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CLINICAL STUDY

Driving ability after pupillary dilatation

S Goel, P Maharajan, C Chua, B Dong, M Butcher and P Bagga

Abstract

Background **The Royal College of Ophthalmologists' guidelines and Driver and Vehicle Licensing Agency (DVLA) recommend that a patient should not drive with dilated pupils based on the rationale that vision may be compromised in acuity and ability to tolerate glare. Arguments exist against these recommendations suggesting that pupillary dilatation does not have any real bearings on driving ability.**

Aim **To determine the effects of pupillary dilatation on the ability to drive.**

Methods **The study was randomised and prospective. A total of 28 patients had their visual parameters (distance vision, near vision, licence plate reading at 20 m or shorter, and glare) measured and analysed pre- and post-tropicamide 1% dilatation. Paired two-tailed Student's *t*-test and χ^2-test were used in the analysis.**

Results **At 20 min, following instillation of one drop of tropicamide 1% there is a significant reduction in visual acuity (VA), for distance Snellen and near. There is a significant reduction in the number of people who could read the licence plate at 20 m. Subjective glare assessment changed from 'none' (average score) in the undilated state to 'mild' in the dilated states. The overall patient feedback indicated that a significant 14% believed they would find it difficult to drive postdilatation.**

Conclusion **This study demonstrates the rationale behind disallowing driving following pupillary dilatation. The risks to safe driving are proved significant as a result of significant reduction in visual quality and quantity after dilatation.**

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Keywords: driving; pupillary dilation; visual function; dilating drops

Introduction

In all, 95% of the sensory input to the brain needed for driving comes from vision.[1] Alterations in visual acuity (VA) thus comprise an important factor in determining fitness for driving. Decrease in VA for the purposes of driving is considered significant if there exists the inability to read in good light (with the aid of corrective lenses if necessary), a registration mark fixed to a motor vehicle and containing letters and figures 79.4 mm high at a distance of 20.5 m, (Section 92 (2) of the 1988 Road Traffic Act).[2] This corresponds to a binocular VA of approximately 6/10 on the Snellen chart.[3] The number plate standard is absolute in law and is not open to interpretation, so also the statutory number plate test. The Driver and Vehicle Licensing Agency (DVLA) recognises that an adequate field of vision is necessary for driving and has defined the minimum visual field for safe driving of at least 120 on the horizontal meridian measured by the Goldmann perimeter on the III4e settings (or equivalent perimetry).[2] Pupillary dilatation adversely affects vision as compared to the undilated state. Factors related to glare, decreased ability for accommodation (in some instances) and refractive aberrations all contribute to decreasing visual quality and quantity.[4,5] Thus, the DVLA recommends that a patient must not drive after pupillary dilatation till the effect of the drops wears off. Patients driving unaccompanied and requiring pupil dilatation (ie both eye dilatation, or one eye dilatation if the other eye has less than adequate vision) may require to return another day either by public transport, or with another driver.

This study aims to ascertain the subjective variations in driving vision post-tropicamide 1% dilatating drop application.

Methods

A total of 28 patients aged 19–76 years were included in the study (mean 48, SD = 16). The patients were randomly selected from those attending outpatient clinic. All had one drop proxymetacaine hydrochloride administered followed by one drop of tropicamide[6] 1%. Postdilatation measurements were made a standard 20 min after instillation of the dilating drop. Repeated instillation of drops was

SHO Ophthalmology
Kent County Ophthalmic Hospital
Maidstone ME14 1DT, UK

Correspondence:
S Goel
SHO Ophthalmology
Kent County Ophthalmic Hospital
Maidstone ME14 1DT, UK
Tel: +447814 958 303
E-mail: sidgoel@hotmail.com

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Institutions to which work attributed: Diana Princess of Wales Hospital, Grimsby and Kent County Ophthalmic Hospital, Maidstone, UK

avoided to help standardise the process. The proxymetacaine drop was used to eliminate the effect of variability in tear washout because of tropicamide-induced reflex lacrimation. Patients who were not actively driving, who had binocular corrected vision worse than 6/12, and those who had pre-existing pupillary abnormalities were excluded.

The equipment used included, standard Snellen's and near vision charts and standard licence plates (yellow and white). The Sekonic FML 308-B2 light meter was used for the objective glare measurements. The light metre glare-recording surface was held close to the patient's eyes and facing the direction of the target that the patient was viewing. This allows for a measure of the glare that the patient's eyes are receiving. Measurements were read in electron volts (eV).

Testing steps:

1. Best-corrected vision assessed by Snellen at 6 m (each eye and binocularly).
2. Near vision assessed—Near test chart (each eye and binocularly).
3. Licence plate reading at 20 m indoor assessed (binocularly).
4. Ambient glare levels objectively measured with the light metre (indoor and outdoor).
5. Licence plate reading at 20 m outdoor assessed (binocularly).
6. Process repeated post dilatation.

Results are analysed using the Student's *t*-test (paired, two-tailed) and χ^2-test.

Results

The pupil size changed significantly by the dilating process indicated above. The mean pupil size predilation was 3 mm in both eyes (SD = 0.4), and the mean pupil size postdilation was 5 mm in the right eye (SD = 1.3) and 6 mm in the left eye (SD = 1.2). The *P*-value of the change in pupil size is <0.001 (by paired two-tailed *t*-test) for both eyes, and this is statistically significant.

The Snellen distance VA changed as indicated in Table 1, and the near VA changed as indicated in Table 2, from the undilated to the dilated state. There is a statistically significant change in the distance[6–8] and near vision pre- and postdilation.

The distance at which the number plate could be read correctly predilation was a mean of 20 m (SD = 0), which is the standard required for driving. Thus, it is established that all patients in this study had vision adequate for driving predilation. Postdilation, the distance at which the number plates could be read dropped to a mean of 19 m (SD = 2), both indoors and outdoors (Table 3). Comparison between licence plate recognition distance dilated *vs* undilated showed $P = 0.07$ (indoor), $P = 0.11$ (outdoor), both not significant—that is, there is no significant change in the distance at which the number plate could be read. The DVLA however is strict about its 20 m reading of licence plate criteria (number

Table 1 Comparison of undilated to dilated Snellen VA

	RE	*LE*
Undilated vision 6/		
Mean	6	7
SD	2	2
Dilated vision 6/		
Mean	9	10
SD	4	4

Denominator of the Snellen fraction is tabulated.
P-value (dilated *vs* undilated VA comparison by paired two-tailed *t*-test) <0.001 (RE), <0.001 (LE).

Table 2 Comparison of undilated to dilated near VA

	RE	*LE*
Near vision undilated N -		
Mean	6	6
SD	1	1
Near vision dilated N -		
Mean	12	13
SD	6	7

Near reading ability has been tabulated. *P*-value (dilated *vs* undilated near VA comparison by paired two-tailed *t*-test) <0.001 (RE), <0.001 (LE).

Table 3 Analysis of ability to read licence plate at 20 m or below, before and after dilatation

	In	*Out*
Undilated		
Mean	20	20
SD	0	0
Dilated		
Mean	19	19
SD	2	2

Numbers indicate the distance at which the licence plates were read (in metres).

Table 4 Glare sensitivity dilated *vs* undilated

Glare sensitivity		*Number of patients*	
Score	*Grading*	*Undilated*	*Dilated*
0	No glare	0	11
1	Mild	0	12
2	Bad tolerable	0	5
3	Bad intolerable	0	0

Table 5 Data spreadsheet for all patients

Sl No.	Age	Eyes R/L	Best corrected VA				Near vision		Pupil size (in mm)				Licence plate recognition (in metres)				Light meter readings (eV)				Glare sensitivity				Can drive
			Undilated		Dilated		Undilated	Dilated	Undilated		Dilated		Undilated		Dilated		Undilated		Dilated		Undilated		Dilated		
			Right	Left	Right	Left	R/L	R/L	Right	Left	Right	left	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor	Indoor	Outdoor	
1	31	Both	6/6	6/6	6/18	6/12	N5/N5	N10/N12	3	3	4	4	20	20	20	20	6	11	7	11	None	None	None	None	Yes
2	46	Both	6/5	6/5	6/6	6/6	N8/N8	N10/N12	3	3	5	5	20	20	20	20	6	11	6	11	None	None	None	Bad but tolerable	Yes
3	30	Both	6/6	6/5	6/6	6/9	N5/N5	N24/N24	4	4	5	5	20	20	20	20	6	11	6	11	None	None	None	None	Yes
4	30	Both	6/5	6/6	6/6	6/9	N5/N5	N12/N12	3	3	5	5	20	20	20	20	6	11	6	11	None	None	None	None	Yes
5	25	Both	6/6	6/6	6/6	6/6	N5/N5	N12/N12	3	3	4	4	20	20	20	20	6	11	6	11	None	None	None	None	Yes
6	46	Both	6/6	6/6	6/6	6/6	N5/N5	N12/N12	3	3	4	4	20	20	20	20	6	11	6	11	None	None	None	None	Yes
7	45	Both	6/6	6/6	6/6	6/6	N5/N6	N8/N12	3	3	5	5	20	20	20	20	6	12	6	12	None	None	None	Bad but tolerable	Yes
8	29	Both	6/5	6/5	6/6	6/6	N5/N5	N12/N12	2	2	6.5	6.5	20	20	16	13	6	13	6	13	None	None	None	Bad but tolerable	Yes
9	51	Both	6/5	6/5	6/6	6/6	N5/N5	N10/N10	3	3	5	5	20	20	15	18	6	11	6	11	None	None	None	Mild glare	Yes
10	70	Both	6/9	6/6	6/12	6/9	N6/N6	N10/N10	3	3	5	5	20	20	19	19	6	10	6	10	None	None	None	None	Yes
11	51	Both	6/6	6/6	6/6	6/6	N5/N5	N8/N8	3	3	4	4	20	20	20	20	6	11	6	11	None	None	None	Mild glare	Yes
12	76	Both	6/9	6/9	6/12	6/12	N8/N8	N10/N10	3	3	5	5	20	20	20	20	6	10	6	10	None	None	None	Mild glare	Yes
13	53	Both	6/6	6/6	6/9	6/9	N6/N6	N8/N8	2	2	5	5	20	20	20	20	6	10	6	10	None	None	None	Mild glare	Yes
14	63	Both	6/5	6/12	6/6	6/12	N5/N5	N6/N6	3	3	4	4	20	20	8	10	5	14	5	13	None	None	None	Bad but tolerable	Yes
15	63	Both	6/6	6/9	6/9	6/12	N6/N12	N8/N24	3	3	6	6	20	20	20	20	6	10	6	10	None	None	None	Mild glare	No
16	33	Both	6/6	6/6	6/9	6/9	N5/N5	N12/N12	3	3	7	7	20	20	20	20	6	10	6	10	None	None	None	Mild glare	Yes
17	50	Both	6/6	6/6	6/9	6/9	N5/N5	N8/N8	3	3	6	6	20	20	20	20	6	10	6	10	None	None	None	None	Yes
18	61	Both	6/6	6/9	6/6	6/12	N5/N5	N8/N8	3	3	7	7	20	20	20	20	6	10	6	10	None	None	None	Mild glare	No
19	19	Both	6/6	6/6	6/9	6/9	N5/N5	N8/N8	3	3	7	7	20	20	20	20	6	10	6	10	None	None	None	Mild glare	No
20	54	Both	6/9	6/9	6/9	6/9	N6/N6	N10/N10	3	3	6	6	20	20	20	20	6	10	6	10	None	None	None	None	Yes
21	57	Both	6/6	6/12	6/9	6/12	N6/N12	N10/N24	3	3	6	6	20	20	20	20	6	10	6	10	None	None	None	Mild glare	Yes
22	81	Both	6/6	6/12	6/9	6/12	N5/N5	N5/N5	2.5	2.5	3	4	20	20	17	20	6	11	6	11	None	None	None	None	Yes
23	64	Both	6/6	6/6	6/6	6/6	N6/N8	N8/N8	3	3	5	5	20	20	19.5	20	6	11	6	11	None	None	None	None	Yes
24	46	Both	6/6	6/12	6/9	6/24	N8/N8	N12/N12	3	3	6	6	20	20	20	20	6	10	6	10	None	None	None	Mild glare	Yes
25	46	Both	6/6	6/6	6/9	6/9	N5/N5	N36/N36	3	3	8	8	20	20	20	20	6	10	6	10	None	None	None	Mild glare	Yes
26	46	Both	6/12	6/9	6/24	6/12	N8/N8	N24/N24	2.5	2.5	5	5	20	20	20	20	6	10	6	10	None	None	None	Mild glare	Yes
27	26	Both	6/5	6/5	6/9	6/9	N5/N5	N12/N12	2.5	2.5	8	8	20	20	20	20	6	10	6	10	None	None	None	Bad but tolerable	No
28	47	Both	6/5	6/5	6/9	6/9	N5/N5	N8/N8	2	2	7	7	20	20	20	20	6	10	6	7	None	None	None	None	Yes

plate test). The number of patients who could not read the licence plate at 20 m indoors was six out of 28 (22%) and the number of patients who could not read the plate outdoors was four out of 28 (14%). Two patients were able to see the plate outdoors but not indoors. The *P*-value (χ^2-test) of the decrease in the number of patients able to read the licence plate at 20 m is <0.05 outdoors and <0.01 indoors (both statistically significant). Thus, a significant number of patients failed the number plate test (reading at 20 m), postdilatation.

Glare sensitivity was subjectively graded and scored as in Table 4. Prior to predilation no patient reported glare. Postdilation, the mean glare score was 0.8, corresponding to a less than mild symptomatology. Light metre readings were a constant 6 eV indoors and a mean of 11 eV (SD 1 eV) outdoors—for both dilated and undilated states. This was carried out to ensure that ambient glare levels were constant during the testing process and hence was not a factor to affect subjective assessment. Five out of 28 patients (1.8%) had bad but tolerable glare in the postdilated state ($P<0.025$ χ^2-test is statistically significant).

The patients were asked at the end of the test to answer yes or no to the question—'can you drive comfortably and safely now under the influence of the drops?' Four of 28 (14%) reported 'no' (ie they would not be able to drive comfortably and safely). This was statistically significant ($P<0.05$ by χ^2-test).

Discussion

This study addresses the debatable question of whether to disallow driving after pupillary dilation (of both eyes or the one better eye). Proponents of allowing driving argue that there is no significant change in the accident rate following dilation in our present experience.[9] This, however, cannot be conclusively determined because of the varying practices adopted across different units. In the UK the present common practice is that patients are advised not to drive postdilation. The study confirms the validity of this practice by demonstrating significant decrease in Snellen's vision, near vision, and licence plate reading ability at 20 m when the pupil size is significantly changed. More relevant however, is that a significant 14% of patients themselves feel unsafe and uncomfortable to drive following dilation. In this study, only one drop of tropicamide 1% was used to standardise the process, whereas in the clinical scenario stronger and increased number of drops may be used for achieving maximal dilation, and this may further decrease the visual capacity of the patient with regard to driving.

Despite this study and others like it, of importance is the fact that these analyses are based on simulating driving conditions. The validity of such studies can be increased greatly by using actual driving situations in future studies. Moreover, the pre-existing refractive state of the patient may have had a bearing on the results. Hypermetropes who often accommodate for distance may have been affected by cycloplegia more than others. Additionally, the effects of dilation in various clinical scenarios need to be looked into, for example, effect of dilation in patients with cataracts of various types, etc.

Recommendations against driving postpupillary dilatation have been made on reasonable expectations of decrease in visual ability to qualify for safe driving. Evidence, as provided in this study, confirms the decrease in visual function below the present acceptable standard. Visual standards however are under constant review because of the inevitable difficulties in standardising the visual criteria with relevance to safety standards. Difficulties arise in accommodating the effects of clinical variables that complicate analyses (eg patients with certain cataracts, postdilatation may in fact have better vision than predilatation). Large-scale controlled studies are required to include the entire spectrum of patients undergoing pupil dilation, and this needs to be correlated to specific measurable reduction in safety standards. Until then the recommendations for allowing or disallowing driving would continue to be based on reasonable expectation, corroborated by evidence as available in this study and others like it.

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