

Abstract

This study investigated the functional effects of new multifocal lens wearers on contrast sensitivity, depth perception, functional mobility and the increased risk of falling with middle aged (40-59 years old) individuals as they adapt to their new multifocal lenses.

Twenty eight volunteers (ages of 40 to 59) were assessed as they began wearing new multifocal lenses (Visit One), at 2 weeks (Visit Two) and 3 month (Visit Three) intervals. Data were collected on each individual's performance for depth perception, contrast sensitivity, and functional mobility. Additionally, a falls questionnaire was administered at each visit.

This study revealed that the visual and gait performance of middle age new multifocal lens users was significantly degraded compared to their prior single lens use. Results did not show effects on frequency of falls for this younger age, as seen in the literature with older populations. Future investigation on the adaptation of new multifocal lens is warranted.

Background

In 2003, nearly 1.5 million nonfatal injuries from unintentional falls were reported.¹ Unintentional falls are the leading cause of nonfatal injuries for every age group except those 15-24 years of age.² On average, \$19 billion is spent on health care for falls This number could reach \$32.4 billion by 2020.¹ Visual impairment, as a consequence of both age-related changes and ocular diseases, is strongly associated with increased risk of both falls and injurious falls.^{3, 4}

Research shows that users of multifocal lenses experience difficulty when viewing objects that appear in the distance through the lower portion of their lens.³ Literature points to a decrease in depth perception, contrast sensitivity, functional mobility, and increased risk of a falls with the use of multifocal lenses in an older population. A study conducted by Lord, Dayhew & Howland in 2002 found multifocal lenses pose a risk for falling at critical distances in an older adult population (60 years and older). The investigators reported that users of multifocal eyeglasses are more than twice as likely to fall than non multifocal eyeglass wearers.⁵

With age, the risk of falling increases. Is this risk of falling evident in the 40s and 50s when multifocals are first prescribed? The literature has not sufficiently investigated the functional effects of multifocal lens eyeglasses on middle aged users. Some literature suggests adaptation occurs in three months, while other literature suggests some individuals never adapt. The uncertainty of if and when the adaptation process of newly prescribed multifocal lenses occurs led to the design of the second research question in this study; Does the visual and functional gait performance of new multifocal lens wearers improve over time? By proposing studies like this study, visual performance and functional gait performance of new multifocal lenses over time, the adaptation process can be better understood.

Objective

To identify the effects of bifocal eyeglasses on vision and gait for new bifocal eyeglass wearers.

Hypotheses

Researchers investigated three research questions to better understand the use of new multifocal lenses. It was hypothesized that there would be significant differences on depth perception, contrast sensitivity and functional gait performance in old single lens glasses vs new bifocal lenses and that these performance scores would not change over three months with use of bifocal lenses only. Below each research question is listed, followed by the sub hypotheses.

1) Will the visual performance and functional gait performance of new multifocal lens wearers be worse than the single lens performance?

- 1.1) Worse depth perception when viewing through the lower lens of bifocal eyeglasses than when viewing through single lens eyeglasses.
- 1.2) Worse distant edge contrast sensitivity when viewing through the lower lens of bifocal eyeglasses than when viewing through single lens eyeglasses.
- 1.3) Worse functional mobility scores with the use of bifocal eyeglasses than with the use of single lens eyeglasses.
- 1.4) There will be a significant difference in the number of falls reported with the use of new multifocal lens compared to single lens.

2) Will the visual performance and functional gait performance of new multifocal lens wearers improve over time?

- 2.1) There will be a significant improvement in depth perception within subjects when viewed through the lower lens of new bifocal eyeglasses over three months.
- 2.2) There will be a significant improvement in contrast sensitivity within subjects when viewed through the lower lens of new bifocal eyeglasses over three months.
- 2.3) There will be a significant improvement in functional mobility within subjects when viewed through the new multifocal lenses over three months.

Methods

28 participants participated in the study (7 males, 21 females). All were 1st time bifocal wearers. The mean age of participants was 48.4 years.

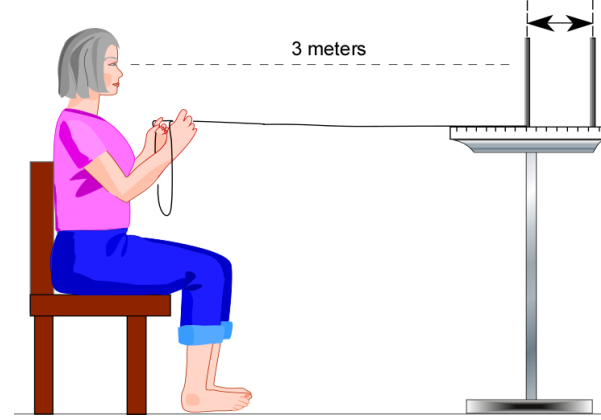
Four data collection instruments were used to observe the functional effects of newly prescribed multifocal lenses. The first two instruments were identical to those used in the Lord et al. study in 2002.

- 1) The Howard-Dohman depth perception apparatus
- 2) An enlarged version of the Melbourne Edge Test
- 3) A modified version of the Dynamic Gait Index (DGI-m)
- 4) A falls questionnaire.

A fall history questionnaire was administered at the beginning of each visit. At Visit One, the participant was asked to consider the last three months and to report how many falls they had experienced. At Visit Two and Visit Three the individual was asked to report the number of falls experienced between Visit Two and Visit Three. If falls were experienced between the visits, the individual was asked to consider the circumstances of each fall. The participants were then asked to report where they were at the time of the fall, what they were doing, if they were wearing glasses, and the type of lighting at the time.

All four variables were assessed at each of the three visits. At Visit One the four dependent variables were assessed with the users single lenses and again with the users never worn, new multifocal lenses. At Visit Two and Visit Three the four variables were assessed with the multifocal lenses to capture the adaptation of the new lenses over time.

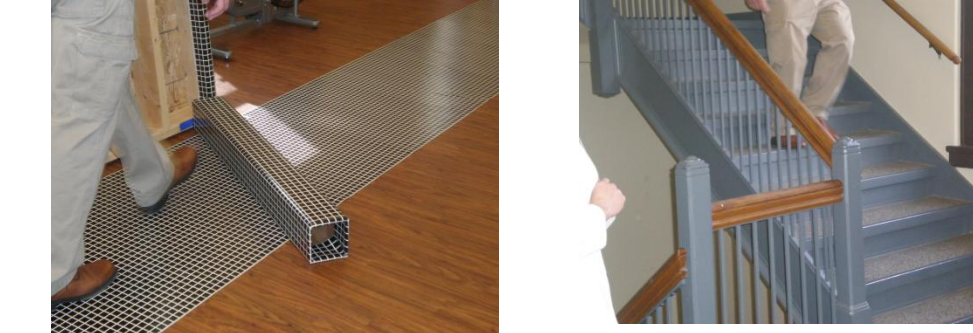
Methods Cont.



The Howard-Dohman depth perception apparatus was used to measure depth perception for this study. As used in previous research by Lord et al., the test has participants align two vertical rods (.8 cm diameter) in depth from a distance of 3m. Possible scores range from 0-20. A score of zero indicates the best score possible; no depth perception impairment.



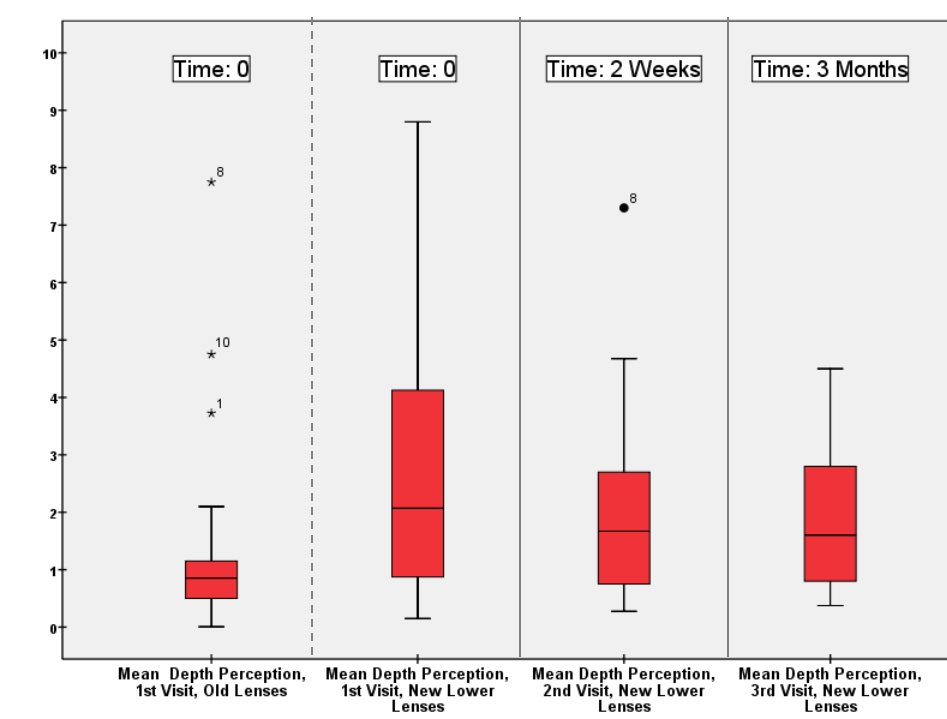
The enlarged version of the Melbourne Edge Test, also used by Lord et al. (2002), used 24 octagonal test plates positioned 135 cm in front of subjects. The lowest contrast plate correctly identified was recorded. Possible scores ranged from 1 to 24. A 1 is the lowest score possible and a 24 is the best possible score of contrast sensitivity.



The DGI-m evaluated an individual's ability to modify gait in response to 10 tasks. Items of the DGI-m included tasks such as head turns, ascending and descending stairs, a change in gait speed, stepping over and around objects and turning the head back and forth. Possible scores range from 0 to 50. A score of 50 is the best possible score, representing the best possible functional gait. A score of zero indicates complete failure of task.

Results

Mean Depth Perception Scores, 3 visits: Old Single Lenses and New Lower Lenses



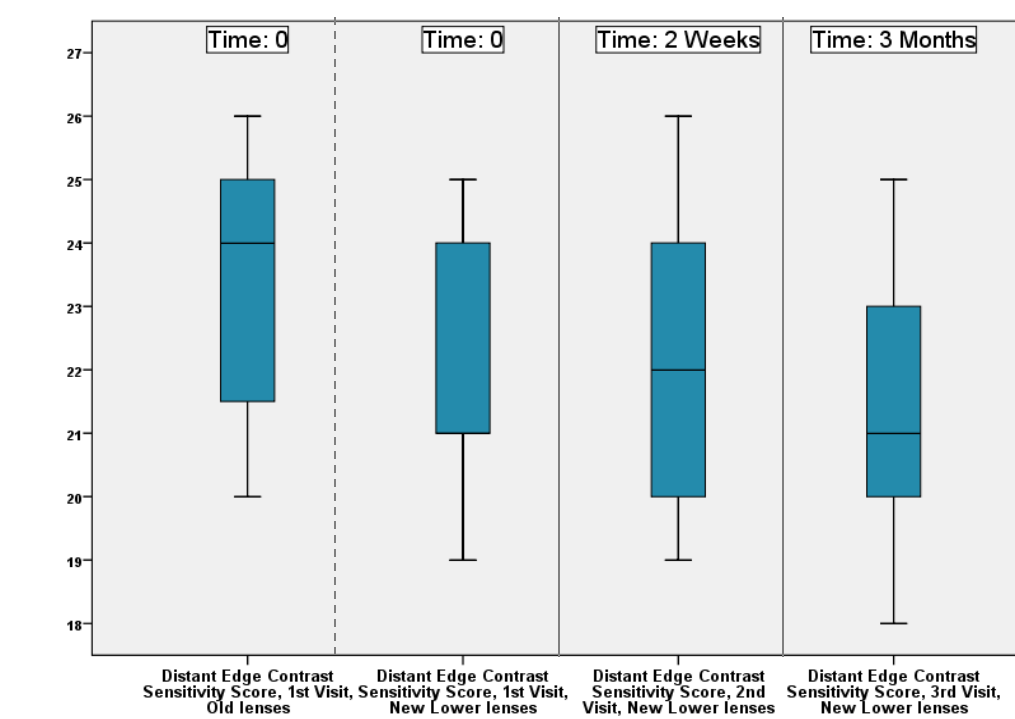
Single lens depth perception performance was performed with a mean of 1.22 mm and new multifocal lens users performed with a mean score of 2.83 mm (p = .003.)

New multifocal lens users depth perception performance scores were significantly worse than with their single lenses. The adaptation of the new multifocal lens users depth perception visual performance occurred gradually. A mean score of depth perception impairment for multifocal lenses at Visit One was 2.85 mm and 1.91mm at Visit Three.

Falls Questionnaire, 3 Visits: Old Single Lenses and New Lower Lenses

A p value of .305 for each visit resulted in no significant differences in falls.

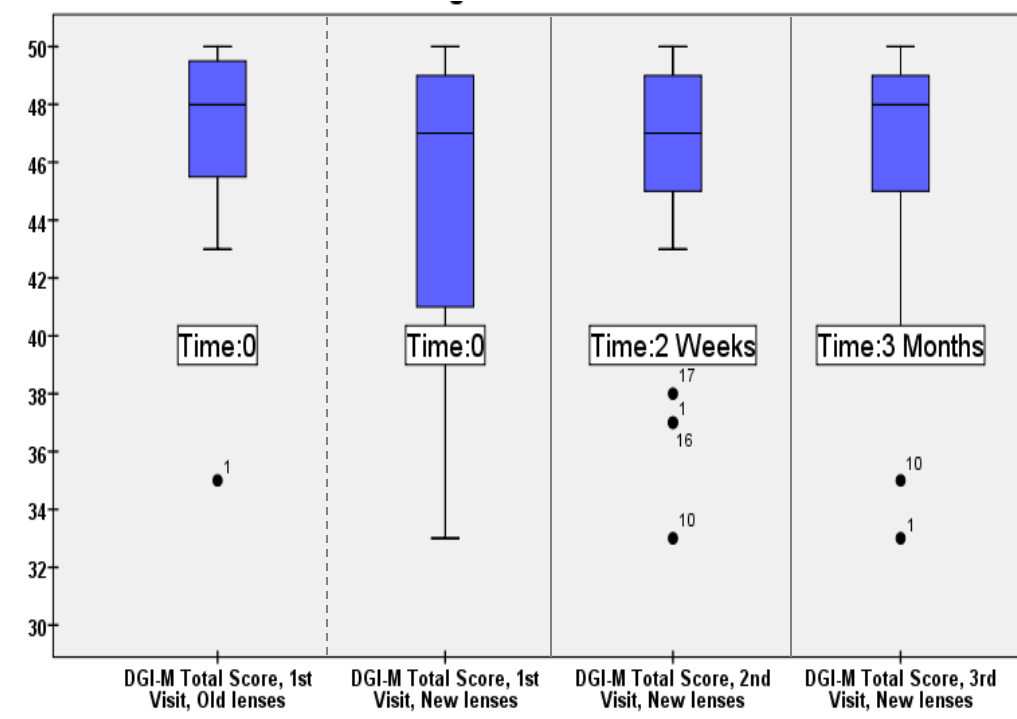
Distance Edge Contrast Sensitivity Scores, 3 visits: Old Single Lenses and New Lower Lenses



Single lens contrast sensitivity performance was performed with a mean of 23.07 and new multifocal lens users performed with a mean of 22.21 (p=.031). Contrast sensitivity showed significant impairments with the use of new multifocal lenses.

Contrast sensitivity performance scores resulted in significant decline in performance (p=.028). Researchers further investigated when this significant decline occurred. A significant decline in performance (p=.005) was found to occur between Visit Two and Visit Three.

DGI-m Scores, 3 Visits: Old Single Lenses and New Multifocal Lenses



Functional mobility results were significant with lower scores for new multifocal lens users (p= .009). Single lens users reported a mean score on the DGI-m tasks of 47 out of 50, while with the use of new multifocal lenses, a mean score of only 45 out of 50 was achieved.

The mean DGI-m score for Visit One was 44.68, the mean score for Visit Two was 44.48 and the mean for Visit Three was 45.64. These results showed no significant difference in functional mobility scores with the use of multifocal lenses over three months (p= .273).

Discussion

Multifocal lens use is prevalent throughout the middle- aged population. This study has found decreases in performance in critical areas of visual perception, as well as gait. These decreases are evident in the initial switch from single lenses to multifocal lenses, and can persist for weeks.

Significant decreases were observed in depth perception, contrast edge sensitivity, and gait. This decreased performance level persisted up to 3 months later, indicating that actual visual perception has been altered by the use of multifocal lenses.

While fall rates did not increase during this study, as had occurred in the Lord et al. study in 2002, the different age groups of the studies may be a significant factor. The younger population of our study may be more resistant to falls due to physical factors, such as being stronger, better agility and quicker reaction times to losses of balance. However, the deficits incurred by wearing multifocal glasses may cause impairments that begin from initial use of the lenses, but do not manifest until individuals get older. There may be significant changes in motor actions and attentional focus that are unconsciously adjusted for by a younger person, but may lead to problems as the person ages.

Falling occurs for many reasons and a multitude of factors play a part in causing falls. An overlooked facet of falls is the use of multifocal lenses. This study has provided a glimpse into the effects of multifocal lenses on visual and gait performance, and points to the significant yet under scrutinized role that vision plays in the complex of factors that can lead to falls.

Consequently, these findings support the theory that the functional skills of younger bifocal wearers compensate for these visual impairments, but as bifocal eyeglass wearers age, their ability to compensate depreciates and falling occurs.

References

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