Abstract

Objective: To create a reliable and valid measure of distant edge contrast sensitivity, which can discriminate between participants wearing single and multifocal lens glasses.

Design: This study used a within-subjects repeated measures design to examine the mean differences between 4 lens conditions.

Participants: Four UWM students volunteered to participate in this study. All participants met inclusion criteria and passed visual and balance screening tests.

Methods: A computerized Contrast sensitivity experiment paradigm based on the Melbourne Edge Test was used. This paradigm uses a timed visual choice paradigm in which the participants have to determine which figure is different from the others. Four contrast levels were used to measure visual sensitivity when wearing different lens types.

Main Outcome Measures: Correct versus incorrect responses and response time to select an answer.

Background

Recent research has shown that wearing multifocal lenses increases the risk rate for falling in older adults by affecting the gait performance and comfort level of the wearer. Individuals who wear multifocal lens glasses have decreased distant edge-contrast sensitivity and depth perception (Lord, S. W., Dayhew, J., & Howland, A. 2002). It has been shown that multifocal lens glasses (lined bifocal, trifocal, and unlined progressives) cause distortions and/or blurred vision in the bottom portion of the glasses, thus affecting contrast edge sensitivity (Smith, Tomashek, Stalberger, & Rust, 2012). Contrast edge sensitivity is affected by the use of multifocal lens glasses and is one of the strongest risk factors for multiple falls (Lord, R. S., & Dayhew, J., 2001). When walking people typically look approximately two steps ahead of them, this is the “critical distance” for detecting environmental hazards (Patla & Vickers, 1997).

Methods

All procedures used in this study were approved by the University of Wisconsin-Milwaukee Institutional Review Board. In the first phase of this study four participants, all UWM students, completed the testing procedure. Each session began with tests of visual acuity, depth perception, ability to see color, and standing balance to determine inclusion eligibility. The test paradigm was projected onto a large screen. Participants stood approximately four feet from the screen with their head stabilized in an apparatus to prevent any extraneous head movements.

Results

Preliminary analyses found a significant difference in the ability to differentiate contrast edge between participants when wearing bifocal lens glasses and the other lens conditions (p<.05).

For further analysis bifocal and progressive lens conditions were grouped together as multifocal lenses and clear and non lens condition were grouped together as non-multifocal lenses. This was done based on performance outcomes and the theoretical premise of the two groups of lens conditions. Additionally, initial analysis found that the 4 contrast conditions grouped into 2 groups, high and low, which were used during analysis. Significant differences (.000) were found between the multifocal and non-multifocal lenses in response time. There was also a significant difference (.000) between the grouping of the two highest contrast levels and the two lowest contrast levels. The interaction of the two lens types and the two contrast level groups approached significance (.056).

<table>
<thead>
<tr>
<th>Condition</th>
<th>F-Statistic</th>
<th>Significance</th>
</tr>
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<tbody>
<tr>
<td>Multifocal vs. non-multifocal lenses</td>
<td>19.005</td>
<td>.000*</td>
</tr>
<tr>
<td>High vs. low contrast</td>
<td>225.896</td>
<td>.000*</td>
</tr>
<tr>
<td>Interaction between lens and contrast</td>
<td>3.668</td>
<td>.056</td>
</tr>
</tbody>
</table>

**Table 1: Levels of significance for contrast levels**

The number of incorrect responses was greatest among the bifocal lens condition. The mean of incorrect responses across lens conditions was .14.

**Discussion**

The findings of this study revealed that there was a significant difference between multifocal and non-multifocal lens wearers. When participants wore multifocal lenses, response times were greater compared to non-multifocal lenses. This is consistent with previous research that found that multifocal users have decreased edge-contrast sensitivity. Lower contrast figures were more difficult to see as noted by the increased time needed to identify the correct target and the higher error rate.

This study warrants further research to determine if cutpoints can be identified for different lens strengths on the perception of distant edge contrast sensitivity.

**Acknowledgements**

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**References**


