

# Tear Film Variability with Contact Lens Use

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## Background

The diagnosis of dry eye and the capability to predict the likelihood of contact lens induced dry eye will benefit by improving the success of contact lens wearers. Tear film stability is measured to provide this information. By comparing the tear film variability between the use of monthly soft contact lenses, daily soft contact lenses, and scleral gas permeable lenses insight was obtained on which contact lens modality allows for a more stable tear film. This knowledge will be especially beneficial when prescribing contact lenses for dry eye patients or those who experience dryness as a result of contact lens wear. The purpose of this study is to compare tear film variability with the use of three different contact lens modalities. The variability will be determined using several tests for tear film evaluation. The variability of the tear film with daily soft contact lenses, monthly soft contact lenses, and scleral gas permeable contact lenses will be evaluated. Specific Aims:

1. Comparison of Non-Invasive Tear Break Up Time
2. Comparison of Lacrimal Lake Reservoir
3. Comparison of Eye Redness
4. Comparison of Invasive Tear Break Up Time
5. Comparison of Patient Satisfaction and Comfort

## Hypothesis

Contact lens wear can have an impact on the ocular surface and tear film stability with and without the presence of dry eye syndrome. Choosing the appropriate contact lens for each contact lens wearer could decrease the likelihood of contact lens induced dry eye and contact lens drop out. Scleral lenses have been used readily for advance ocular surface disease and are a plausible option for moderate to severe dry eye patients. Daily contact lenses are known to be thinner, more wetttable, and healthier and should be evaluated as a first line option for those with dry eye syndrome.

## Methods

Each type of contact lens will be worn for one week and the tear film will be evaluated at the beginning and conclusion of the week. The patients will initiate wearing the lenses on the Saturday of each week and the tear film will be evaluated on the following Monday and Friday. The tests being performed are Non-Invasive Tear Break Up Time with a Keratograph, Lacrimal Lake measurement with a Keratograph, Eye Redness measurement with a Keratograph, and Invasive Tear Break Up Time with NaFI. All tests will be performed in the same order after 5 minutes of lens removal. The subjects will also complete a survey at the final visit for each type contact lens to determine patient comfort and satisfaction with the form of contact lenses. There will be one experimental group, consisting of five participants. Each participant will wear three different categories of contact lenses, soft monthly contact lenses, soft daily contact lenses, and gas permeable scleral contact lenses. Participants will be recruited from the student population within the College of Optometry. Patient must be a myope, under the age of 40, between -0.50 and -8.00D of spherical prescription and less than -2.00D of corneal or refractive cylinder, baseline ocular anterior segment examination should free of disease, participant is a good candidate for contact lens wear, participant is willing to wear contact lenses 7 days/week for at minimum 8 hours for 3 weeks. Participants will be required to have a baseline examination, daily contact lens initial and final visit, monthly contact lens initial and final visit, and scleral contact lens initial and final visit. The participants will be required to wear the prescribed lenses seven days per week for at minimum eight hours each day for the duration of three weeks. The participants will be required to use a specifically prescribed solution for care of the lens. There will be an absence of deception in this study. The expected duration for each participant is approximately 1-1/2 months; this includes the time for the baseline examination and fitting, as well as three weeks of actual lens wear.

## Results

A total of five right eyes and five left eyes were examined. Three different analysis of variance (ANOVA) tests were administered to determine whether a significant relation exists between variables. A significance level of 0.05 was used to indicate whether a difference existed when there was no actual difference. Variables were considered statistically different if  $p < 0.05$ . Statistical analysis revealed an absence of significant difference when comparing the non-invasive tear break-up time results and the tear meniscus height results after day seven of monthly soft contact lens wear, day seven of daily soft contact lens wear, and day seven of scleral gas permeable lens wear with p-values of 0.91 and 0.65, respectively. With that said, there is not enough evidence to reject the null hypothesis that the population means are all equal. On the contrary, a significant difference existed after statistical analysis of the invasive tear break-up time results with a p-value of 0.017. It should also be noted that the average invasive and non-invasive TBUT was highest after day seven of scleral lens wear, while average tear meniscus height was largest after day seven of monthly soft contact lens wear (see table for comparison). Comparison of bulbar redness with the Keratograph showed that the most redness was observed after seven days of scleral gas permeable lens wear. Although the eyes appeared the reddest after scleral lens wear, patients reported the most overall comfort after this week.

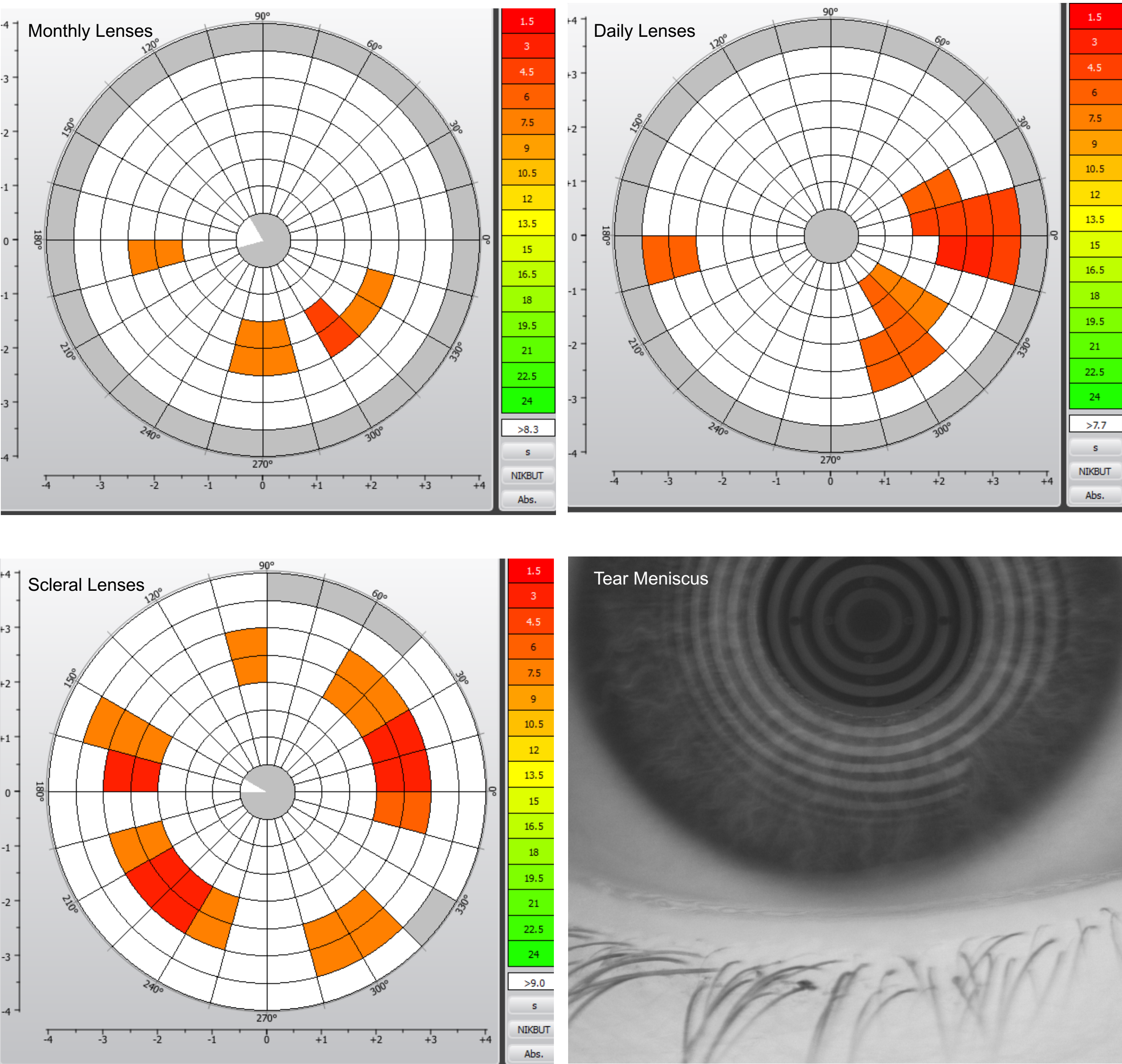
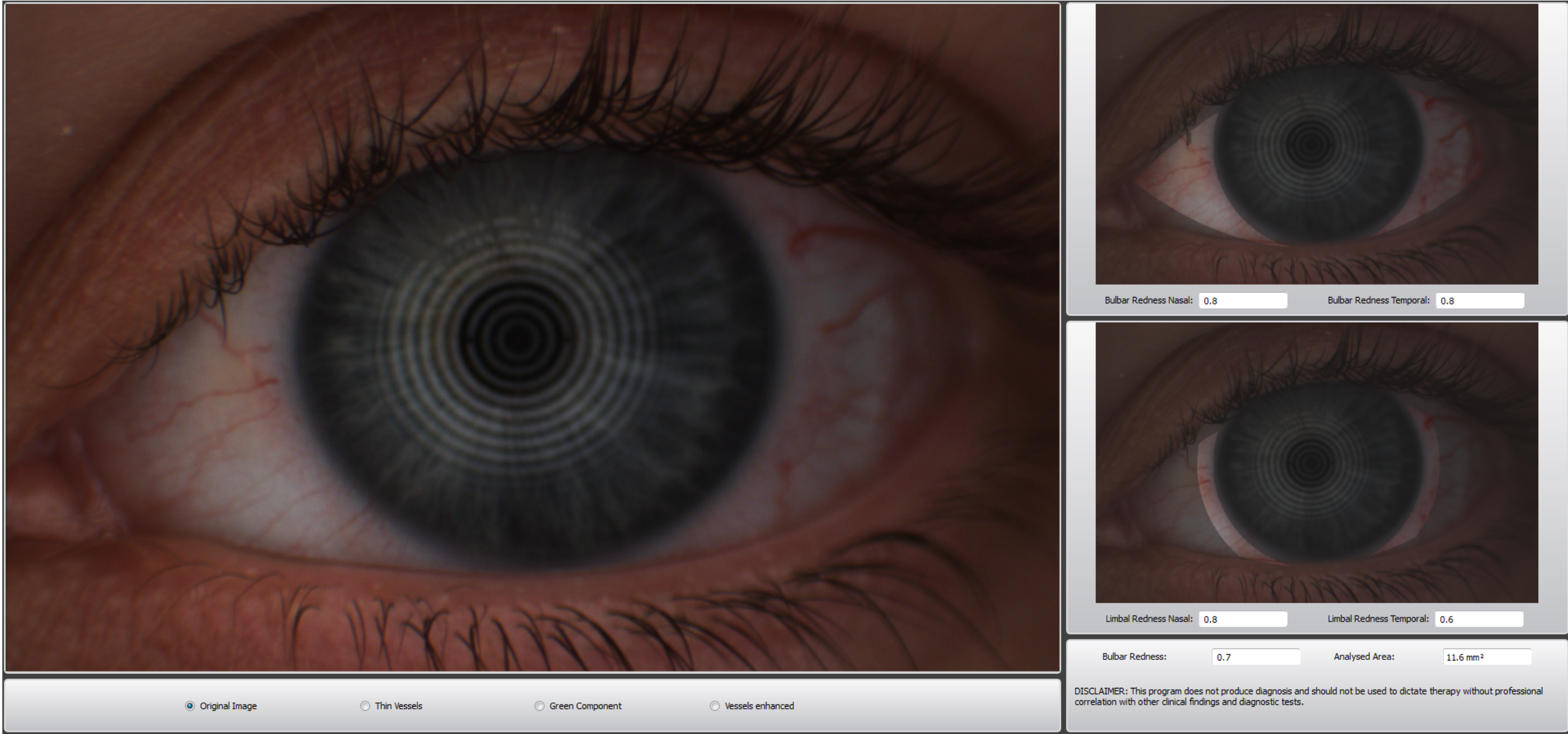


Table 1: Summary of Results

	Average Invasive TBUT	Average Non-Invasive TBUT	Average Tear Meniscus Height	Average Bulbar Redness	Average Overall Comfort
Day 7 Monthlies	6.0 seconds	9.64 seconds	0.38 mm	0.48	7.7/10
Day 7 Dailies	7.9 seconds	8.89 seconds	0.37 mm	0.55	7.3/10
Day 7 Sclerals	8.6 seconds	9.76 seconds	0.35 mm	0.68	7.9/10



## Conclusions

Tear film variability, tear volume, and patient symptoms are a few variables important in contact lens satisfaction and contact lens intolerance (1). The tear film variability present in contact lens wearers often mimics signs seen in dry eye patients (1). Results would have been more accurate if the scleral lenses were fit perfectly and the patients had the ability to completely adapt to wearing the lenses prior to the study. Using fluorescein to measure the tear break-up time is invasive and has low test repeatability and reproducibility (2). However, a study conducted by Tian, et al revealed that measurements of non-invasive tear break-up time and tear meniscus height provide acceptable repeatability and reproducibility (2). Participants in our study varied in overall satisfaction with their current lenses. While some participants have worn soft contact lenses the majority of their lives with little to no discomfort or dry eye, others entered the study with signs and symptoms of dry eye and were intolerant to their current contact lenses. We were also looking to see if there would be much variance between the non-invasive TBUT and the invasive TBUT pertaining to a study performed by Best which showed the Keratograph to detect much earlier tear film changes but our data reveals, the average non-invasive TBUT was actually greater than that of our invasive TBUT (3). Other studies by Jiang also showed that the average non-invasive TBUT was significantly shorter than the invasive TBUT but they had stated that there had previously been an absence of agreement determining which measurement would be longer (4). Another downfall to the non-invasive TBUT measurement is the inability for practitioner input into the measurements and the possibility for the instrument to miss partial blinks while recording the TBUT measurements.

After seven days of lens wear, gas permeable scleral lenses produced the highest non-invasive and invasive tear break-up times, while providing the most comfort overall. The downfall of the gas permeable scleral lenses was the increase in bulbar conjunctival redness. Average tear meniscus height was measured to represent highest after wearing monthly soft contact lenses. For patients with contact lens intolerance resulting from tear film instability, gas permeable scleral lenses should be considered to relieve their symptoms.

## Bibliography

1. Glasson, M. J., et al. "The effect of short term contact lens wear on the tear film and ocular surface characteristics of tolerant and intolerant wearers." Contact Lens and Anterior Eye 29.1 (2006): 41-47.
2. Tian, Lei, Jing-hao Qu, and Xu-guang Sun. "Repeatability and reproducibility of noninvasive keratograph 5M measurements in patients with dry eye disease." Journal of ophthalmology 2016 (2016).
3. Best, Nigel, L. Drury, and James S. Wolffsohn. "Clinical evaluation of the Oculus Keratograph." Contact lens and anterior eye 35.4 (2012): 171-174.
4. Jiang, Yongxiang, et al. "Noninvasive Keratograph assessment of tear film break-up time and location in patients with age-related cataracts and dry eye syndrome." Journal of International Medical Research 42.2 (2014): 494-502.
5. Downie, Laura E., Keller, Peter R., Vingrys, Algis J. "Assessing ocular bulbar redness: a comparison of methods." Ophthalmic Physiol Opt 36 (2016): 132-139.