Effect of Low-Dose Atropine on Accommodation and Visual Acuity in Children Aged 6 to 17 Years

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PURPOSE

To determine the effect of 0.01%, 0.03%, and 0.05% atropine on visual acuity at distance and near, pupil size, and accommodation in children aged 6 to 17 years.

METHODS

Forty-six children (28 girls and 18 boys) aged 6 to 17 years were randomized into 4 eye drop groups: placebo (n=10), 0.01% (n=13), 0.03% (n=11), or 0.05% (n=12) atropine. One drop of atropine or placebo was administered into each eye once. The following measurements were collected before drop administration, and then 30 minutes, 60 minutes, and 24 hours following application of eye drops: pupil size, accommodative lag using the Grand-Seiko WAM-5500 Binocular Autorefractor, amplitude of accommodation using pull away and a 20/50 target, and visual acuities at distance OD, OS, and OU, and at near OU. All measurements were taken through habitual correction. Repeated measures ANOVA with post hoc comparison was performed to determine the effect of 0.01%, 0.03%, and 0.05% atropine eye drops on accommodation, visual acuity, and pupil size at each time point.

TABLE 1
Characteristics of Participants

	Control	0.01% Atropine	0.03% Atropine	0.05% Atropine
	n=10	n=13	n=11	n=12
Age (years)				
Mean	11.08 ± 2.75	11.38 ± 3.18	10.28 ± 2.63	10.13 ± 3.04
Spherical equivalent of cycloplegic refractive error (D)				
OD	-1.69 ± 1.82	-1.75 ± 2.48	-1.93 ± 1.60	-1.45 ± 1.67
OS	-1.66 ± 1.91	-1.92 ± 2.78	-1.54 ± 1.57	-1.52 ± 1.61

FIGURE 1
Effect of Low-Dose Atropine on Accommodation Amplitude Over Time

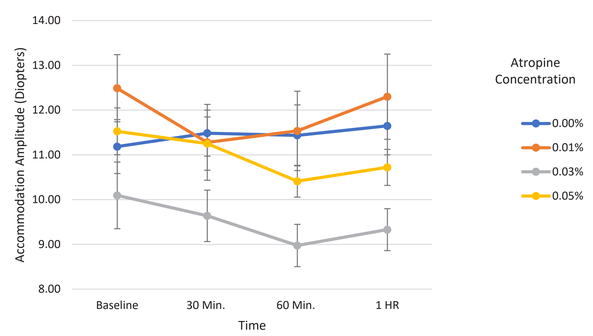


FIGURE 2
Effect of Low-Dose Atropine on Accommodation Lag Over Time

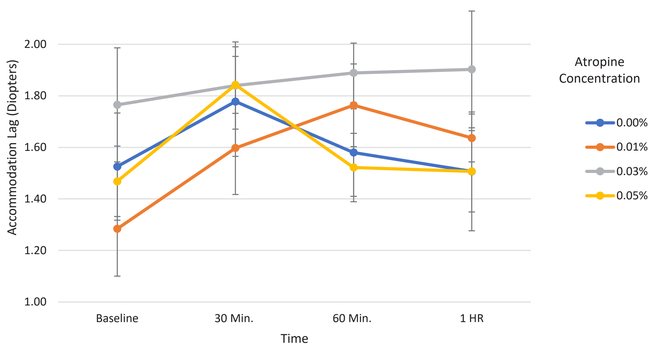
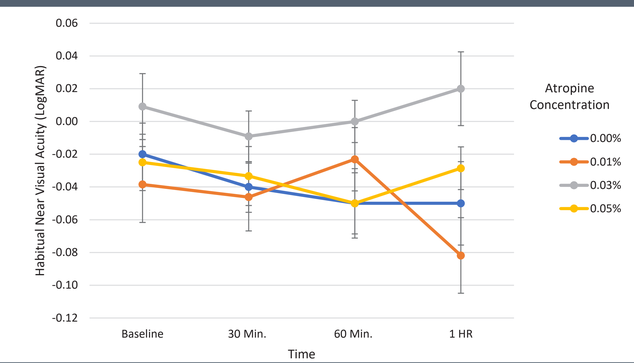


FIGURE 3
Effect of Low-Dose Atropine on Habitual Near Visual Acuity Over Time



RESULTS

The mean age of participants was 10.73 ±3.01 years. Average spherical equivalence by cycloplegic refraction was -1.70 ± 1.98 D and -1.72 ± 2.10 D, OD and OS respectively. Difference in pupil diameters in bright and dim illumination was statistically significant when comparing all 3 atropine groups to the placebo group over time (P <0.001). Atropine eye drops had the most effect on pupil diameter 60 mins after installation (P <0.001). Pupil diameter was partially recovered at 24 hours with no statistical significance compared to the 30-minute time point (P >0.05), although still significantly different from baseline in the 0.03% atropine group (P=0.002). In the 0.01% and 0.05% atropine groups pupil diameter fully recovered after 24 hours with no significant difference from baseline (Ps >0.05). There was no significant difference in accommodation measurements including accommodation lag and amplitude of accommodation comparing 0.01%, 0.03%, and 0.05% atropine to the placebo eye drop group at baseline, or 30 minutes, 60 minutes, and 24 hours following application of the eye drops (Ps >0.05). There was also no significant difference in distance visual acuity OD, OS, and OU or near visual acuity OU (Ps >0.05) at any of the time point of measurements.

CONCLUSION

Pupil size was significantly enlarged by 0.01%, 0.03%, and 0.05% atropine in both dim and bright illumination with more effect at 60 minutes after application. However, low dose atropine eye drops have no significant effect on accommodation or visual acuity at distance or near as compared to baseline. Thus, in respect to accommodation and visual acuity, it is relatively safe to use low-dose atropine to treat myopia progression in children aged 6 to 17 years.

DISCUSSION

Some of the strengths presented in our study include the testing of several atropine concentrations (0.01%, 0.03%, and 0.05%), the variety of tests performed at each time point, and the objectivity of the tests selected. Our study was limited primarily by sample size, as well as study drop-out at the 24-hour time point of 6 participants (13.04%). Further investigation must be conducted to explore the effect of low-dose atropine on accommodation and visual acuity.

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