

## Brief communication (Original)

# Efficacy of temporary lower punctal occlusion in enhancing pupil dilation after 1% tropicamide instillation

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**Background:** Pupil dilatation is essential for complete fundoscopic examinations and some eye surgeries. Whether temporary punctal occlusion will enhance the magnitude of pupillary dilation is not known.

**Objectives:** We measured the pupil diameter after one drop of 1% tropicamide instillation with and without temporary punctal occlusion at 0 and 30 min in the same patient.

**Methods:** Ninety-eight eyes from 49 patients at the Department of Ophthalmology, King Chulalongkorn Memorial Hospital were randomized into temporary punctal occlusion group (group 1) and simple closure group (group 2) after instillation one drop of 1% tropicamide in both eyes. Pupil diameters were photographed and measured before starting the drop and again 30 minutes later for each patient.

**Results:** At 30 minutes the mean pupil sizes of group 1 and group 2 were  $3.92 \pm 1.53$  mm and  $3.83 \pm 1.43$  mm, respectively. The mean difference of pupillary dilatation in group 1 was  $2.75 \pm 1.94$  mm whereas group 2 was  $3.19 \pm 1.77$  mm. The difference between the two group was statistically significant but not clinically important ( $p = 0.001$ ) (95% CI (-0.69)-(-0.18)).

**Conclusions:** Temporary punctal occlusion could enhance pupil dilation after one drop of 1% tropicamide instillation within 30 minutes. The degree of dilatation was not clinically important. Additional doses of 1% tropicamide or combination preparation will be required for clinically adequate mydriasis.

**Keywords:** Eyelid, punctal, pupil, tear, 1% tropicamide

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Pupil dilation is still one of the routine measures in complete fundoscopic eye examinations and for some ophthalmic surgeries. The dilation in uncomplicated cases will assist the ophthalmologists in finding abnormalities in the vital parts of an eye behind the iris and lens. This can help speed up the diagnosis before searching for further diagnostic tools in some uncomplicated eye disorders. In addition, the majority of ophthalmological procedures also need an effectively dilated pupil within a certain period of time, such as cataract surgery. Good dilation itself also reduces the operation time and decreases the risk of complications from the operation.

To have an eye dilated, the ophthalmologist needs an effective medication that provides full size dilatation with minimal systemic side effects. Most of the mydriatic agents are well prepared for topical route. One percent tropicamide (Mydriacyl®, Alcon Laboratories) is one of the mydriatic agents that are widely used among others especially in our institution, due to its short onset of action (20-40 minutes), short duration (four to six hours), and low systemic side effects [1]. This procedure takes time but needs to be done quickly without any side effects from the topical dilating agents. Many studies try to show that tropicamide itself does not affect the systolic and diastolic blood pressure in normal subjects. Moreover, Gregory H. Botz, MD et al. found that there was no change in the EKG report after instillation of tropicamide drop for 15 minutes. They also found no abnormality of the ST segment and no signs or

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symptoms of ischemic heart disease [2]. Punctal occlusion or nasolacrimal occlusion is recommended, as it improves the efficacy and systemic safety of topical ocular drugs [3, 4].

This study aims to assess the effect of temporary lower punctal occlusion in enhancing pupil dilatation after 1% tropicamide instillation, i.e. whether or not temporary punctal occlusion will enhance the magnitude of pupillary dilation. If it helps in shortening both the dosages of tropicamide and timing of the process, it will help in routine eye examinations or even in operations that required prolonged mydriasis.

### Materials and methods

Forty-nine patients were recruited and seen at the outpatient clinic, the Department of Ophthalmology, King Chulalongkorn Memorial Hospital. We defined temporary punctal occlusion as applied digital pressure against everything nasal side of lower lid margin of an eye for five minutes. We allowed the patients to blink as usual in simple closure group.

The sample size was determined to provide 90% power to detect a difference of pupil diameter of one millimeter or more. The exclusion criteria were eyes with previous intraocular surgery, having current ocular medication and ocular or systemic diseases that affected pupil dilation (e.g. diabetes mellitus), nasolacrimal stenosis or insufficiency, occludable angle, and known contraindication to tropicamide. The protocol conforms to the Declaration of Helsinki, and has been approved by the Ethics Committee of the Faculty of Medicine, Chulalongkorn University.

Prior to 1% tropicamide (Mydracil®, Alcon Laboratories) instillation, the pupil diameters of the participants were photographed binocularly by Slit-lamp Topcon SL.8Z with a digital camera, Nikon D100, at 10x magnification with constant illumination.

We did simple randomization by using random number table and selected one eye of each patient that would have temporary punctal occluded between two eyes. Then each subject was instilled with one drop of 1% tropicamide (Mydracil®, Alcon Laboratories) into the right eye and 30 seconds later into the left, consecutively. We did simple closure in one eye while temporary punctal occlusion was applied for five minutes in the selected eye by a technician. Then, we photographed the pupil of both eyes at 0, 10, and 30 minutes with constant illumination by Slit-lamp Topcon SL.8Z with a digital camera, Nikon D100, at 10x magnification. We used this magnification correction ( $\times 10$ ) while the pupil diameter

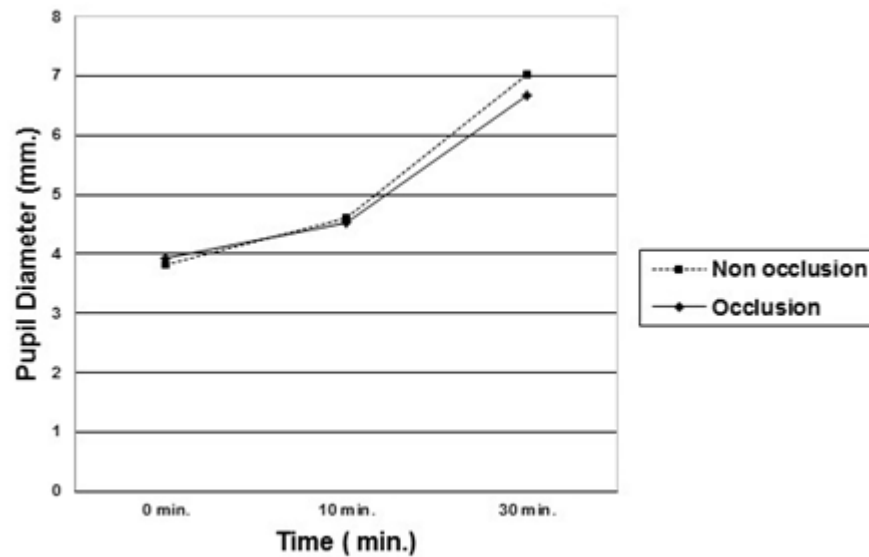
were measured by our staff in the same constant illumination. Only the pupil size at 0 and 30 minutes from the two groups would be determined.

The vertical and horizontal pupil diameter measurements were done on a monitor with a ruler using computerized pictures by one of our staff who did not know which side was temporarily occluded. We preferred the ruler than the pupil gauge because it was easy to measure while we know the exact magnification correction ( $\times 10$ ). The examiner measured them thrice on both the vertical and horizontal pupil diameters. Only the mean of horizontal pupil diameter will be used in calculation due to the inadequate view of vertical diameter in some subjects. We tried to find the mean difference of the pupil size with and without temporary punctal occlusion. The averages of these were calculated. Paired *t*-test was applied to determine the difference between the two groups. A *p* value of 0.05 or less was considered statistically significant. The SPSS package version 15 statistical software was used for statistical analysis.

### Results

Of the 98 eyes in 49 patients, there were 19 males (38.78%) and 30 females (61.22%). Forty-nine eyes (50%) were temporary punctal occluded whereas the others (50%) were allowed to blink as usual. Their mean age and standard deviations were  $41.37 \pm 14.49$  year-old (range 21 to 74). The mean pupil diameter and standard deviations before instillation of 1% tropicamide were  $3.92 \pm 0.77$  mm. and  $3.83 \pm 0.72$  mm in temporary punctal occlusion and simple closure group. There was no statistically significant difference between the two groups ( $p = 0.065$ ) [95% CI (-0.01)-(0.19)] before instillation. At 10 and 30 minutes after 1% tropicamide instillation, the mean pupil diameter and standard deviations were ( $4.53 \pm 0.84$  mm), ( $6.67 \pm 1.08$  mm) in the temporary punctal occlusion group and ( $4.61 \pm 0.93$ ), ( $7.02 \pm 0.95$  mm) in the simple closure group. There was a statistically significant difference between the two groups ( $p = 0.005$ ) [95% CI (-0.58)-(-0.11)] at 30 minutes. **Figure 1** shows the pupil diameter of the occlusion and the non-occlusion groups as a function of time.

At 30 minutes, the mean difference of pupillary dilatation and standard deviations in group 1 was  $2.75 \pm 1.94$  mm whereas group 2 was  $3.19 \pm 1.77$  mm. The difference was statistically significant but not clinically significant ( $p = 0.001$ ) [95% CI (-0.69)-(-0.18)]. No systemic or ocular side effects were observed.



**Figure 1.** Pupil diameter (millimeters) is plotted against the time (minutes) within 30 minutes.

## Discussion

We have been telling the patients to do punctal occlusion after applying topical drug in order to improve local activity and lessen the systemic side effects of the drop. In this randomized controlled double-blind study, we evaluated the efficacy of temporary lower punctal occlusion with simple closure of the eyelids. The result showed that temporary punctal occlusion within five minutes did not increase mydriasis after one drop of 1% tropicamide instillation. The difference was statistically significant but not clinically important. At 30 minutes the mean difference of pupillary dilation and standard deviations in group 1 was  $2.75 \pm 1.94$  mm whereas group 2 was  $3.19 \pm 1.77$  mm, ( $p = 0.001$ ) [95% CI (-0.69)-(-0.18)]. As one drop of 1% tropicamide has the onset of action from 20 to 40 minutes [1], we did not use the pupil size at 10 minutes for statistical calculation. However, we also took the picture of pupil at 10 minutes because we wanted to see the trend of pupillary dilation. Furthermore, pupil dilation appeared to be slightly larger in simple closure group with statistical significance, but there was no clinical significance. This was similar to the previous study that showed nasolacrimal occlusion did not enhanced pupil dilation, but this study applied nasolacrimal occlusion for three minutes, which was inadequate for drug clearance [5]. We did not record systemic side effects in this study because there were a number of previous studies reported that 1% tropicamide had no systemic

side effects especially on the blood pressure, electrocardiography [2, 6, 7, 10] and intraocular pressure [7-9, 11].

In our study, simple closure alone showed better results than temporary lower punctal occlusion after 1% tropicamide instillation. However, the way we occlude the punctum in this study might not be effective enough. While we everted the lower lid margin out, the tear lake volume was decreased, and this lessened the contact time of the drugs. Therefore, it would be good for other kinds of occlusion such as using collagen plug, etc. As for pre-operative patients, contamination may occur and therefore it can possibly bring infection into the eyes.

## Conclusion

Temporary punctal occlusion enhanced the magnitude of pupil dilation after one drop of 1% tropicamide instillation within 30 minutes. However, the magnitude of dilation was not enough to warrant routine clinical use. Additional doses of 1% tropicamide or combination preparation will be required for clinically adequate mydriasis in terms of further investigations or even for time-consuming operations.

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