Role Of Multifocal Lens Glasses on Walking Balance
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Abstract
The literature has shown a link between visual impairments and an increased risk of falling in older adults (Lord, 2002). Falling is a major reason for hospitalization, injury, and death amongst individuals over 65. Multifocal eyeglasses, which are designed for both distance viewing and correcting presbyopia, distort vision in the lower part of the visual field at ground level while walking. This project provides clarification on the relationship between multifocal eyeglasses and gait. Specifically, this pilot study analyzes performance of 6 young, healthy individuals while wearing progressive and single lens glasses. Using the Dynamic Gait Index-modified (DGI-m) and Motion Capture Analysis (MCA). Participants complete a series of trials containing the DGI-m and the step/ramp obstacle. MCA measures participant’s joint flexion and extension of the lower extremities to detect changes in gait. MCA data is being collected and analyzed using the Cortex 2.0.0 software, and the DGI-m is scored by a trained rater. These preliminary results provide the groundwork for future research to analyze different interventions that reduce the number of falls while wearing multifocal eyeglasses. These interventions include changing single lens glasses, a falls intervention with education on bifocals, and SuperFocus manually adjustable multifocal lenses.

Background
It is estimated that over 85% of all adults over the age of 45 will develop presbyopia (Holden, 2008). This condition develops with age and causes loss of near distance viewing. Reading glasses are used to correct presbyopia. When an individual develops presbyopia and has a far distance viewing impairment, reading glasses are not sufficient to cure both impairments. Because of this dilemma, multifocal lenses, which include lined bifocals, trifocals, and progressive lenses, are often prescribed. In lined bifocals the lower lens corrects near distance and may experience discomfort because of this. The effects of multifocal lenses could be a factor that cause increased risk for falls in aging individuals.

Methods
This study examined performance of six young, healthy adults while wearing +2.75 progressive lens and non-corrective single lens glasses for a 1.5 hour testing session. The study was approved by the University of Wisconsin-Milwaukee Institutional Review Board. Two measures are used in trials: Dynamic Gait Index-modified (DGI-m) and Motion Capture Analysis (MCA). Participants performed 36 trials of a loop course. The loop course includes 15 meters of walking straight while encountering a ramp/step or step/ramp followed by a DGI-m task. Single and progressive lens glasses were switched every nine trials.

The DGI-m consists of nine walking tasks. These include: walking at normal speed, changing speeds, turning the head horizontally while walking, turning the head vertically, walking then pivoting, stepping over a shoebox and diagonal long box, stepping around an obstacle, and stepping on off a platform. Figures 3 illustrates the shoebox task. All nine tasks are scored by a trained rater. Scoring is based on a zero through five scale. Figures 4 illustrates the DGI-m score for both lens conditions.

Results
When comparing progressive lens glasses to single lens glasses, there is an increase in toe clearance during the step up trials. Toe clearance was measured by the vertical lifting of the foot (r = 0.99). In Figure 5 toe clearance is higher in both steps for bifocal lenses. Higher toe clearance indicates that the individual was using a cautious strategy for foot placement to reduce trip risk. This indicates that younger wearers adapt a similar strategy for stepping when wearing multifocal lenses as older adults (Elliott, 2010).

Figure 5: Participant performing Task 6 of the DGI, Stepping over an obstacle.

Figure 6 compares the DGI-m scores of single lens and bifocal lens trials. The bar graph shows a decrease in scores for bifocal lens trials.

Discussion
Preliminary results of this pilot study reveal that multifocal lenses cause young, healthy adults to use a cautious strategy to prevent falls and near falls. Cautious strategies result in greater toe clearance variance and lower DGI-m scores. Similar cautious strategies are used by elderly multifocal wearers. Knowing that young, healthy adults perform the similarly eliminates fall risk variables such as poor balance and walking impairments that are experienced in elderly individuals. Multifocal lenses are determined to be a fall risk factor that increases with age. Further study of this phenomenon will only strengthen the hypothesis that multifocal lenses are a fall risk factor.

References

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