Connecting Contact Lenses and Digital Technology

PROTOCOL

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I. STUDY OBJECTIVES

This study seeks to address whether or not multifocal contact lenses may be a beneficial option for pre-presbyopic patients complaining of eye strain and visual discomfort while using digital devices. The primary outcome measure will be change in average score on a ten question Visual Comfort Survey using a Visual Analogue Scale (VAS) technique from baseline to day 7. Secondary outcome measures include lens preference based on a two-alternative forced choice survey, symptom changes based on the Convergence Insufficiency Symptom Survey (CISS), symptom changes based on the Contact Lens Dry Eye Questionnaire-8 (CLDEQ-8), and objective measures of binocularity and accommodation.

II. BACKGROUND AND RATIONALE

American Millenials spend an average of 18 hours a day consuming media[1] on smartphones, digital tablets and home computers – often multiple forms simultaneously. The visual demands of this type of work are unique and require the use of prolonged intermediate vision. For contact lens-wearing young adults, correcting for this working distance before the onset of presbyopia may contribute to less eye strain and visual discomfort.

Recent studies researching contact lens discomfort have attributed symptoms to a myriad of issues from undiagnosed accommodative-binocular disorders, to ocular surface disease, to the angle of computer screens.[2, 3] There is no definitive evidence stating that one variable is responsible. Meanwhile, the number of symptomatic patients is growing. Although "occupational" spectacles are a growing trend, there appears to be no contact lens recommendation for symptomatic patients.

III. STUDY METHODOLOGY

a. Study Design and Intervention

This is a prospective, single site, randomized, double-masked, crossover pilot study. Subjects will be randomized in a 1:1 ratio based on a randomization schedule according to sequentially assigned subject numbers to either the test or control group at the first visit. Subjects will crossover at the second visit. There will be an equal number of subjects in each group.

This study will evaluate the ability of multifocal contact lenses to decrease signs and symptoms of asthenopia for non-presbyopic patients with prolonged near and intermediate work (at least 6 hours) on digital devices. After informed consent, baseline testing will be performed to confirm an appropriate ocular health and refractive state and subjects will be screened for vergence disorders for which a near addition would be contraindicated. Symptoms will be measured by administering the CISS[4] and CLDEQ-8.[5] Subjects will also complete a 10-question VAS survey regarding subjective visual comfort at the baseline visit, at the end of day 1 and day 3 (via home diary), and at the follow-up visit at day 7. At the end of the study, subjects will be asked their preference in a two-alternative forced choice format.

b. Study Lenses

Johnson and Johnson 1- Day Acuvue Moist Brand spherical and multifocal contact lenses will be used (Table 1). According to recent research,[6] the preferred viewing distance on digital devices for a similar

age group was 63 cm which would require an add of +1.59 D. A low add yielding up to +1.25 add was selected to provide an intermediate near addition without compromising distance vision as much as would be expected with higher add powers.

The site study coordinator will mask (over-label) the contact lens foils so that both examiners and subjects remain masked. The lens power (distance only), will be transcribed on the new label and the lens lot number, and expiration date will be kept in a linking log by the unmasked coordinator The unmasked team member will assign a group number, "A" or "B" to match the randomization order for the multifocal from single vision lenses so that the examiners may dispense lenses while remaining masked.

Table 1. Study lenses

Brand	Base Curve	Diameter	Power	Add
1-Day Acuvue Moist Multifocal	8.4	14.3	Vertexed, spherical-equivalent of manifest refraction	LOW (up to +1.25)
1-Day Acuvue Moist	8.5	14.0		None

c. Sample selection

Up to 45 subjects may be enrolled in the study to provide at least 30 evaluable subjects (allowing for up to a 33% screen failure, drop-out, or poor or missing data). A total of 30 subjects will be randomized to begin with either multifocal or single vision distance contact lenses. Subjects will wear the lenses on a daily-wear, daily-disposable schedule. Following one week (± 2 days) of lens wear, subjects will be evaluated and the alternate lenses dispensed. The sample size was based on previous publications studying subjective and objective outcomes with multifocal and single vision contact lenses.[7,8] Expectations for normal distributions of data and the ability to use parametric tests are generally met with sample sizes of about 30.

d. Inclusion Criteria:

- 18 to 35 years of age
- Spectacle prescription of -0.75 to -6.00 D sphere with no more than 0.75 diopters of refractive cylinder
- Current single-vision soft contact lens wearer
- Monocular acuity of 20/25 or better in each eye (Snellen)
- Self-reported minimum of 6 hours a day on digital devices
- Self-reported complaint of eyestrain on digital devices
- No ocular pathology and/or history of eye surgery
- No history of strabismus or strabismus surgery
- No gas permeable lens wear for at least 3 months
- Subjects may not be optometrists, opticians or optometry students

Following consent, subjects will be screened further in order to exclude those with ocular surface disease and/or binocular disorders that would not benefit from a near addition.

e. Exclusion Criteria:

- Corneal staining, blepharitis and/or MGD worse than Grade 2 using the Efron Grading Scale[9]
- NRA less than +1.50 D
- Exophoria at near > 6 prism diopters[10]
- Vertical phoria > 1 prism diopter
- Presence of tropia
- Response of 3 or higher on question 2b of the CLDEQ-8
- Unacceptable contact lens fit (i.e. substantially decentered, excessive movement)

f. Study Procedures

Potential study candidates will sign an informed consent form prior to any clinical procedures or tests specific to the protocol are performed. All screening examination procedures will be performed by the investigator or trained personnel working under the investigator's supervision. Subjects will undergo examination to determine eligibility at the Baseline visit. A medical, ocular and medication history will be obtained. Subjects who elect to participate will complete the study as outlined in Table 2. All tests and measurements will be obtained in accordance with the procedures specified in this protocol.

g. Subject Discontinuation

Subjects may discontinue participation at any time. Investigators may withdraw a subject if their continued participation poses a risk to their health or vision or they do not meet the study enrollment criteria. Discontinued or withdrawn subjects will have an exit assessment performed.

h. Adverse Events and Safety Outcomes

An adverse event is any new or worsened medical occurrence, disease, injury or significant clinical finding that occurs in subjects during the study. These events may or may not be related to the study procedures or devices. Safety outcomes, including subject symptoms and slit lamp findings, will be recorded. All adverse events will be recorded. Adverse events will be reported to the IRB using Good Clinical Practice Guidelines.

The risks associated with contact lens wear are expected to be the same as for those wearing contact lenses in the general population. The most common risks associated with daily disposable contact lens wear include:

- Burning, stinging, tearing, redness and/or itching of the eyes
- Contact lens related ocular discomfort
- Foreign body sensation
- Dryness

More serious side effects are less common, and include:

- Corneal infiltrates, ulcers or erosions
- Corneal edema
- Corneal neovascularization
- Iritis

The contact lenses used as part of the study are FDA approved for daily wear in a daily disposable modality. Subjects will be educated on proper use of contact lenses to minimize the risk of adverse events

Table 2: Study procedures

	Visit 1/Baseline (to present wearing no contact lenses)	**Visit 2 (7 days ± 2 days from V1)** (to present wearing Study Lens 1 for minimum 3 hours)		**Visit 3 (7 days ± 2 days from V2)** (to present wearing Study Lens 2 for minimum 3 hours)
		In study lens 1	In study lens 2	
Informed consent	X			
Entering acuity[A]	X	X		X
Auto-refraction and keratometry	X			
CL fit assessment		X		X
Slit lamp exam with staining	X			
Tear break up time	X			
Manifest refraction[B]	X			
Distance Snellen BCVA	X			
Pupil size in dim and bright light	X			
Unilateral cover test and stereopsis	X			
Administration of CLDEQ-8, CISS, and Visual Comfort Survey	X	X		X
Ocular alignment[C]	X	X		X
Accommodative amplitude[D]	X			
Accommodative response[E]		X		X
Negative and positive relative accommodation (NRA/PRA)	X	X		X
Monocular and binocular accommodative facility[F]	X			
Study lens order randomization[G]	X			
Removal of study lens and slit lamp exam with staining		X		X
Insertion of CL and settling (15 min)	X		X	
CL fit assessment	X		X	
Distance HCHL logMAR acuity	X		X	
Exit Snellen acuity	X		X	X

BCVA = best corrected visual acuity
HCHL = high contrast high luminance

[A]Entering acuity to be measured in spectacles or most recent refraction in phoropter.
[B]Refraction and over-refractions will be confirmed by performing red-green duochrome test. Patients will be fogged by +1.00D and the fog will be reduced in 0.25D steps until the patient reports equality, or until the last red response is reached.
[C]Lateral and vertical heterophoria to be measured via Modified Thorington in free space at 40cm.
[D]Monocular push-up method with the Aston Accommodative Rule (20/30 letters at 40cm) with the subject reporting "first sustained blur" measured to the nearest one-half centimeter.
[E]Measured with WAM-5500 at 25 and 40cm.
[F]Performed using a +/-2.00 flipper in free space at 40cm working distance.
[G]To be performed by unmasked research staff

IV. DATA ANALYSIS

a. Data Collection

All source data will be collected on paper source documents. Data will be entered into an Excel spreadsheet with double data entry to check for error before locking the data set.

b. Outcome Measures

The primary outcome is improvement of average asthenopic symptoms on digital devices as measured by a 10-question VAS repeated in-office after 1 week of lens wear. The VAS is widely used due to its simplicity and adaptability to a broad range of populations and settings. Secondary outcomes include lens preference based on a two-alternative forced choice survey and changes in CISS and CLEDQ-8 and objective measures of accommodation and binocularity.

c. Statistical Analysis

The primary outcome measures will be assessed using paired t-tests. A chi-square will be used to assess final subject preference. Exploratory analyses may be conducted to assess trends in binocular findings, accommodative test results and symptoms, as well as to determine the appropriate sample sizes needed for future studies planned around these outcomes.

APPENDIX

1. VISUAL COMFORT SURVEY

Subject ID: Date:

Based on written questionnaire developed by Hayes et al. containing 10 questions regarding the level of ocular discomfort experienced during computer tasks[11]

In your current contact lenses, to what extent do you experience:

1. Blurred vision at near distances (e.g. book or cell phone)
2. Blurred vision at intermediate distances (e.g. computer screen)
3. Blurred vision at far distances (e.g. driving)
4. Difficulty or slowness in refocusing my eyes from one distance to another
5. Irritated or burning eyes
6. Dry eyes
7. Eyestrain
8. Headache
9. Tired eyes
10. Sensitivity to bright lights

0 (mm) —————————————————————————— 100 (mm)
Not at all Severe

APPENDIX

2. Convergence Insufficiency Symptom Survey (CISS)

Subject ID: Date:

Instructions: Read the following "Patient" instructions and then each item exactly as written. If subject responds with "yes" - please qualify with frequency choices. **Do not give examples.**

Patient instructions: Please answer the following questions about how your eyes feel when reading or doing close work.

		Never	(not very often) Infrequently	Sometimes	Fairly often	Always
1.	Do your eyes feel tired when reading or doing close work?					
2.	Do your eyes feel uncomfortable when reading or doing close work?					
3.	Do you have headaches when reading or doing close work?					
4.	Do you feel sleepy when reading or doing close work?					
5.	Do you lose concentration when reading or doing close work?					
6.	Do you have trouble remembering what you have read?					
7.	Do you have double vision when reading or doing close work?					
8.	Do you see the words move, jump, swim or appear to float on the page when reading or doing close work?					
9.	Do you feel like you read slowly?					
10.	Do your eyes ever hurt when reading or doing close work?					
11.	Do your eyes ever feel sore when reading or doing close work?					
12.	Do you feel a "pulling" feeling around your eyes when reading or doing close work?					
13.	Do you notice the words blurring or coming in and out of focus when reading or doing close work?					
14.	Do you lose your place while reading or doing close work?					
15.	Do you have to re-read the same line of words when reading?					
		__ x 0	__ x 1	__ x 2	__ x 3	__ x 4

Total Score: ____

APPENDIX

3. Contact Lens Dry Eye Questionnaire-8 (CLDEQ-8)

Subject ID: Date:

Patient/Subject #:_____
Date:__/___/____Time:_____

CONTACT LENS QUESTIONNAIRE-8 (CLDEQ-8)

1. Questions about **EYE DISCOMFORT**:

   a. During a typical day in the past 2 weeks, **how often** did your eyes feel discomfort while wearing your contact lenses?

   0 Never
   1 Rarely
   2 Sometimes
   3 Frequently
   4 Constantly

   When your eyes felt discomfort with your contact lenses, **how intense was this feeling of discomfort…**

   b. At the end of your wearing time?

Never have it	Not at All Intense				Very Intense
0	**1**	**2**	**3**	**4**	**5**

2. Questions about **EYE DRYNESS**:

   a. During a typical day in the past 2 weeks, **how often** did your eyes feel dry?

   0 Never
   1 Rarely
   2 Sometimes
   3 Frequently
   4 Constantly

   When your eyes felt dry, **how intense was this feeling of dryness**…

   b. At the end of your wearing time?

Never have it	Not at All Intense				Very Intense
0	**1**	**2**	**3**	**4**	**5**

3. Questions about **CHANGEABLE, BLURRY VISION:**

   a. During a typical day in the past 2 weeks, **how often** did your vision change between clear and blurry or foggy while wearing your contact lenses?

   0 Never
   1 Rarely
   2 Sometimes
   3 Frequently
   4 Constantly

   When your vision was blurry, **how noticeable was the changeable, blurry, or foggy vision** …

   b. At the end of your wearing time?

Never have it	Not at All Intense				Very Intense
0	**1**	**2**	**3**	**4**	**5**

4. Question about **CLOSING YOUR EYES:**
   During a typical day in the past 2 weeks, **how often** did your **eyes bother you so much that you wanted to close them**?

   0 Never
   1 Rarely
   2 Sometimes
   3 Frequently
   4 Constantly

5. Question about **REMOVING YOUR LENSES:**
   How often during the past 2 weeks, did your eyes *bother you so much* while wearing your contact lenses that you felt as if you needed to stop whatever you were doing and **take out your contact lenses**?

   1 Never
   2 Less than once a week
   3 Weekly
   4 Several times a week
   5 Daily
   6 Several times a day

REFERENCES

1. Ember, Sydney. “Brands Woo Millennials With a Wink, an Emoji or Whatever It Takes.” *New York Times* 28 September 2015: B1.

2. Rueff, Erin. "Contact Lens Induced Dry Eye And Binocular Vision Disorders: A Study Of Similar Symptoms." (2014): *Networked Digital Library of Theses & Dissertations*. Oct. 2015.

3. Cooper, Jeffrey S., et al. "Care of the patient with accommodative and vergence dysfunction." American Optometric Association. USA (1998): 5-10.

4. Rouse, Michael W., et al. "Validity and reliability of the revised convergence insufficiency symptom survey in adults." Ophthalmic and Physiological Optics 24.5 (2004): 384-390.

5. Chalmers, Robin L., et al. "Contact Lens Dry Eye Questionnaire-8 (CLDEQ-8) and opinion of contact lens performance." *Optometry & Vision Science* 89.10 (2012): 1435-1442.

6. Jaschinski, Wolfgang. "The proximity-fixation-disparity curve and the preferred viewing distance at a visual display as an indicator of near vision fatigue." Optometry & Vision Science 79.3 (2002): 158-169.

7. Richdale, Kathryn, G. Lynn Mitchell, and Karla Zadnik. "Comparison of multifocal and monovision soft contact lens corrections in patients with low-astigmatic presbyopia." Optometry & Vision Science 83.5 (2006): 266-273.

8. Fedtke, Cathleen, et al. "Visual performance of single vision and multifocal contact lenses in non-presbyopic myopic eyes." Contact Lens and Anterior Eye 39.1 (2016): 38-46.

9. Efron, Nathan. "Clinical application of grading scales for contact lens complications." Optician 213.5604 (1997): 26-34.

10. Morgan MW. The clinical aspects of accommodation and convergence. Am J Optom 1944; 21:301-13.

11. Hayes, John R., et al. "Computer use, symptoms, and quality of life." *Optometry & Vision Science* 84.8 (2007): E738-E755