

Effects of Diagnostic Mydriasis on Distant and Near Vision

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Abstract: To determine the effects of diagnostic mydriasis using 1% tropicamide and 2.5% phenylephrine on the distant and near vision of patients attending the Eye Clinic of University of Port Harcourt Teaching Hospital, an interventional 'within-patient' comparative hospital-based study was conducted over 3 months. The **right** eyes of 137 subjects requiring diagnostic mydriasis received 1% tropicamide and 2.5% phenylephrine. The **left** eyes served as control. Visual acuities for distance and near were assessed pre dilatation and at 130 minutes post dilatation using the Snellen's and near charts respectively. There were 137 study participants- 86 males (62.8%) and 51 females (37.2%). The mean age of participants was 44.87 ± 15.94 years. Visual blurring was noted post dilatation and was commoner with near vision. The mean post-dilatation near VA ($N30.68 \pm 14.81$) for the RE was worse than the mean pre-dilatation near VA ($N18.78 \pm 16.31$), this difference was statistically significant ($p=0.0001$). Considerable reductions in distance and near vision could occur after dilatation.

Date of Submission: 25-02-2019

Date of acceptance: 11-03-2019

I. Introduction

Visual acuity frequently refers to the clarity of vision. Visual acuity is affected by a number of factors such as aberrations, diffraction, photoreceptor density, refractive error, size of the pupil, illumination, time exposure of target, area of retina stimulated, state of adaptation of the eye and eye movements.¹ More light enters the eye through larger pupils thereby causing increased stimulation of the retina. This is however without its downside as resolution is affected as a result of the increased aberrations due to an increase in light. Small pupils cause reduced optical aberrations due to less light entering the eye however, resolutions are limited by diffraction. For good visual acuity therefore, the optimum is a mid-size pupil of approximately 3mm to 5mm as this is a compromise between the diffraction and aberration limits.¹ Pupillary dilatation (mydriasis) is routinely done for ophthalmological examinations to aid diagnosis (diagnostic mydriasis), treatment and follow up of a wide range of ocular disorders. It facilitates the examination of ocular structures such as the retina thereby producing better diagnostic and therapeutic outcomes compared to the natural undiluted pupil.²⁻⁴

Mydriatics used for diagnostic mydriasis are parasympatholytics or sympathomimetic agents. The parasympathetic control dominates the sympathetic control of the pupil therefore, the application of only a sympathomimetic agent is usually not adequate to provide sustained mydriasis in bright light during indirect ophthalmoscopy.^{5,6} Also, the combination of both parasympatholytic and sympathomimetic drugs provides greater pupillary dilatation than the use of a single drug.⁷ Examples of parasympatholytics include atropine, homatropine, cyclopentolate and tropicamide. Examples of sympathomimetics include phenylephrine, ephedrine and hydroxyamphetamine.⁸ The onset of action of tropicamide is 15-30 minutes with a duration of action of 3-8 hours.⁹ Phenylephrine achieves maximum mydriasis within 60-90 minutes with recovery after 5-7 hours.¹⁰ Blurring of vision after mydriasis may affect a patient's working and reading ability.¹¹⁻¹³ There is paucity of studies on the exact effects of diagnostic mydriasis on vision in the Nigerian population hence the need for this study.

II. Material And Methods

This was an interventional 'within-patient' comparative hospital-based study in which the **right** eyes of 137 subjects requiring diagnostic mydriasis received 1% tropicamide and 2.5% phenylephrine. The **left** eyes served as control. Visual acuities for distance and near were measured using the Snellen's and near charts respectively. Visual acuities were checked prior to instillation of dilating drops and 130 minutes after the onset of dilatation.

Study Design: Interventional 'within-patient' comparative hospital-based study

Study Location: Department of Ophthalmology, University of Port Harcourt Teaching Hospital.

Study Duration: November 2016 and January 2017

Sample size: 137 patients.

Inclusion criteria:

1. Adult patients (aged 18 years and above) visiting the clinic and requiring dilatation

Exclusion criteria:

1. Patients with an only eye
2. Patients with pre-existing ocular pathology such as uveitis, high myopia, glaucoma

Procedure methodology

Aftersigned informed consent was obtained and Ethical approval from the University of Port Harcourt Teaching Hospital sought, **right eyes** of 137 subjects requiring diagnostic mydriasis received 1% tropicamide and 2.5% phenylephrine. The **left eyes** served as control. Visual acuities for distance and near were measured using the Snellen’s and near charts respectively. Visual acuities were checked prior to instillation of dilating drops and 130 minutes after the onset of dilatation. Data was analysed using the Statistical Package for Social Sciences (SPSS) version 20.0 at significant level of $p < 0.05$.

III. Result

Table I shows the age and sex distribution of study participants. There were 78 (56.9%) males and 59 (43.1%) females with a male to female ratio of 1.32:1. The mean age of participants was 44.87 ± 15.94 years (Range 19-83years). Majority of the participants were 41 years and above (87 out of 137). Overall, those aged 41-50 years had the highest proportion (43 out of 137) while those above 70 years had the least proportion (4 out of 137). The sex distribution of the various age categories showed that there was a female preponderance in the younger than 20 years (100%), 41-50 years (53.5%), 61-70 years (60%) and older than 70 years (100%) age categories. All other age categories had a male preponderance. The differences in proportion of the age categories by sex of participants were statistically significant ($p = 0.0001$).

Table I: Age and Sex Distribution of Study Participants

Age Groups (Years)	Sex		Total Number (%)
	Male Number (%)	Female Number (%)	
≤20	0 (0.0)	8 (100.0)	8 (100.0)
21 – 30	19 (73.1)	7 (26.9)	26 (100.0)
31 – 40	11 (68.8)	5 (31.2)	16 (100.0)
41 – 50	20 (46.5)	23 (53.5)	43 (100.0)
51 – 60	20 (100.0)	0 (0.0)	20 (100.0)
61 – 70	8 (40.0)	12 (60.0)	20 (100.0)
>70	0 (0.0)	4 (100.0)	4 (100.0)
Total	78 (56.9)	59 (43.1)	137 (100.0)

Fisher’s exact test = 36.713; p-value = 0.0001*

*statistically significant

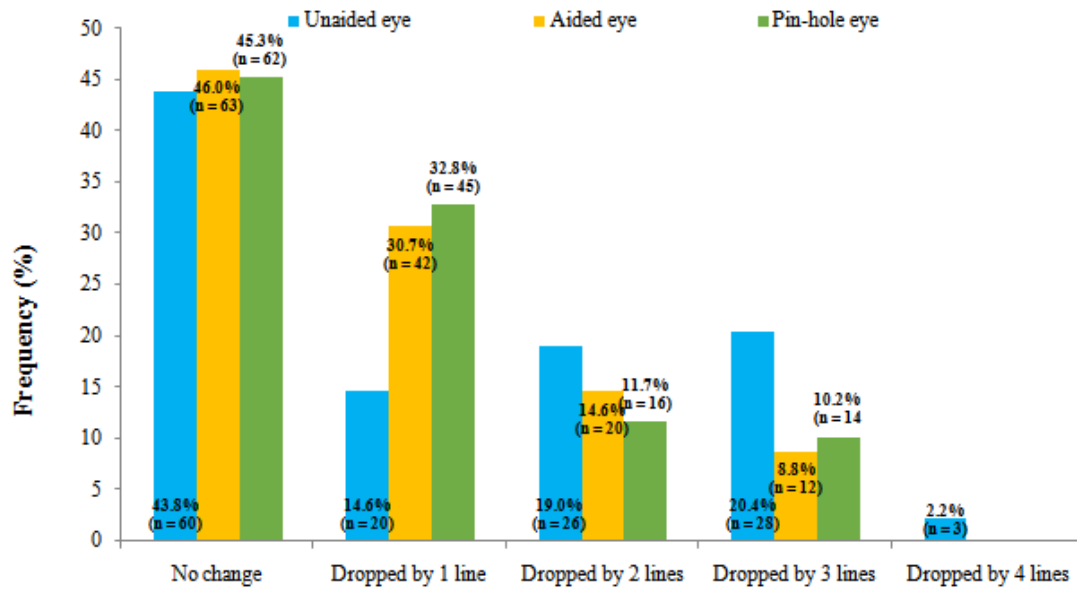
Table II shows the levels of education and occupation of study participants. Majority of participants had tertiary level of education (79.6%) while 5.8% had none and primary levels of education. The highest proportion of study participants were business owners (32.9%) while farmers (5.8%) and retirees (5.8%) had the least.

Table II: Educational levels and Occupation of study participants

Variables (N=137)	Number	%
Educational level		
None	8	5.8
Primary	8	5.8
Secondary	12	8.8
Tertiary	109	79.6
Total	137	100
Occupation		
Student	23	16.8
Business	45	32.9
Professional	38	27.8
Farmer	8	5.8
Civil servant	15	10.9
Retiree	8	5.8
Total	137	100

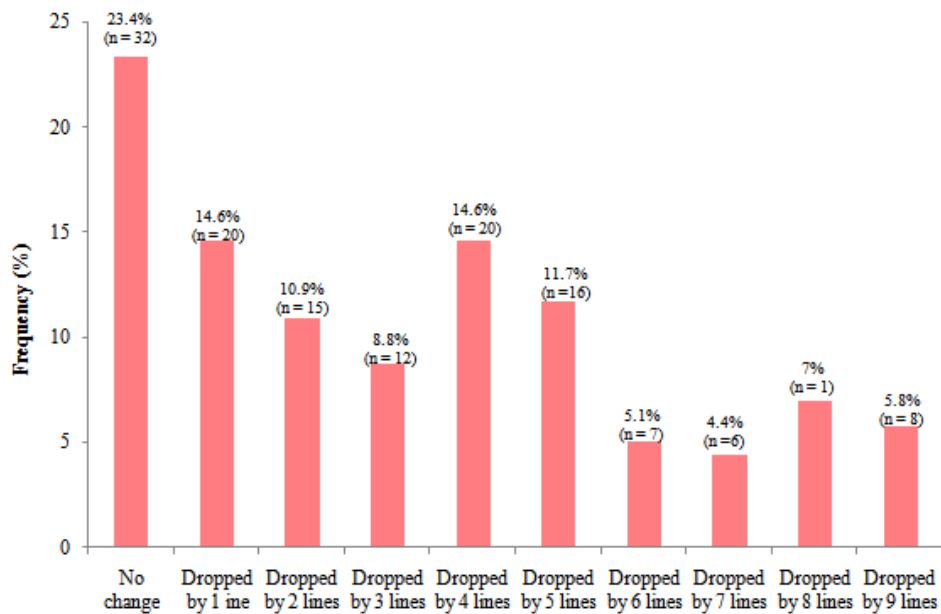
Figure 1 summarizes the changes observed in the distant VA of the RE post dilatation. Slightly less than half of the participants had no change in their distant visual acuity (43.8%, 46.0% and 45.3% of unaided, aided and pinhole visual acuities respectively). Of those who had a change in distant visual acuity, the largest reductions were a drop by 3 lines for the unaided visual acuities and by 1 line for the aided and pinhole visual acuities.

Figure 1: Changes observed in distance VA of the RE Post dilatation.



Changes observed in distance VA of the RE Post dilatation

Figure 2: Changes observed in the near VA of the RE Post dilatation.



Changes observed in the near VA of the RE post dilatation

Figure 2 shows the changes observed in near visual acuity obtained at 33cm in the RE after dilatation. Thirty-two (23.4%) study participants had no reduction in their near visual acuities. The remaining 105 participant's Right eyes all had drops in their near visual acuities ranging from drops by 1 line to 9 lines after dilatation.

Table III shows the Mean near visual acuity in the dilated RE of study participants before and after pupillary dilatation. The mean pre-dilatation near visual acuity was N18.78±16.31 while the mean post-dilatation near visual acuity was N30.68±14.81. This difference in near visual acuity was statistically significant (p=0.001).

Table III: Mean pinhole near VA in dilated RE Pre and Post dilatation

Variables	Near Vision
	Mean ± S.D
Pre-instillation near vision	18.78±16.31
Post-instillation near vision	30.68±14.81

*Paired t-test = 11.170; p=0.0001** *statistically significant; S.D - Standard deviation

Table III shows the Mean near visual acuity in the dilated RE of study participants before and after pupillary dilatation. The mean pre-dilatation near visual acuity was N18.78±16.31 while the mean post-dilatation near visual acuity was N30.68±14.81. This difference in near visual acuity was statistically significant (p=0.001).

IV. Discussion

Pupillary dilatation for dilated fundus examination (diagnostic mydriasis) is a very important aspect of ophthalmic practice. Diagnostic mydriasis has the ability to cause both ocular and systemic effects. In this study, there were 137 study participants with more males 78 (56.9%) than females 59 (43.1%) females. The age range of participants was 19-83years (44.87±15.94 years).

Previous studies have also shown the effects on visual function following pupillary dilatation. In a study by Lam et al., 51 Chinese patients were randomized to receive topical 1% tropicamide and 2.5% phenylephrine while 50 received a fixed combination of tropicamide 0.5% and phenylephrine 0.5%.¹¹ Both regimens induced blurred near vision.

Eyeson-Annan et al. in their study also noted a drop in visual function after pupillary dilatation using either 10% phenylephrine alone or in combination with 1% tropicamide.¹² Potamis et al. assessed the effect of pupil dilation on vision and driving ability and found a deterioration in both high and low - contrast visual acuities following dilatation.¹³

Similarly, Goel et al. also noted a significant reduction in visual acuity (VA), for both distance Snellen and near following instillation of tropicamide 1% hence and also noted a significant reduction in the number of people who could read the licence plate at 20 m. They concluded that significant risks to safe driving occurred as a result of significant reduction in visual quality and quantity after dilatation and therefore, there was a logical basis for disallowing driving following pupillary dilatation.¹⁴

On the other hand, [Watts P](#) et al. in their study found that after pupillary dilatation with 2.5% phenylephrine and 1% tropicamide, the distant visual acuities were not affected.¹⁵

In this study, slightly above half of the patients had a reduction in their distance visual acuity while most participants (>75%) had reduction in near acuities. The reduction of visual acuities found in this study is probably due to effects such as increased ocular aberrations and glare and decreased accommodation that could occur following pupillary dilatation. This blurring of vision for at least 130 minutes after dilatation as shown in this study, is particularly important in counselling patients on the possibility of poor performance of certain activities such as driving, reading and signing of important documents post dilatation .

V. Conclusion

It is important to educate patients on the potential side effects of blurring of both distance and near vision prior to diagnostic mydriasis

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Adediji AK. “Effects of Diagnostic Mydriasis on Distant and Near Vision.” *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, vol. 18, no. 3, 2019, pp 45-49.