FULL PROTOCOL TITLE: Evaluating Contact Lens Optics

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Table of Contents

1.0 Objectives

This is a pilot study to explore the feasibility of using optical models to predict how multifocal contact lens designs affect retinal defocus and visual performance. Multifocal contact lens designs are being used and optimized for myopia control. However, these lens designs must be tested on-eye to measure their effect on retinal defocus and visual performance. This process is expensive and time consuming. The purpose of this study is to develop a model to predict changes in retinal defocus and visual performance with multifocal soft contact lenses.

We hypothesize that optical modelling can be used to accurately predict changes in retinal defocus and visual performance with multifocal soft contact lenses. This hypothesis is based on published works that show optical models can replicate central and peripheral wave aberrations (Polans et al. 2015, Nadeem Akram et al. 2018) and that some visual quality metrics can predict changes in visual performance due to the optical aberrations. (Ravikumar et al. 2013)

The study will also identify visual quality metrics that are correlated with changes in visual performance with different multifocal contact lens designs, and how some optical properties of the eye change with multifocal contact lenses.

2.0 Background

Most multifocal contact lenses being studied for myopia control such as the Biofinity Multifocal D,(Walline et al. 2020) Proclear Multifocal D (Walline et al. 2013) and NaturalVue multifocal lenses (Cooper et al. 2018) were initially designed for presbyopia. Based on results from animal studies, (Smith 2011) it is hypothesized that these lenses are able to slow myopia progression by simultaneously providing clear foveal vision and myopic defocus. Thus, the initial steps in assessing the efficacy of any new myopia control lens must include an assessment of its effect on both visual performance and retinal defocus. Currently, this assessment is done on-eye in a cohort study. This process is expensive, time consuming and inefficient, and can severely hamper the ability to test several new multifocal contact lens designs.

The rationale for this study is to create a model that can predict changes in retinal defocus and visual performance with novel lens designs. With this model, several multifocal contact lens designs can be tested, and only promising lens designs are manufactured for further on-eye testing. This model can then be used by us and other researchers to quickly test the performance of several lens designs. Lens designs that maintain good visual performance with a maximum myopic change in retinal defocus have a high potential of being a good myopia control lens that warrant on-eye testing in a cohort study.

3.0 Inclusion and Exclusion Criteria

Inclusion Criteria

- Able to read and understand the informed consent document
- 18 to 39 years of age (inclusive)
- Best corrected visual acuity of 20/25 or better in the right eye
- Refractive error from -1.00D to -6.00D with astigmatism less than or equal to -1.00D in the right eye (corneal plane).

Exclusion Criteria

- Any ocular or systemic conditions affecting vision, refraction, or the ability to wear a soft contact lens.
- History of ocular trauma or surgery causing abnormal or distorted vision
- Current Rigid Gas Permeable (RGP) contact lens wearers
- Unwilling to have contact lens fit photographed
- Pregnant and/or lactating females, by self-report

A screening examination will be performed on all potential subjects to determine their eligibility for the study. Eligibility will be based on the listed criteria and will be determined by the study personnel listed on the study protocol.

The following special populations will be excluded from the study;

- Adults unable to consent
- Individuals who are not yet adults (infants, children, teenagers less than 18 years old)
- Pregnant women, by self report*
- Prisoners[+]

* Pregnant and/or lactating women will be excluded from the study because of the potential for shifts in the refractive components of the eyes during pregnancy, which would affect the study results. In clinical practice, pregnant or lactating women typically do not have dilation drops instilled when not necessary, unless as part of a comprehensive eye examination, to avoid any potential side effects for the child.

[+] Prisoners will be excluded from the study because the study requires the participant to be able to come to the University of Houston College of Optometry due to the specialized instruments needed to complete the study visit.

The following special populations may be included in the study;

- Students for whom the Principal Investigator have direct access to/influence on grades

4.0 Vulnerable Populations

Study subjects may be students for whom the principal investigator has access to or influence over their grades. For this reason, the principal investigator will not be responsible for recruiting or obtaining consent from students in their own courses in order to prevent undue influence or coercion. A study team member (e.g., sub-investigator) without access to or influence on grades will be responsible for these tasks.

5.0 Number of Subjects

The proposed study is a single site study and will be conducted at the University of Houston College of Optometry. To ensure that at least 10 subjects complete the study, up to 25 subjects will be enrolled and screened for inclusion in the study.

For this study, a sample size of 10 gives the study 80% power at an alpha level 0f 0.05 to detect whether a correlation of at least 0.8 exists between change in peripheral refraction with a multifocal contact lens compared to the change predicted by the model.

This study will not present more than minimal risk to the subjects. All visits will involve procedures and instruments that are routinely used in optometric examinations. The contact lenses the subjects will wear are FDA approved.

6.0 Recruitment Methods

Potential subjects will be recruited from the faculty, patients, students and staff (including relatives) of the University Eye Institute/University of Houston College of Optometry, as well as the surrounding community via word of mouth, print media (e.g., study fliers, newspaper adverts), telephone and electronic media (e.g., email, College of Optometry and The Ocular Surface Institute Websites, social media).

7.0 Study Timelines

The study is a single visit study. Subjects will be invited to participate in a study visit that will last approximately 2.5 hours. We expect to take up to 9 months to complete all visits and an additional 3 months to complete primary analyses after the last subject completes the study.

8.0 Study Endpoints

This is a minimal risk study. Correlations between measured changes in peripheral refraction and visual performance will be compared to modelled changes in these outcomes.

9.0 Procedures Involved

The study is a single visit, non-dispensing study of changes in visual performance and retinal defocus with multifocal contact lenses. The targeted number of participants is at least 10. Eligibility for the study will be determined during a screening examination after informed consent has been obtained. The study visit is expected to last approximately 2.5 hours and only approved clinical instruments will be used for examinations. Two FDA-approved soft contact lenses will be used in the study; a single vision contact lens and a multifocal contact lens.

Study Procedures

Item	Details
Informed Consent	Review and complete the informed consent form
Subject Eligibility	Review inclusion and exclusion criteria
Auto-refraction	Subject's refractive error and corneal curvature will be measured using a clinical, non-contact autorefractor.
Subjective Refraction	A subjective measurement of the subject's refractive error (i.e., prescription) will be determined using a phoropter.
Slit Lamp Examination	A slit lamp (i.e., a microscope used to examine the eye) will be used to assess the health of the subject's eyes. Standard clinical dyes (sodium fluorescein) will be used to assess the health of the front surface of the eye.
Pupil dilation and cycloplegia	After instillation of a topical anesthetic (either 0.5% proparacaine or 0.5% tetracaine), the pupil of each subject's right eye will be pharmacologically dilated using either 1% tropicamide alone or in combination with 2.5% phenylephrine to ensure adequate pupil dilation.
Optical biometry	A non-contact optical biometer will be used to measure the biometrics of the eye including axial length, anterior chamber depth, lens thickness and vitreous chamber depth.
Aberrometry	Eye aberrations will be measured using a standard clinical instrument with and without wearing FDA-approved contact lenses.
Corneal topography	The surface curvature and elevation of the cornea with and without FDA-approved contact lenses will be measured using a corneal topographer.

Contact Lens Fitting	FDA-approved contact lenses will be fitted to the right eye. This includes checking the fit of the lenses (movement and centration), determining the appropriate lens power, and measuring visual acuity with the lenses. A picture of the contact lens fit will be taken to determine centration. Contact lenses will be fitted in random order based on a randomization schedule. Each subject will be fitted with a new contact lens. Contact lenses will not be reused between subjects.
Visual Acuity	High- and Low-Contrast Visual Acuity will be measured at various distances. Acuity measurements will be made with and without a standard optical setup to maintain a consistent artificial pupil size for all subjects.
Contrast Sensitivity	The subject's contrast sensitivity function will be measured by viewing a series of targets using an automated contrast sensitivity measuring device. Testing will be done through a standard optical setup to maintain a consistent pupil size for all subjects.
Intraocular Pressure	The intraocular pressure of the eye will be measured using a standard clinical instrument and either 0.5% proparacaine or 0.5% tetracaine.

Interested subjects will first go through an initial screening using a screening script before being scheduled. Potential subjects who pass the initial screening script will be scheduled and will initially complete the informed consent process. Should they agree to partake in the study, they will then undergo a screening examination to determine their eligibility for the study. As part of this examination, a standard most plus, least minus manifest refraction will be performed to determine refractive error and best-corrected visual acuity.

Eligible subjects will be fitted with two different contact lenses (one sphere and one multifocal, in random order) in their right eye. Each subject will be fitted with a new, previously unworn contact lens. Next, the pupil of the right eye of the subject will be pharmacologically dilated. As the subjects are waiting for their pupil to be fully dilated, the axial length and other biometrics of the eye will be measured. After pupil dilation, the central and peripheral aberrations of the right eye of each subject will be measured.

Lens centration, corneal topography, central and peripheral aberrations, low- and high-contrast visual acuity, and contrast sensitivity will be measured with the first contact lens. After this, the second contact lens will be inserted, and the same measurements will be repeated.

10.0 Setting

All study visits will be conducted at the University of Houston College of Optometry in the investigators' clinical research examination lanes in the J. Davis Armistead Building and The Ocular Surface Institute (TOSI) in the Health 1 Building.

11.0 Risks to Subjects

The risks to the subjects in the study are the same risks found in standard clinical practice. During study procedures, there is the risk of mild ocular discomfort during clinical procedures due to light being shined on the eye (e.g., slit lamp biomicroscopy), by being asked to not blink for a short period of time during a procedure, or through the use of topical ophthalmic diagnostic agents (e.g., sodium fluorescein, 1% tropicamide, 2.5% phenylephrine, topical anesthetic). Pupil dilation may interfere with subjects' vision for the next few hours and make near work difficult and increase their sensitivity to light. Potential subjects will be examined to ensure that their pupil can be safely dilated. Potential discomfort from these procedures is transient, self-limiting and is no different than what occurs during pupil dilation and contact lens fitting in standard clinical practice.

Contact lenses will be fitted on right eyes as part of this study. All contact lenses are FDA approved. The risks of contact lens wear are no different than if fitted in clinical practice. The potential for contact lens complications (listed below) are minimal because no contact lenses are being dispensed to the subject (all study contact lenses are worn during the study visit only).

The following problems may occur with routine contact lens wear:

- Burning, stinging, and/or itching of the eyes
- Less comfort over time than when the lens was first placed on the eye
- A feeling like there is something in the eye (foreign body, scratched area)
- Reduced vision or temporary loss of vision due to peripheral infiltrates (white blood cells), peripheral corneal ulcers (inflammation of the cornea), microbial keratitis (infection of the cornea), and/or corneal erosion (defects in the corneal surface)
- Local or generalized edema (swelling)
- Corneal staining (defect in the corneal surface)
- Redness
- Tarsal abnormalities (bumps on the inside upper eye lid)
- Iritis (internal inflammation of the eye)
- Conjunctivitis (infection or inflammation of the white part of the eye or under the eyelids)
- Excessive watering, unusual eye secretions, or redness of the eye

- Poor visual acuity
- Blurred vision
- Rainbows or halos around objects
- Sensitivity to light
- Dry eyes may also occur if lenses are worn continuously or for too long a time

Subjects will be instructed that in the event they experience signs or symptoms associated with a potential adverse event during the study visit, they should immediately inform study personnel.

12.0 Potential Benefits to Subjects

There are no direct benefits that subjects are expected to gain from participating in this study. However, the results from this research may increase our understanding of how multifocal contact lens optics affects retinal defocus and visual performance. This information can ultimately lead to a tool to design more effective multifocal contact lens optics for myopia control.

13.0 Withdrawal of Subjects

Participation in the study is voluntary and subjects can withdraw from the study at any time. Subjects may also be withdrawn from the study by study investigators if they have a study-related adverse event that warrants withdrawal from the study or they fail to follow the study instructions.

14.0 Costs/Payments to Subjects

There is no cost to participate in the study and subjects will not be charged for any of the study procedures. Subjects who are eligible to participate and complete the study will receive a $50 Amazon gift card. Subjects must be eligible and complete all study procedures to receive the gift card. A parking pass will be provided for subjects on the day of their visit.

15.0 Confidentiality

Subjects will enter their name on the consent form, and their contact information will also be collected for subject scheduling purposes. Identifying information will not be collected on the data collection forms. A unique identification code will be assigned to each subject and used on the data collection forms to identify subjects. The study key linking each subject to their unique identification code will be stored on a password-protected file and will be available only to the study personnel. This key will be stored for 3 years after study completion. All study documents will be securely kept in the investigator's laboratory.

16.0 Provisions to Protect the Privacy Interests of Subjects

Study personnel will discuss the details of the study with potential subjects. This discussion will take place in a quiet and private area, and will take as long as necessary to explain all the details of the study to the understanding of the subject.

17.0 Informed Consent Process

This study will follow the University of Houston Division of Research SOP: Informed Consent Process for Research (HRP-090). The participant will be provided an opportunity to read the informed consent form and to have any questions answered before deciding whether to participate. Should they decide to participate, study personnel will obtain written informed consent from the participant. The consent form will be signed and dated by both the participant and a member of the study personnel who has been approved to obtain consent. The participant will receive a copy of the signed consent documents and the originals will be filed in the subject binder on site in a secure location.

18.0 Process to Document Consent in Writing

The study will follow the University of Houston Division of Research standard operating procedure regarding written documentation of informed consent (SOP: Written Documentation of Consent (HRP-091)). The consent form will be signed and dated by both the study subject and a member of the study personnel who has been approved to obtain consent. The study subject will receive a copy of the signed consent documents and the originals will be filed in the subject binder on site in a secure location. A copy of the informed consent document is included in the study related documents.

19.0 HIPAA

To assess eligibility for participation in the study, demographic information, general medical and eye health information will be collected on the potential subjects by self report. No information will be obtained from or added to any medical record at the University Eye Institute.

20.0 Data Management

Data will be stored both in a paper file and electronically. Paper files will be locked in the research lab, and electronic data will be stored on a password protected computer. Data will be kept for a minimum of 3 years after completion of the project.

Data analyses will be conducted using standard software packages. Descriptive statistics will be conducted to describe the data. Tests of normality will then be conducted followed by appropriate parametric or non-parametric hypothesis testing and correlation analyses.

21.0 Sharing of Results with Subjects

At the end of the study, subjects will be informed of the order in which contact lenses were worn. Results from analysis of the data will not be shared directly with subjects but may be presented at as part of a research talk or published in an academic journal.

22.0 Resources

The study team has completed all necessary requirements for ethical training. David Berntsen OD PhD, has nearly two decades of experience conducting clinical care and research and will oversee all study personnel.

With an abundance of contact lens wearers in the surrounding community, we do not anticipate difficulty identifying eligible subjects. We understand the possibility of slower than normal recruitment due to COVID-19; therefore, we have set an anticipated target of 9 months to complete all visits.

All clinical equipment that will be needed to complete the study are available within the University of Houston College of Optometry.

23.0 References

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