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Which visual measures affect change in driving difficulty after first eye cataract surgery?

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ABSTRACT

Objective: To investigate self-reported driving difficulty before and after first eye cataract surgery and determine which visual measures are associated with changes in self-reported driving difficulty after surgery.
Methods: A cohort of 99 older drivers with bilateral cataract were assessed the week before and 12 weeks after first eye cataract surgery. Visual measures including visual acuity, contrast sensitivity, stereopsis and useful field of view were assessed. Self-reported driving difficulty was measured via the Driving Habits Questionnaire. Cognitive status was assessed using the Mini Mental State Examination. Regression analysis was undertaken to determine the association between changes in visual measures and self-reported driving difficulty after first eye cataract surgery.
Results: Overall, self-reported driving difficulty improved after first eye cataract surgery. However, 16% of participants did not improve and driving difficulty worsened in 11% following surgery. Improvement in driving difficulty score after first eye cataract surgery was associated with improved contrast sensitivity in the operated eye ($p < 0.001$), new glasses after surgery ($p < 0.001$), and fewer chronic health conditions ($p = 0.016$).
Conclusion: Contrast sensitivity rather than visual acuity was a significant factor affecting change in self-reported driving difficulty after first eye cataract surgery for bilateral patients. This has implications for driver licensing authorities worldwide that rely heavily on visual acuity as a measure of visual fitness to drive.

1. Introduction

Due to the ageing population in many developed countries, the number of older drivers on the roads and drivers with cataract is rapidly increasing (King et al., 2007). Cataract can negatively affect different aspects of vision, potentially having serious consequences for driving ability. It was reported that older drivers with cataract were almost 2.5 times as likely to have an at-fault crash than those without cataract and four times more likely to report difficulty driving (Owsley et al., 1999).

It is widely accepted that cataract surgery leads to significant improvements in vision including visual acuity, contrast sensitivity and stereopsis (Elliott et al., 2000; Baranano et al., 2008). Evidence has suggested it also has a beneficial impact on driving performance. A United States based cohort study reported that 174 patients who had cataract surgery experienced only half the crash risk compared to 103 patients who did not have surgery during the four to six year follow up period (Owsley et al., 2002). An Australian study also found that the driving performance of 29 drivers with bilateral cataract significantly improved after bilateral cataract surgery when compared to controls (Wood and Carberry, 2006). In addition, a meta-analysis of one retrospective (Chang-Godinich et al., 1999) and four prospective cohort studies (Monestam and Wachtmeister, 1997; Mamidipudi et al., 2003; Monestam et al., 2005; Monestam and Lundqvist, 2006) concluded that the risk of self-reported driving difficulty could reduce by 88% following cataract surgery (Subzwari et al., 2008).

Cataracts are usually bilateral (Asbell et al., 2005), but cataract surgery is usually performed one eye at a time. Public hospital patients in Western Australia typically experience long waiting periods from six months to one year before both first and second eye surgery (Meuleners et al., 2012). Average waiting times

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for cataract surgery in Western countries vary greatly, for example, from one to six months in European countries (Mojon-Azzi and Mojon, 2007). There is evidence suggesting some patients do not improve or even decline on various self-reported outcomes after first eye cataract surgery (Castells et al., 1999; Black et al., 2009). This may be because first eye surgery can result in large differences in vision between the operated and un-operated eyes in some bilateral cases (Castells et al., 2006; Comas et al., 2007). Several studies examining driving outcomes to date, have not clarified whether participants underwent surgery on the first, second or both eyes, or analysed all participants together. Furthermore, driving is a complex activity and the majority of studies that have examined self-reported driving difficulty were based on only two driving-related items addressing day and night driving (Castells et al., 1999; Elliott et al., 2000; Mamidipudi et al., 2003; Mcgwin et al., 2003; Bevin et al., 2004). Only one study used the validated, eight item Driving Habits Questionnaire (Owsley et al., 2002).

Although visual acuity is the predominant measure used to determine surgery success and for assessing visual fitness to drive for licensing authorities, it may be inadequate for identifying individuals at risk on the road (Desapriya et al., 2011). Since some bilateral cataract patients continue to experience visual impairment after first eye surgery (Acosta-Rojas et al., 2006; Comas et al., 2007), it would also be useful to determine whether other visual measures affect change in driving difficulty after first eye surgery.

To address the gaps in the evidence, our study investigated self-reported driving difficulty before and after first eye cataract surgery and determined whether changes in particular visual measures after surgery were related to driving difficulty for bilateral patients.

2. Materials and methods

2.1. Study design

This was a prospective cohort study using a before and after design. Older drivers with bilateral cataract were assessed the week before and approximately 12 weeks after first eye cataract surgery. Ethics Committee approval was obtained from the Curtin University Human Research Ethics Committee and the three Perth teaching hospitals involved. This research adhered to the tenets of the Declaration of Helsinki.

2.2. Participants

A total of 99 participants were recruited from three public hospitals in Perth, Western Australia between October 2009 and December 2010. All participants (aged 55 years or older) had bilateral cataract and were scheduled to undergo first eye cataract surgery by phacoemulsification. They were licensed to drive in Western Australia and drove at least once per week. Participants were excluded from the study if they had a confirmed diagnosis of Dementia, Parkinson's Disease or significant psychosis, wheelchair bound, had other significant ocular conditions, undergoing combined ocular surgery or did not speak English. Eligible participants were recruited consecutively. Of the 109 eligible patients identified, 101 agreed to participate (response rate 93%). Two participants were lost to follow up resulting in a final sample of 99 participants with complete data.

2.3. Data collection

Before any data was collected, informed written consent was obtained from each participant. Participation was entirely voluntary and patients were informed they could withdraw from the study at any time without consequence for their current or future cataract treatment. Data were collected at two time points for each participant; during the week before first eye cataract surgery and approximately 12 weeks after surgery. No participant underwent second eye cataract surgery during the follow-up period. Information on socio-demographic variables and health status were collected at baseline. Participants' medical records also were reviewed to confirm these details and to obtain information on other ocular conditions and intra-operative or post-operative complications. The majority (95%) of patients had their worse eye operated on first, which was defined by visual acuity.

At both assessments, four vision-related tests were performed under standard conditions. Current correction was used for visual testing if participants wore their corrective lenses for driving. Visual acuity (surgery eye, non-surgery eye and binocular with current lens correction) was measured using an Early Treatment Diabetic Retinopathy Study (ETDRS) chart (Ferris et al., 1982). Scores were expressed on a logarithm of the minimum angle of resolution (logMAR) scale and those who could not read any letters were assigned a score of 1.3 logMAR units. Contrast sensitivity (surgery eye, non-surgery eye and binocular with current lens correction) was measured using a Pelli-Robson chart in log units (Pelli et al., 1988). Stereopsis, a form of depth perception, was assessed by the Titmus Fly Stereotest (Stereo Optical Co., Inc.) which measured disparity from 1.602 to 3.447 log seconds of arc. Stereopsis may assist drivers in judging the distance of objects located closer than 40 m (Bauer et al., 2001), affect the onset of braking and affect stopping distance (Tijtgat et al., 2008). Participants who could not see any images were assigned a score of 3.653 log seconds of arc.

Useful field of view was measured using the computer-based UFOV® test software, version 6.1.4 with the PC mouse-based format (Visual Awareness, Inc.). Useful field of view is a test of information processing ability that may be associated with driving ability (Ball and Owsley, 1993; Clay et al., 2005). The test consisted of three subtests assessing speed of visual processing under increasingly complex task demands. The first subtest examined visual processing, the second examined divided attention and the third, selective attention. The score was the minimum presentation duration for 75% correct performance, with lower scores (shorter presentations) representing better performance (Ball and Owsley, 1993). The personal computer-based UFOV test has been previously shown to have high test–retest reliability ($r = 0.884$ for mouse version) among older adults (Edwards et al., 2005). Cognitive ability was assessed using the Mini Mental State Examination (MMSE) (Folstein et al., 1975).

Driving-related information was collected via a researcher-administered questionnaire containing the driving difficulty section of the Driving Habits Questionnaire (Owsley et al., 1999). It has been widely used for the examination of driving with visual impairment and its construct validity and test–retest reliability have been established (Owsley et al., 1999). The self-reported driving difficulty scale contained eight items relating to driving in the rain, driving alone, parallel parking, making turns across traffic, driving on the freeway, in high traffic, at peak hour and at night. Each item was measured on a five point scale, with a score of "one" indicating the participant had stopped driving in that situation due to vision, and "five" indicating no difficulty in that situation. A driving difficulty composite score ranging from zero to 100 was calculated from these items with lower scores representing more difficulty (Owsley et al., 1999). Information on the number of kilometers driven per week was collected using the Driving Habits Questionnaire (Owsley et al., 1999) to control for driving exposure in the analysis.

2.4. Pilot study

The questionnaire was pilot tested on a separate sample of 37 older drivers with or without cataract, through the Royal