Visual Impairment and Ability to Drive: Epidemiology, Evaluation, Education, and Ethics

William L. Park, OD, FAAO

ABSTRACT

Visually-impaired drivers, who have mild, moderate, and severe visual dysfunction due to ocular and/or systemic disease, often demonstrate driving skill deficits. This article presents an overview of the evaluation, education, and assessment of the visually-impaired driver. The role of the low-vision rehabilitation physician and of the certified driving instructor in substantiating safe driving skills is also discussed. Three case studies are presented, which illustrate moral and ethical issues that are frequently encountered when assessing driving ability in visually-impaired patients.

INTRODUCTION

In today's society, driving a motor vehicle plays a major role in an individual's lifestyle, and when a driving license is revoked for medical reasons, it can lead to social isolation and depression. On the other hand, patients themselves and members of the community need to be protected from unsafe drivers.[1-6]

BACKGROUND

Epidemiology

With visually-impaired individuals, there is, and always will be, controversy about driving ability. The ability to drive is the ultimate form of independence in today's society, and in the United States, a driver's license is intrinsically tied to quality of life. Elderly drivers are the most rapidly growing segment of the driving population in the United States. The percentage of drivers over age 65 is expected to increase by 17% by the year 2020, as compared to an increase of 12% in 1990.[2] The rate of motor vehicle fatalities among older adults has increased substantially, although the rate of motor vehicle fatalities among the general population is declining. The elderly drive fewer miles, but have the highest rate of accidents (crashes) per miles driven. Drivers, who are 65 years and older, are still driving approximately 250 miles per week.[7]

Figure 1 demonstrates the projected growth of age 65+ population in the United States, is from a current 33 million escalating to 81 million in 2050. Figure 2 demonstrates that the 65+ age population is still driving almost 1000 miles per month. Figure 3 demonstrates the increasing fatality frequency over age 65, partially attributable to the fragility of the human body to trauma, including safety features such as air bags (John Melvin, "An overview of Tissue Tolerance," Aging and Driving Symposium, Association for the Advancement of Automobile Medicine, Southfield, MI, February 19-20, 2001).[7]

A review of a study during 1998 to 1999, by the National Center for Statistics and Analysis[8] reveals that over 12 states had a >5% increase in motor vehicle fatalities (range 5% to 29%), 13 states had an increase of 1% to 5%, while 25 states had no increase or a decrease (range 0 to 24%). The question remains, "what is being done correctly or incorrectly to account for these state differences in motor vehicle fatalities?"

There are many important issues to consider regarding visually-impaired drivers. We have to look at the impact on society when visually impaired drivers are able or not able to drive. We have to determine if there should be different standards for relicensure of the older adults or for people with progressive ocular or systemic disease, and if vision screening performed by the motor vehicle administration incorporates tests that measure the appropriate dimensions of vision performance. Optometrists need to be aware of their responsibility when their patient is driving, but they are not legally entitled to do so. We need to know whether a clinical low-vision assessment and rehabilitation might mean that a patient may not be a safe driver even though they are driving.[1-6]

Clinical Evaluation

First and foremost, it is important to ensure that visually-impaired individuals have obtained maximal correction for refractive errors, and that best corrected visual acuity (BCVA) has been achieved. The following areas (and the tests that are used) comprise the clinical evaluations needed to determine if the patient has the visual capability

W.L. Park — Wilmer Eye Institute, Low Vision Service, Johns Hopkins University, School of Medicine, Baltimore, MD

Correspondence to: Dr. William L. Park, Johns Hopkins University, 600 N. Wolfe Street, B1-70, Baltimore, Maryland 21287; e-mail: wpark@jhmi.edu

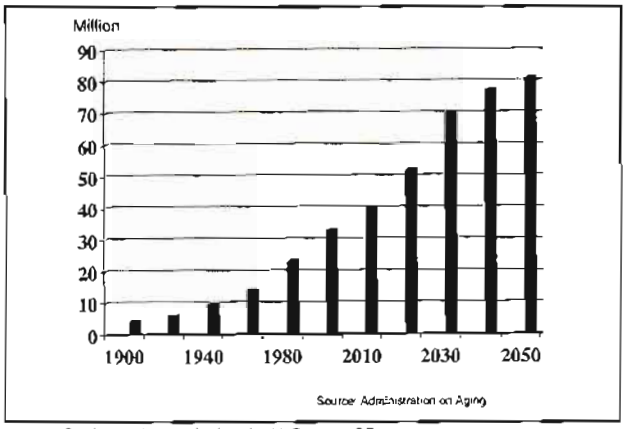

Fig. 1 Projected population in U.S. age 65+

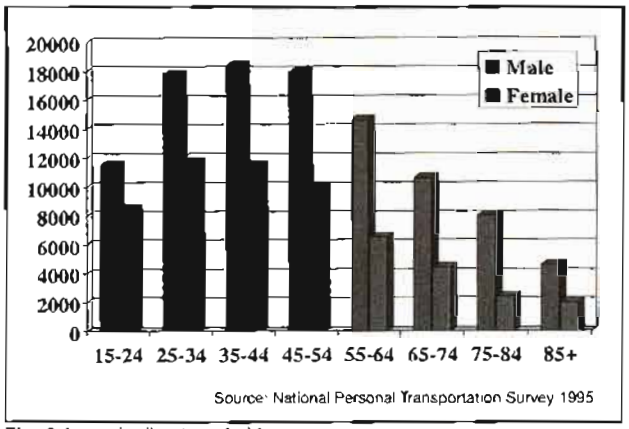

Fig. 2 Annual miles traveled by age

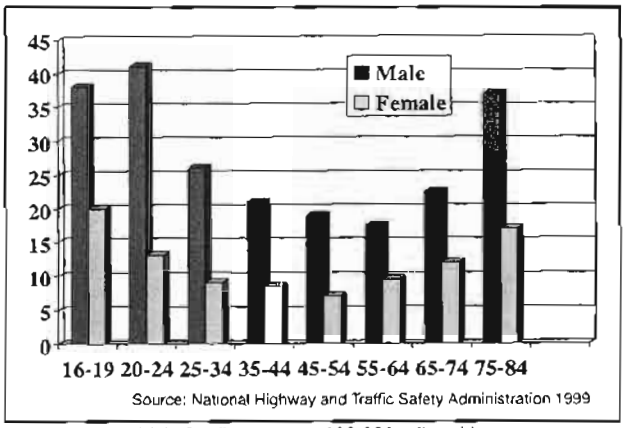

Fig. 3 Motor vehicle fatality rate per 100,000 miles driven

to drive safely: BCVA (Mentor BVAT, ETDRS), contrast sensitivity (Peli-Robson), glare sensitivity (BAT and subjective history), color perception (Farnsworth D –15), binocularity, stereopsis (Worth 4 Dot, Randot Circle test), and visual fields (Goldmann).

Other areas of concern include: assessment of visual function when performing activities of daily living (as evaluated by a rehabilitation teacher, by an orientation and mobility specialist, and/or by an occupational therapist), determination of whether the patient has psychosocial characteristics detrimental to driving, and determination of implications of any ocular/systemic disease that is present. Other issues to be addressed, when indicated, should include the Motor Free Visual Perceptual test (MVPT), the Mini Mental Screening Examination (MMSE), and assessment of extremity strength, range of motion, and reaction time.

Ball et al. noted that many older adults experienced difficulty in activities of daily living, even though thorough eye examinations revealed no clinical basis for these difficulties. They proposed (and substantiated) that age-related declines in visual function and deficits in visual attention are not adequately determined by clinical testing and/or visual fields alone. They argue that clinical perimetry measures the detection of a luminance target presented in isolation, whereas everyday activities, such as driving, require responses such as localization or identification of suprathreshold targets, in cluttered visual scenes as well as simultaneous use of foveal and peripheral vision.[9-13]

Detecting information that is relevant to the ability to drive depends on determining driving attention. The Useable Field of Vision (UFOV) test determines ability of visual processing, and of performing select-attention tasks and divided-attention tasks. The measure of UFOV size is expressed in terms of a reduction (0 to 90%) of a maximum 35-degree radius field. Owsley et al.[12] evaluated 294 older drivers (aged 55 to 87 years) in a prospective cohort study with 3 years of follow-up. They found older drivers who demonstrated a 40% reduction in UFOV (using a previously established cut point), were 2.2 times more likely to have an accident, and with each further 10% decrease in UFOV, there was a 16% increase in likelihood of having an accident.

The Visually-Impaired Driver

When evaluating the visually-impaired driver, the author and colleagues feel that there is an inappropriate focus on visual acuity. The focus should be more on visual processing, consideration of psychosocial implications, and driving skills that can lead to morbidity. Poor driver education of today's older adult drivers is partly due to the fact that they received driver's education, if any, in the early 1940s or sooner. We also find that visually-impaired drivers lack an active, ongoing, subjective thought process to compensate for this condition.[3,4,6]

A Driver Education Program for Visually-Impaired Drivers

From the onset of driver education for visually-impaired drivers, safe driving skills should be emphasized.[1,6] These skills include the ability to control the car with increases in speed within the legal limits. Inability to do this results in a significant increased incidence of minor and major collisions, along with death. The driver needs to learn the importance of a ½ second of response time (which can result in a 50% reduction in collisions). Visually-impaired drivers need to learn to improve response time, adopt increased driver vigilance, and adopt better search habits. Common poor driving habits, that can result in death, typically exhibited in visually-impaired drivers include: poor search habits, driving too fast, lack of adjustment in speed or position of the car, inability to maintain a proper lane position, assuming a following distance that is too close, delayed braking, and significantly reduced response time.

The driving course should provide exposure to unfamiliar environments, including different types of roadways with different speed limits. Expressways, two-lane highways, and congested areas with significant peripheral noise often provide abnormal events and environments that can be used to specifically evaluate the visually-impaired driver's awareness and knowledge of sign recognition, pavement markings and of state laws. Education should continue with teaching basic procedures for starting and parking the vehicle, controlling the vehicle, managing space, and processing information about the surrounding environment. Education of compensatory actions involves controlling speed for stability, driving in the right-hand lane (control the environment), proper searching habits (where, why, how, what) and using all available space. Heavily emphasized, throughout the education process, should be the strategy of early "over-braking," which controls the front of the car by controlling the rear. By over-braking, the driver learns to brake early and to follow cars at a distance that leaves adequate space in front for escape from an abnormal event. This enhances time and space management, and increases response time for unexpected events.

We find that, in general, visually-impaired drivers are not aware of how difficult it is to drive safely, or of their own inabilities. They do not realize the visual processing ability that is necessary to be a proficient driver. While the visually-unimpaired driver processes information 20 to 30 seconds before reaching an obstacle, visually-impaired drivers tend to process information only 4 seconds ahead of time and they generally respond approximately 2 seconds more slowly to an incident (personal communication with Herbert Simon, certified modified driver instructor, Maryland Motor Vehicle Administration). Driving speed also impacts on ability to respond to unexpected incidents. Since 1 mile per hour is equivalent to 1.5 feet per second, at 45 mph, a vehicle travels at 67.5 feet per second, whereas at 30 mph, the vehicle travels at 45 feet per second. At 30 mph, an abnormal event 180 feet ahead would allow the driver 4 seconds to make a controlled stop. At 45 mph, the driver would have only 2.67 seconds to stop, which would almost require an all-out braking procedure (due to the 1.33 seconds of lost response time).

Use of Telescopic Systems for Driving

The use of spectacle-mounted telescopic systems for driving has been, and will probably, always be controversial. Should visually-impaired drivers be able to drive using a spectacle-mounted telescopic system? If so, how should optometrists ensure that patients are appropriately trained in the use of these devices and demonstrate safe driving skills with these devices?

Thirty-four states in the United States allow individuals to obtain driving licenses for driving with spectacle-mounted telescopic systems. There is a significant variance among these states in the protocol for obtaining these driving licenses, and for competency requirements for driving using these devices.[5] Required protocols for obtaining licenses for use of these devices ranges from no requirements to categorical requirements of as much as 50 hours of behind-the-wheel driving, completed in a specific format. There is also variance in whether the motor vehicle administrations of each state requires documentation from the practitioner (who prescribed the device) concerning the individual's capability to use the device for activities of daily living. Few states address the issue of written certification of the type of training provided to the patient in order to establish efficient use of the telescopic system and of the need to specify who provided that training.[3-6]

The author[3,4,6] feels strongly that there should be specific clinical protocols for evaluating patients, for prescribing spectacle-mounted telescopic systems, and for training patients to use these devices for activities of daily living. (The author has always loaned the device for a minimum of 1 week to a patient for whom it appeared to be clinically viable.) This was done to rule out individuals who were inappropriate candidates for using these devices. Static and dynamic assessment of telescopic skills by a rehabilitation teacher, by an orientation and mobility instructor, and/or by an occupational therapist should be performed prior to prescribing the device, and frequently should be done again after prescribing the device. This becomes even more important if the patient's goal is to drive while using a spectacle-mounted telescope. Visual impairment combined with possible systemic modalities clearly indicates the need for a trans-disciplinary approach in the evaluation, training, education, and rehabilitation of the visually-impaired patient.

continued on page 216

Park — continued from page 214

The author and colleagues[4,6] found that of the 149 respondents (to a 50 item questionnaire) of 529 drivers who were licensed to drive with a spectacle-mounted telescopic system in the state of Michigan, more often than not, had very little training in the use of the telescopic system for activities of daily living (ADL), let alone the complex skill of driving. The study found that 44% of the licensed telescopic drivers in the state had no follow-up visits, after receiving the device, to assess their ability to use the device effectively. (In Michigan, a driving evaluation is not necessary for demonstrating competency for safe driving skills using a telescopic system.) The frequency of patient education, training, and/or assessment in being able to perform a visual task while using a telescopic system was also alarmingly poor for the following areas: viewing stationary objects while stationary (only 33% of patients were educated, trained, or assessed), viewing moving objects while stationary (51% of patients), or viewing moving objects while moving (52% of patients). Even more disturbing, these patients were rarely referred (26% of patients) for any rehabilitation concerning the use of the telescopic system while driving and/or for substantiation of safe driving skills.

Ethics

Driving is a privilege that requires a license, it is not an automatic right; in order to be able to drive, the individual should be skilled. Therefore, it is the responsibility of the optometrist to ensure that the patient is indeed a skilled driver, if and when, a telescopic device is prescribed for driving.

For those optometrists whose practices involve low-vision rehabilitation, every day brings driving-related issues along with patients who should not be driving, but continue to do so. The optometrist needs to be familiar with state laws about patient confidentiality and physician immunity. Each practitioner should know their state law and then make their own decisions. This author has never hesitated in the two states he has practiced in (Maryland and Michigan) to initiate re-examination of a patient (and thus acting as the catalyst for revocation of a license) due to illegal driving based on state law about vision requirements. Strikingly, all such patients were men who also indignantly maintained that they were skilled drivers, despite their impaired visual manifestations.

When there is a question of whether an individual is a safe driver, the decision cannot be made by clinical data alone, the decision is derived from the patient's ability to drive a car. The following three cases illustrate this point.

Case Reports

Case 1

A 27-year-old white man with retinitis pigmentosa was seen for vision rehabilitation. His chief complaint was nyctalopia. He was currently driving 56 miles each way to work, and stated that he had no difficulty driving except for night driving. His BCVA was 20/30 (6/9) OD, 20/30 (6/9) OS, and 20/25 (6/7.5) OU, with contrast sensitivity of 1.65 log units. Goldmann visual fields were performed, with a V4e isopter, a 5-degree field was elicited. Because the patient was adamant about having safe driving skills (the author had an incredible disbelief that the patient could drive safely), it was requested, by the author, that the patient participate in a road evaluation that the author would attend. The patient consented and drove on a challenging standardized driving course (developed from Michigan State University) for 45 minutes. Throughout the session, the patient demonstrated excellent driving skills and drove flawlessly. To date, he demonstrated driving skills that were as good as anyone that the author has ever assessed (out of hundreds of patients). Despite this, upon reflection, and because of the state law, procedures to revoke the patient's license were initiated (this patient was evaluated in Michigan where we did not grade on a scale, as we do in Maryland).

Case 2

A 49-year-old man with retinitis pigmentosa presented, expressing his chief complaint as "I am having trouble driving and I think I need cane instruction." He had a self-admitted history of driving his car into objects (such as trash containers) in the driveway, and his car had visible damage as a result of those collisions. He stated that he limited his driving to a specific, 7-mile route between work and home. He had recently renewed his driver license, which involved a vision test that included peripheral vision. He admitted to cheating on the test by turning his head to see the field stimuli.

The patient's BCVA was 20/15 (6/4.5) OD, 20/15 (6/4.5) OS, and 20/15 (6/4.5) OU. His contrast sensitivity was 1.20 log units and stereopsis was 60 seconds of arc. His Goldmann visual fields were 10 degrees with a V4e isopter. The patient's visual attention with select and divided tasks was reduced. He was taken on a road evaluation using his route to work. Throughout the evaluation, the patient verbalized and demonstrated excellent thought and visual processing, along with route planning and compensatory actions. His mean grade of 25 driving skill areas was 3.4 out of 4 (where 1 = poor, 2 = fair, 3 = good, 4 = excellent). The patient therefore passed our evaluation (on this sole occasion), and demonstrated only minimum driving deficits. The patient was re-informed, however, that he was not legally eligible to drive. He is currently driving. He mentioned that the driver education given during the road evaluation was very helpful and requested more training so "I can drive safer." His case has been presented to the Motor Vehicle Administration for their review.

Table I Mean grade in driving skills*	
Driving Skill	**Mean Grade**
Awareness of pavement marking	2.1
Maintains lane placement	2.1
Sign recognition	2.3
Risk management skill	2.4
Awareness of environment	2.4
Awareness of traffic flow	2.4
Merging	2.4
Highway driving	2.5
Management of time and space	2.5
Checking of blind-spot	2.5
Skills at controlled intersections	2.6
Lane changing	2.6
Sign recognition	2.6
Braking and stopping	2.6
Residential driving	2.6
Expressway driving	2.6
Proper use of mirrors	2.7
Maintaining the appropriate following distance	2.7
Maintains appropriate speed control	2.9
Performing left hand turns	3.0
Performing right turns	3.1
Acceleration skills	3.5
Steering skills	3.5
Exhibits excuse making dialogue	3.5
Follows instructions and commands	3.6
Grade 1 = poor; Grade 2 = fair; Grade 3 = good; Grade 4 = excellent	
*36 visually-impaired drivers who underwent a driver education program; grades were assessed by a certified driving instructor	

Case 3

An 81-year-old white man with Parkinson's disease presented with a chief complaint of intermittent diplopia. His BCVA was 20/20 (6/6) OD, 20/20 (6/6) OS, and 20/20 (6/6) OU. His color perception was normal, and stereopsis was 180 seconds of arc at 6 meters and 60 seconds of arc at 40 centimeters. His Goldmann visual fields (using the V4e and III4e) were 140 degrees. The patient demonstrated a shuffled gait, notable weakness in his extremities (arms and legs), and significant head, hand, and leg tremor. The patient was referred to occupational therapy for a cognitive assessment and for a home-activities of daily-living assessment concerning personal safety. His cognition was found to be mildly impaired, and his home environment was modified for safety according to his systemic disease manifestations. A road evaluation was recommended, and with his wife's encouragement, the patient consented to this.

This patient was graded in 25 driving skill areas. He had a mean grade of 1.52 out of 4. He demonstrated poor performance (a grade of 1 out of 4) in the following areas: maintaining lane placement (he drifted out of the lane throughout the evaluation), judgment of time and space, checking of blind spots, braking and stopping skills, risk management, awareness of pavement marking, awareness of surrounding environment, awareness of traffic flow, residential driving, highway driving, and expressway driving. The patient made excuses throughout his driving evaluation and thought he "did fine" in spite of three braking interventions and two steering wheel interventions. He was informed verbally and in writing that he should no longer drive, based on the results of this driving evaluation.

Discussion

These three cases illustrate significant moral and ethical issues for the practitioner, by forcing decisions that will adversely affect the mobility and independence of the patient, while attempting to keep the road safer for others. Of the 36 patients who participated in the program 80.6% were given positive recommendations.

The importance of a driving education and evaluation program, for visually-impaired drivers, is that it teaches drivers finite skills. Contrary to much of the literature or dialogue that advocates that visually-impaired drivers stop driving; a driving program not only acts to keep individuals on the road, but takes action to ensure safety for others as well as for themselves. It also serves as a buffer for adult children (taking them out of the decision-making process) if, for example, they feel that their 78-year-old father should not be driving because of his advanced age. And, as previously mentioned, a driving program serves as a positive reinforcement for those who have lost confidence in their driving ability. A driving program for visually-impaired individuals can also have a constructive and tremendously positive socioeconomic impact on individuals and on society.

Amazingly, our driving education program for 36 visually-impaired drivers, from a year ago until the present, showed that 75% of all participants (who were all legally eligible to drive except for one patient) had discontinued driving from 1 month to 20 years earlier, due to a lack of confidence in their safe driving skills. The participants had a mean age of 66.7, and 61% were of working age (under age 65). Nine patients were driving currently, but had lost confidence in their driving skills. The patient's acuity ranged from 20/20 to 20/40 (6/6 to 6/12) [14 patients]; 20/40 to 20/70 (6/12 to 6/21) [15 patients]; and 20/70 to 20/100 (6/21 to 6/30) [7 patients]. Their mean contrast sensitivity was 1.45 log units, and all patients' visual fields were greater than 110 degrees as required by law (except for one patient who had a 10-degree central field). The patients were graded in 25 areas, with grades of 1 = poor, 2 = fair, 3 = good, and 4 = excellent. Common skill deficits, reported as the mean grade for all participants as determined by the certified driving instructor, are summarized in Table I.

It is the opinion, of the author, (based on 16 years of co-directing a driving education program for visually-impaired drivers) that enrollment in such a program is paramount in ensuring safe driving skills through on-the-road training and driving theory.[1,4,6] Certified driving instructors or certified driving rehabilitation specialists (CDI/CDRS), who are familiar with driver education of the visually-impaired, play an integral role in assessing visually-impaired patients and patients with brain injuries, and in training and educating these patients in safe driving skills. This issue will become even more important in the future as society ages, technology improves, and driving laws change.

Conclusion

There is a significant need for further research regarding visual impairment and driving, particularly concerning our increasingly aging population. There is also a continued need for improved ergonomic designs of cars for geriatric drivers. In many states, there is a dire need for review of driving license policies. Administrative requirements of state motor vehicle administrations are often inconsistent with performance requirements. There is also a need for better functional measurements of driving ability (not only of visual acuity), in order to eliminate the presumption of inferior performance that is based on a trait or disease that a person possesses. ❑

References

1. McLean IM, Mueller E, Buttery RG, Mackey DA. Visual field assessment and the austroads driving standard. Clin Exp Ophthalmol 2002; 30: 3-7.
2. Schipp, MD, Penchansky R. Vision testing and the elderly driver: is there a problem with meriting policy change? J Am Optom Assoc 1995; 66(6): 343-351.
3. Park WL. Vision rehabilitation for age-related macular degeneration. In: Dunn JP, Smolin G, Friedlaender MH, eds. International Ophthalmology Clinics. Philadelphia: Lippincott Williams & Wilkins, 1999; 39: 143-162.
4. Park WL, Unatin J, Hebert A. A driving program for the visually impaired. J Am Optom Assoc 1992; 63: 54-59.
5. Peli E, Peli D. Driving with confidence: a practical guide to driving with low vision. Singapore. World Scientific Publishing Company, 2000
6. Park WL, Unatin JK, Park JM. A profile of the demographics, training, and driving history of telescopic drivers in the state of Michigan. J Am Optom Assoc 1995; 66(5): 274-280.
7. Stutts J. The epidemiology of the aging driver. Aging and Driving Symposium. Association for Advancement of Automotive Medicine. Southfield, Michigan. February 19- 20, 2001.
8. Report on percentage of change in fatalities in each state in the US from 1998–1999. National Center for Statistics and Analysis: 2000.
9. McGwin G, Owsley C, Ball K. Identifying crash involvement among older drivers: Agreement between self-report and state records. Accid Anal Prev 1998; 30(6): 781-791.
10. Ball K, Owsley C, Stalvey B, et al. Driving avoidance and functional impairment in older drivers. Accid Anal Prev 1998; 30(3): 313-322.
11. Ball K, Owsley C. The useful field of view test: A new technique for evaluating age-related declines in visual function. J Am Optom Assoc 1992; 63: 71-79.
12. Owsley C, Ball K, McGwin G, et al. Visual processing impairment and the risk of motor vehicle crash among older adults. JAMA 1998; 279: 1083-1088.
13. Sims RV, Owsley C, Allman RM, et al. Preliminary assessment of the medical and functional factors associated with vehicle crashes by older adults. J Am Geriatr Soc 1998; 46: 556-561.

Printed in Canada