Article • A Pilot Study: Effect of Vision Impairment Simulation on Patients' Understanding of Glaucoma

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ABSTRACT

Background: Improving adherence to glaucoma management requires thorough and accurate patient education. Patient education can take many forms. This study informs on the effect simulation goggles may have on the understanding of how glaucomatous visual loss can impact many tasks. Effective methods to increase patient adherence to glaucoma management will reduce vision loss. The aim of this study was to use simulation goggles to demonstrate glaucomatous vision loss and to show the impact on the subjects' short-term intentions for glaucoma compliance.

Methods: Twenty-six subjects aged 50-70 with glaucoma participated. Each subject wore goggles that simulated glaucomatous vision loss while performing everyday tasks. Prior to simulation goggle intervention, all subjects completed the Glaucoma Activity Limitation (GAL-9) questionnaire and answered questions regarding baseline knowledge of glaucoma visual impact. These questions were repeated following the intervention.

Results: There was a statistically significant increase in mean GAL-9 score with simulator goggles (29.81±5.3) compared to baseline (15.04±5.2). When asked to respond to glaucoma knowledge questions, correct answers regarding peripheral vision loss increased by 30.8%, blurry vision increased by 26.9%, and loss of contrast sensitivity increased by 34.6%. After the intervention, the percentage of subjects who responded that they now understood glaucoma well increased by 26.9%, and 100% of subjects reported that the activity increased their awareness of potential vision loss due to untreated glaucoma.

Conclusion: This study demonstrates that this level of vision loss simulated in the goggles can properly impact visual function. This study also demonstrates that experiential knowledge gained through vision simulation goggles has the potential to increase knowledge about glaucoma, as well as potential intention for short-term compliance with glaucoma management.

Keywords: adherence, education, glaucoma, simulation, understanding, vision loss

Introduction

Worldwide, it is expected that over 111 million people will have glaucoma by 2040.[1] The personal negative impact of vision loss from glaucoma is significant. Glaucoma is associated with decreased quality of life,[2] increased depression,[3] fear of falling,[4] decreased physical activity,[5] difficulties with driving,[6] increased issues with visual crowding,[7] and decreased reading ability.[8]

Glaucoma includes a group of eye diseases that can cause vision loss and blindness through damage to the optic nerve. Treatments can include follow-up visits, topical medications, oral medications, laser, and surgical interventions. The only current modifiable risk factor is intraocular pressure, through topical or oral medications or surgical or laser intervention. While treatment doesn't guarantee to halt the progression of glaucoma, studies show that ocular hypotensive treatment significantly reduces the risk of progression and visual field loss.[9]

A significant challenge for eye care providers is patients' adherence to prescribed management to prevent vision loss. Studies have found that a large percentage of patients do not adhere to their treatment due to different factors, including long clinic

wait times, cost, insurance coverage, forgetfulness, follow-up ability, educational background, mental health (depression/cognition), side effects, language barriers,[10] or cultural differences.[11] Since most types of glaucoma are initially symptomless, patients are often less motivated to use their medication as prescribed, resulting in non-adherence and vision loss.[12] In a 2016 retrospective cohort study, it was estimated that 51-56% of patients were using their ocular hypotensive medication as prescribed.[13] It is essential for patients not only to be managed early, but also to adhere to their treatment protocol as directed. This is especially a concern with the use of topical ocular hypotensive medications, as they are directed to be used daily and require follow-up visits to monitor for progression and whether changes in treatment are needed.

Simulation goggles have been used to increase understanding of vision loss. For example, goggles have been introduced into academic settings to improve graduate students' understanding of vision impairment. Scores on understanding of the condition after the simulation increased significantly.[14] This same technique was used amongst pharmacy students to improve their understanding of the severity of peripheral vision loss in glaucoma.[15] However, there is limited information about the level of vision loss intended and needed to simulate the desired vision loss. There is also limited commercial availability of simulation goggles, so consistency in simulator effects may differ.

The aim of this pilot study was to confirm that the study simulation goggles affected visual function and that simulation goggles impacted the subjects' short-term intentions for glaucoma treatment compliance. It was hypothesized that patients who undergo vision-loss simulation might have a better understanding of the potential severity of glaucoma. This intervention might then be a tool for clinicians to use to increase patient understanding and treatment adherence, thereby preventing unnecessary vision loss from glaucoma.

Methods

Subjects

A retrospective record review was completed of patients recently seen at the Illinois Eye Institute (Chicago, IL) using inclusion criteria of International Classification of Disease, Tenth Revision, (ICD-10) codes for mild and moderate primary open-angle or low-tension glaucoma. Per ICD-10, for both primary open-angle and low-tension, "mild" glaucoma indicates optic nerve abnormalities not currently affecting the visual field, and "moderate" glaucoma includes optic nerve abnormalities and glaucomatous visual field abnormalities in one hemifield, but not within 5 degrees of fixation. An additional inclusion criterion was self-reported ability to walk without assistance. Exclusion criteria included cognitive impairment, vision loss due to other ocular conditions including cataracts, or glaucoma diagnosed for more than 2 years. Records were reviewed to ensure that subjects met inclusion criteria, and 201 study recruitment

Table 1. Subject Characteristics

Gender	Percentage	Number (of 26)
Male	46.15%	12
Female	53.85%	14
Age		
50-54	3.8%	1
55-59	0%	0
60-64	50.0%	13
65-69	46.2%	12
Glaucoma Type with ICD 10 codes		
POAG mild H40.1111/1121/1131	61.5%	16
POAG moderate H40.1112/1122/1132	30.8%	8
Low-tension mild H40.1211/1221/1231	3.8%	1
Low-tension moderate H40.1212/1222/1232	3.8%	1

Table 2. Glaucoma Activity Limitation (GAL-9) Questionnaire: 9-Item and 5-Response Category Instrument

Pre-Activity Instructions: "Does your vision give you any difficulty, even with glasses, with the following activities?"

Post-Activity Instruction: "Based on your experience through the vision simulation goggles, rate how difficult you think the following activities would be while wearing those goggles."

Scale: 1 no difficulty, 2 a little bit of difficulty, 3 some difficulty, 4 quite a lot of difficulty, 5 severe difficulty

Items

1. Walking after dark
2. Seeing at night
3. Walking on uneven ground
4. Adjusting to dim lights
5. Going from a light to a dark room and vice versa
6. Seeing objects coming from the side
7. Walking on steps/stairs
8. Judging distance of foot to step/curb
9. Finding dropped objects

letters were mailed to potential participants. This letter was followed by up to two telephone calls. Twenty-six subjects aged 50-70 years old responded, consented to, and then participated in the study (Table 1). All subjects completed the study.

Procedure

The study consisted of a single 60-minute visit, which included three components: pre-activity questions, vision impairment simulation, and post-activity questions.

Pre-Activity Questionnaires

Before their assigned activity, all subjects completed the Glaucoma Activity Limitation (GAL-9) (Table 2) and answered questions regarding baseline knowledge of glaucoma visual impact. The GAL-9 has 9 questions on vision-related activity limitations in patients with glaucoma.[16,17] Each question is ranked on a scale of one to five, with a final score ranging from 9-45 and a higher score representing increased difficulty with vision-related activities. Tasks listed are basic tasks that all subjects experience daily; the subjects answered questions based on their current vision. Baseline questions regarding glaucoma visual impact were also asked to the subjects prior to goggle intervention. These baseline questions were similar to those used and recognized in other glaucoma studies. These questions focused on knowledge surrounding peripheral vision loss,[18] blurry vision, and faded vision associated with glaucomatous vision changes.[19] Subjects were asked the following and were instructed to answer "True," "False," or "I do not know": Glaucoma can make you lose your side vision, Glaucoma can make you have blurry vision, and Glaucoma can make you have faded vision.

Activity

Subjects wore wrap-around vision impairment simulation goggles. These goggles were designed to simulate vision loss due to advanced glaucoma. Commercially available safety goggles with dark/opaque sides were used to create the vision loss simulators. The goggles used were modified by using construction paper with a 1.5 cm central hole and ~0.4 Bangerter occlusion foils. The goggles simulated visual acuity reduction to between 20/40 and 20/50, moderate log contrast sensitivity loss to between 1.04 and 1.48, and visual field reduction to between 20 and 30 degrees. The goggles were worn over the habitual correction of the subject and allowed the subject to view through both their distance and near prescription. These subjects were allowed unlimited time to perform a series of 12 everyday routine activities. These tasks included pouring a glass of water, using a smartphone, using a computer, reading printed material, walking around obstacles in normal and dim illumination, identifying facial expressions, and watching TV.

Post-Activity Questionnaires

Subjects repeated the GAL-9 questionnaire and the baseline questions regarding glaucoma visual impact. For the post-activity GAL-9 questionnaire, subjects answered questions based on their experience through the vision loss simulation goggles. After all questions, subjects were given the chance to make any desired comments; comments were recorded. Average scores pre- and post-intervention were compared.

Data Analysis and Consent

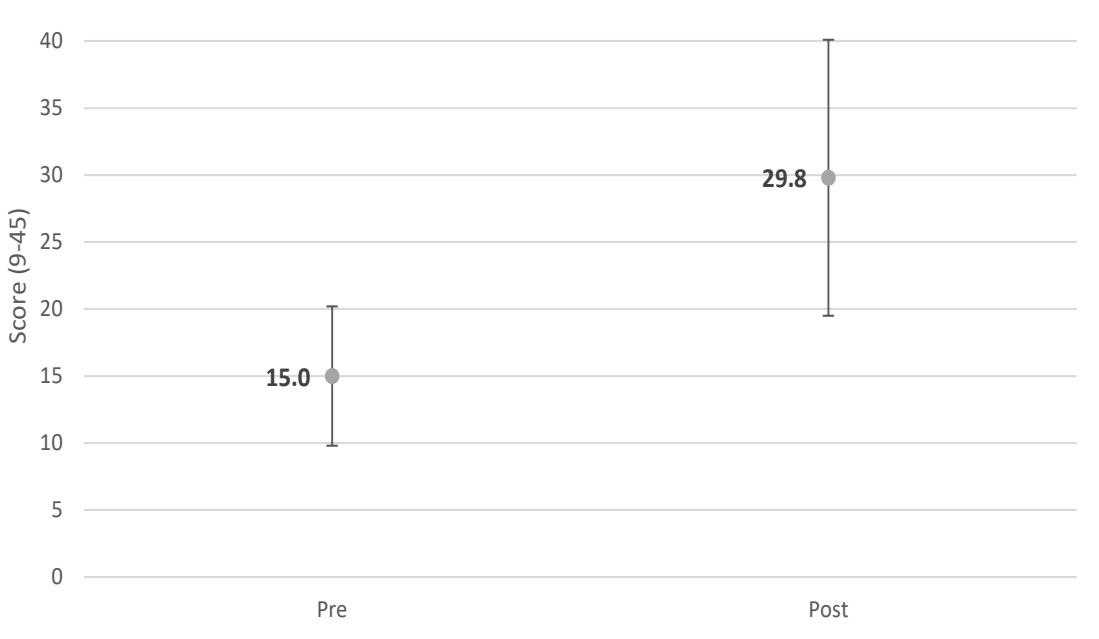

Figure 1. Pre -and post-activity mean and SD Glaucoma Activity Limitation (GAL-9) results

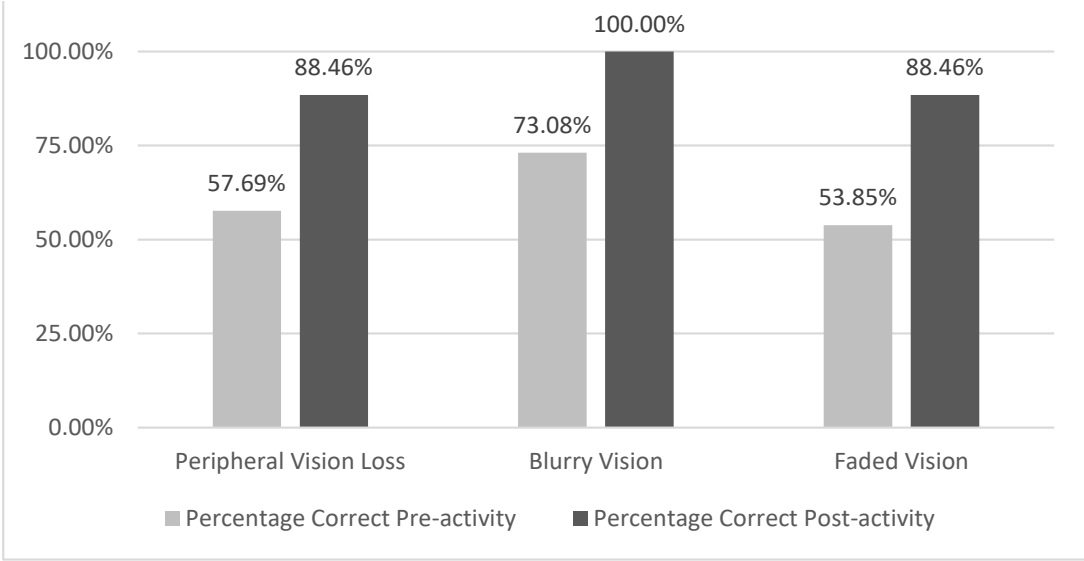

Figure 2. *Comparison of correct answers on baseline glaucoma questions regarding visual impact pre- and post-activity*

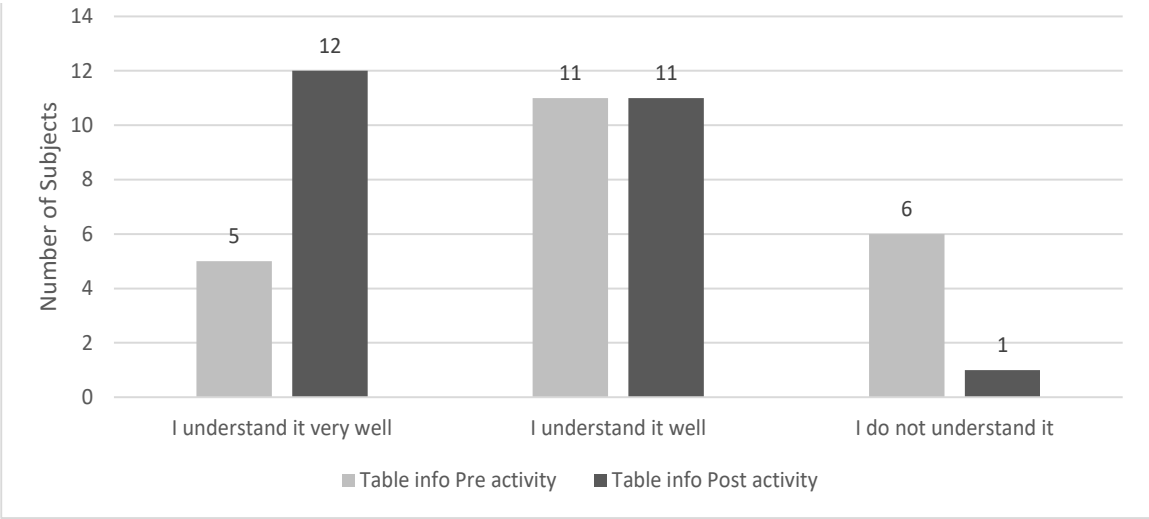

Figure 3. *Comparison of subjects' answers on glaucoma understanding pre- and post-activity*

Data was entered into an excel spreadsheet, and statistical analysis (paired t-test) was performed using SPSS software (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0 Armonk, NY: IBM Corp. Chicago, IL). The study was approved by the Institutional Review Board of the Illinois College of Optometry and conformed to the tenets of the Declaration of Helsinki. Written informed consent was obtained from all subjects.

Results

Twenty-six subjects completed the study, with approximately equal gender participation. Most subjects were between 60 and 69 years old and were diagnosed with mild primary open-angle glaucoma. Table 1 includes subject characteristics and complete diagnosis breakdown. There was a statistically significant increase in mean GAL-9 score with simulator goggles (29.81±5.3) compared to baseline (15.04±5.2) (Figure 1). This indicates that the goggles greatly impacted the subjects' visual function.

When asked to respond to glaucomatous peripheral vision loss ("glaucoma can make you lose your side vision (peripheral vision)"), the percentage of correct answers increased from 57.7% to 88.46% (by 30.8%). Correct answers regarding glaucomatous blurry vision ("glaucoma can make you have blurry vision") increased from 73.1% to 100% (by 26.9%). Lastly, correct answers regarding glaucomatous faded vision ("glaucoma can make you have faded vision (loss of contrast sensitivity)") increased from 53.9% to 88.5% (by 34.6%) (Figure 2). When asked the question, "Do you feel that you understand what glaucoma is?" before and after the intervention, the number of subjects who responded, "I feel that I understand it very well" increased from 5 to 12 subjects (by 26.9%).

The number of subjects who responded, "I feel that I do not understand it" was reduced from 6 to 1 subject (by 19.2%) (Figure 3). After the intervention, 100% of participants stated that the activity increased their awareness of potential vision loss due to untreated glaucoma.

Anecdotal comments that any subject made were recorded. Overall, 7 subjects (26.9%) verbalized being more conscious of using their medications in the future, and 6 subjects (23.1%) said that they would call and check their next glaucoma appointment.

Discussion

In this pilot study, the results suggest that participation in a vision-loss simulation exercise can improve understanding of the effect that glaucoma can have on vision. After analyzing the GAL-9 scores and the baseline glaucoma knowledge questions, the study shows that the intervention increased awareness and understanding of glaucoma for the subjects. With this type of meaningful intervention, the negative impact of glaucoma on the quality of life of a patient can be impacted.

The significant increase in pre- versus post-intervention GAL-9 scores suggests that the goggles influenced understanding of vision loss as it would apply to real life. While there is potential clinical use of virtual reality glaucomatous vision loss simulation using the HTV Vive headset,[20] this study offers an alternate, inexpensive, and accessible option using altered safety goggles. This study supports that simulator goggles can be easily created and efficiently demonstrated in clinical settings to show potential glaucomatous vision loss to patients. Potential future implications include patients remembering their experience through the simulation goggles and a resulting increased desire to avoid future vision loss by adhering to prescribed glaucoma treatment.

For the baseline questions regarding the visual impact of glaucoma, there was a significant increase in correct responses for all three questions. This reveals that the activity properly demonstrated and increased subject awareness regarding moderate and late-stage visual symptoms of glaucoma.

The increase in the number of subjects who responded that they understood glaucoma very well post-activity shows that the activity also increased the patients' comfort surrounding awareness of glaucoma. This is also shown by the reduction in the number of subjects who responded that they did not understand glaucoma post-activity. Overall, this demonstrates that vision loss simulation goggles have the potential to increase medication adherence through heightened understanding and education about glaucoma. This is supported by other studies that show a positive association between patient glaucoma education and medication adherence.[21-23]

The long-term effect of these interventions is unknown. Future research is planned to track this cohort and to assess long-term health literacy, as well as to examine adherence to medications and follow-up care. This was a pilot study with subjects who volunteered; a larger cohort will be needed to determine whether similar findings can be confirmed.

Limitations to this study included a small sample population size due to time constraints. In addition, there is likely selection bias given that participants who responded to the research letter may have already been more likely to show interest and understand the importance of glaucoma medication adherence. A third limitation is the short duration of the study. We are currently only able to make inferences regarding possible future medication adherence; long-term tracking of the cohort is needed.

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