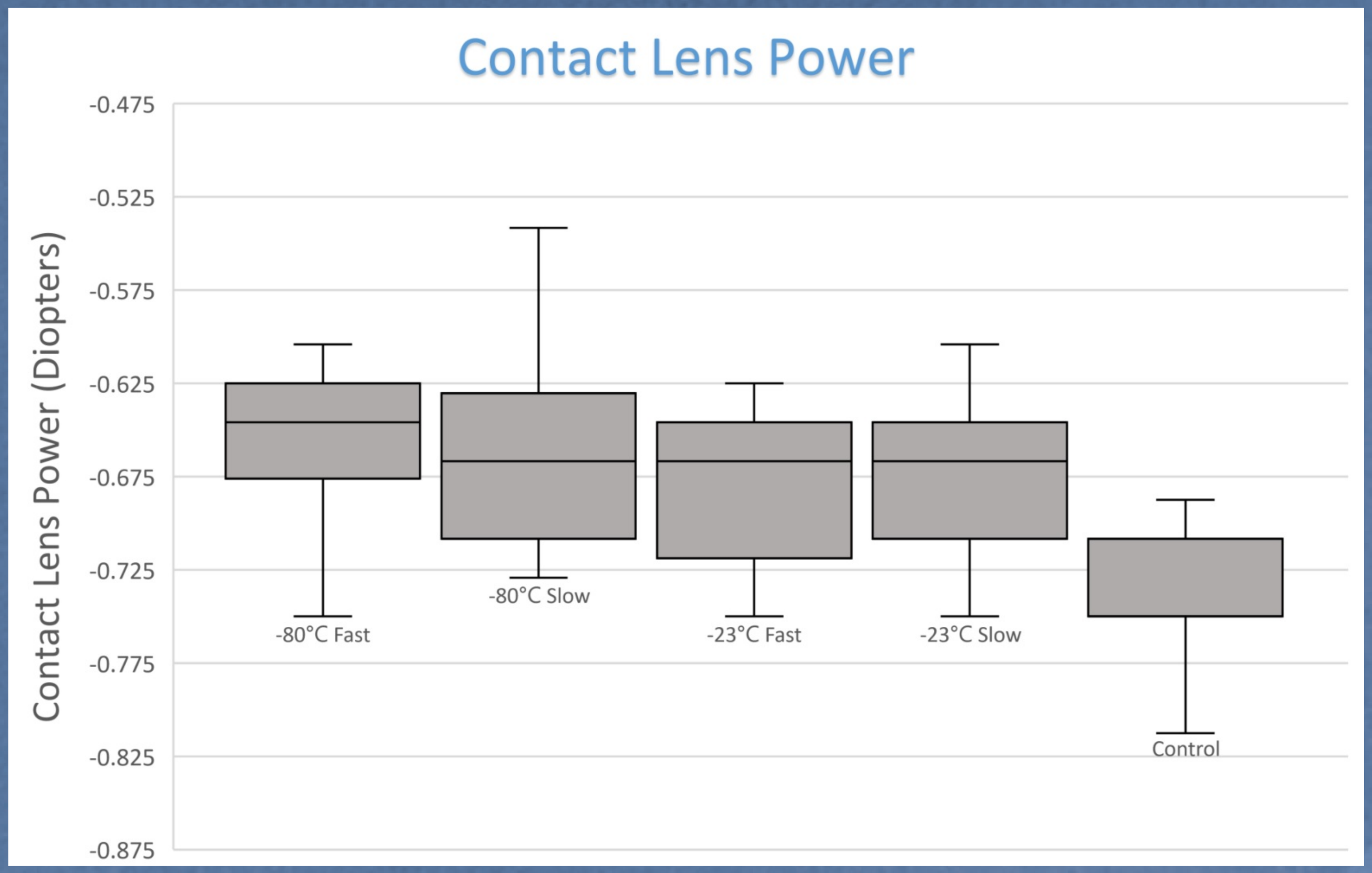

Figure 1. Comparison of power (D) ranges between various conditions

Diameter Changes in Various Conditions

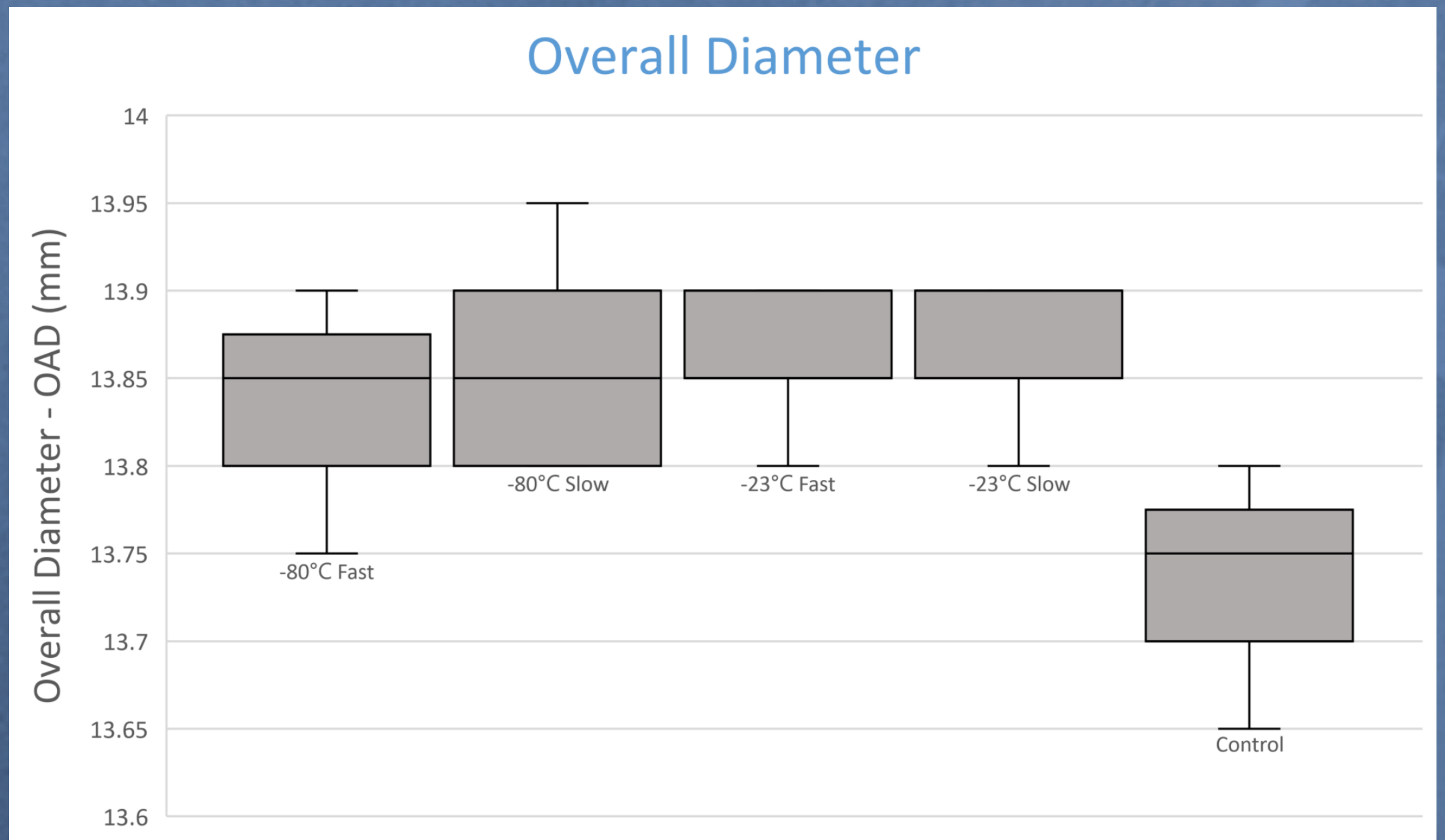

Figure 2. Comparison of diameter (mm) ranges between various conditions

Results

- Power measurements in solution were significantly lower than -3.00D due to the index matching.
- As seen in Figure 1, the control lenses averaged -0.73D and test lenses averaged -0.66D (-80 Fast and -80 Slow), -0.68 (-23 Fast), and -0.67D (-23 Slow).
- As seen in Figure 2, lens diameters for the control lenses averaged 13.75mm and test lenses averaged 13.85mm (-80 Fast and -80 Slow) and 13.87mm (-23 Fast and -23 Slow).
- Statistical analysis using ANOVA showed a statistical relationship for both power and diameter ($p<0.001$).
- Multiple comparisons revealed that this difference was between the control condition and each of the freezing conditions with no significant differences between freezing conditions ($p<=0.001$).
- The power difference corresponds to approximately 0.25D when scaled to the -3.00D.

Conclusion

- Freezing lenses, regardless of temperature and thaw rate, decreases power and increases overall diameter.
- These changes may impact the optical quality and structural integrity of the lenses.
- Other possible changes include the lifetime of a lens, the health of the eyes, lens fit, and comfort.
- These study results could have implications in the shipping, handling, and storage of these lenses.
- Our research has shown that power and diameter are both changed to a clinically significant amount when lenses are frozen to either -80 degrees or -23 degrees.

References

1. Young, Graeme. "The Effect of Temperature on Soft Contact Lens Diameter." BioPortfolio. Contact Lens Association of Ophthalmologists, 05 Sept. 2016. Web. 02 Feb. 2017.
2. Jackson, A. Jonathan, and Clive J. Wolsley. "Rigid Gas Permeable Contact Lenses: Out in the Cold." Contact Lens and Anterior Eye 32.5 (2009): 204-06. Web.