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The Effect of Atropine 0.01% Eye Drop to Slow the Progression of Myopia in Bangladeshi Children: Follow-up Study in a Myopia Clinic

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Abstract

Background: Progressive myopia in growing children has become a major public health burden worldwide and its control remains a current challenge. Topical atropine has emerged as a very effective and promising treatment modality in myopia control.

Objective: We aimed to evaluate the efficacy of low-dose atropine (0.01% eye drop) in Bangladeshi children with myopia and its side effects on them.

Methods: This was a single-centre, prospective, interventional study. A total of 94 participants aged 5–15 years with myopia ranging from -1D to -8D (spherical equivalent or SE) in either/both eyes, progression equal or greater than -0.5D in the preceding year, astigmatism of 2.5D or less, anisometropia of 2D or less, and best-corrected visual acuity at least 6/9 were enrolled in the study and received 0.01% atropine in the effected eye/ eyes for 1-year. A standardized eye examination, including cycloplegic refraction and axial length, was performed at baseline, and 6 and 12 months after initiation of therapy. Data were analyzed using the intention-to-treat principle.

Results: Among 94 cases, 76 participants (80.9%) completed their follow-up at the 6th and 12th month of therapy and continued treatment with same strength. The remaining 18 children (19.1%) adhered to atropine treatment with an increased strength (0.05% atropine drop) after these 12 months due to a poor/no response to the lower strength of atropine. Mean spherical equivalent at baseline was −3.90 D (±3.23). The progression rate of spherical equivalent (SE) before treatment (−0.5D/year or more) was diminished substantially after 12 months' treatment (−0.27 D annually in right eye and -0.29 D annually in left eye; p <0.001 in both cases). In case of AL measurement, it was of 0.13 mm in right eye and -0.02 mm in left eye, respectively (p >0.05). Reduction in Myopia progression was statistically significant (p < .001) in children, irrespective of age group, but not in the case of Axial length. Corresponding with age, only near-work time (mean 8.14±0.7 hrs/week) showed a significant difference (p-value 0.022), but screen-time and outdoor-activity time were not showing any significance.

Conclusion: The study suggested that 0.01% atropine is effective and safe in retarding the progression of myopia in the eyes of Bangladeshi children.

Keywords: Myopia; Progression; Atropine eye drop

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Introduction

Myopia is the most common eye pathology in humans, and also the commonest cause of correctable visual impairment among adults as well as children in different countries [1-4]. In this modern era, our lives are increasingly entwined with the use of digital media and screens. Prolonged education hours and poor outdoor activities also play a crucial role in development of myopia in children and its control remains a current challenge. In addition to the direct economic and social burdens, associated ocular complications may lead to substantial vision loss. So, the focus for interventions should be on early life when myopia progression is faster.

Previous reviews have reported that among various treatment options, topical atropine shows a promising reduction in myopia progression (MP). Recently, different studies have shown that low-dose (0.01%) atropine has a better treatment-to-side-effect ratio and is an effective and safe treatment modality in myopia control [5-9]. But there is racial and ethnic variation of response in this regard [10-12]. Again, various non-sharing environments and family-related confounding factors (time spent for near work, less outdoor activity, prolonged screen time, and positive family history) can also influence the rate of myopia progression [13-14]. Considering the existing paucity in the literature and non-availability of data from the Bangladeshi population, this study aimed to determine myopia progression (MP) and axial length (AL) elongation in our very own sample of Bangladeshi children with myopia. We also tried to find out the adverse effects of the drug and how various modifiable and non-modifiable factors impact myopia progression.

Methodology

This clinic-based prospective study was conducted over a period of one year in the setting of the 'Myopia Clinic' of the Children's Eye and Orthoptic Centre, Dhaka (a tertiary eye-care centre in Bangladesh). The study protocol received institutional review board approval from the Institute of Child and Mother Health, Dhaka. From records of myopia clinic children aged 5–15 years with myopia ranging from − 1D to − 8D (SE) in either or both eyes, progression equal or greater than -0.5D in the preceding year and astigmatism of 2.5D or less were purposively enrolled in the study. Patients with ocular pathology like spherophakia, retinal dystrophies, corneal dystrophy or other diseases, allergy to atropine eye drops, or children who were already under treatment for myopia control were excluded. Written informed consent was obtained from parents and verbal consent was obtained from the participants. A one-on-one interview was conducted with a structured questionnaire to obtain basic information regarding demographics, parental history of myopia, and baseline day-to-day behavioral pattern in the most recent year, e.g., the time spent doing activities at a short distance (near-work, such as reading, writing, school assignments, drawing, craft-work, etc.), time spent on gadgets (like smart phones, tablets, iPads, laptop, video-games, etc.) and outdoor activities in daylight (outdoor sport, time spent in backyard, walks etc.).

Participants underwent a detailed ophthalmological examination at the time of recruitment. Best-corrected visual acuity was measured with the Snellen distance chart. Cycloplegic auto-refraction and Optical biometry were performed. All participants received treatment with 0.01% atropine eye drops every night in their myopic eyes and were advised for follow up at 6-monthly intervals. The annual baseline rate of myopia progression was calculated based on the cycloplegic refraction available in the documented previous-year data of the patient. A full refractive correction was prescribed to each participant during enrollment. Participants were followed up at 6 and 12 months after the initiation of therapy.

The main outcome measures were annual myopia progression (difference in SE) and axial length elongation (ALE) in eye/eyes, measured at each follow-up. Secondary outcome measures were the occurrence of any adverse events.

Results

Among 94 myopic children, we had a slight female predominance. Urban dwellers and middle-income families were more numerous. The majority had family history of myopia. (Table I).

Table I: Distribution of baseline demographic features of study participants with progressive myopia

Characteristics	Number	Percentage
Age in groups		
5-7 years	25/94	26.6%
8–10 years	30/94	31.9%
11–13 years	28/94	29.8%
14-15 years	11/94	11.7%
Mean age in years (SD), (range)	9.57 (±0.986), (5.7–15)	
Gender		
Male	46/94	48.9%
Female	48/94	51.1%
Residence		
Urban	71/94	75.5%
Rural	11/94	11.7%
Semi-urban	12/94	12.8%
SE status		
High	32/94	34%
Middle	51/94	54.3%
Low	11/94	11.7%
Family h/o Myopia		
Yes	79/94	84%
No	15/94	16%

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The maximum (76/94, 80.9%) of children adhered to atropine treatment for 12 months and beyond; 18 of the 94 children showed no/poor response and switched to therapy with increased strength of atropine drop (0.05%) and they did so within 1 month after the end of 12 months of this study period with 0.01% atropine drop therapy.

Table II: Clinico-behavioral measures of study participants with progressive myopia

Variables	Number (%)	p-value
Time spent doing near-work (reading, writing, school assignments, drawing, craft-work) None <5 hrs/week, 5-15 hrs/week, >15 hrs/week	03/94 (3.2%) 38/94 (40.4%) 44/94 (46.8%) 09/94 (9.6%)	.022
Mean near work time (±SD)	8.14±0.7 hrs/week	
Outdoor activities in daylight (time spent in the school-yard, outdoor sports, going for walks) <1 hr/day 1-3 hrs/day >3 hrs/day	68/94 (72.3%) 24/94 (25.5%) 02/94 (2.2%)	.807
Mean outdoor activities time (±SD)	1.3±0.5 hrs/day	
Screen time/time spent on near gadgets (smartphones, laptop, tablets, iPads, video games) None <2 hrs/day 2-4 hrs/day >4 hrs/day	07/94 (7.4%) 40/94 (42.6%) 24/94 (25.5%) 23/94 (24.5%)	.376
Mean screen time (±SD)	2.67±0.932 hrs/day	

Corresponding with age, only near work time (mean 8.14±0.7 hrs/week) was significant (p-value 0.022) (Table II). Mean spherical equivalent and cylindrical equivalent in both eyes showed statistically significant changes (Table III) from baseline at the end of the study.

Mean spherical equivalent at baseline was −3.90D (±3.23) and progression was equal or greater than -0.5D in the preceding year (as per inclusion criteria). The measure of change in SE refraction and axial growth per year was the clinically relevant marker for the Myopia Progression (MP) and Axial Length (AL). So, the true Efficacy of the drug in an individual was described as a numerical annual mean reduction of SE and/or AL in treatment eyes, calculated as below:

The most prominent reported adverse events were itching/burning/irritation (8.6%), followed by Astigmatism or squinting of eyes (7.4%), and redness (5.3%). Photophobia and headaches were reported by 2 cases (2.1%) and only 1.1% complained of blurred vision or eye pain (Table V).

Discussion

The present study evaluated the effectiveness, adherence, and safety of prolonged low-dose atropine (0.01%) therapy in children with progressive myopia over a 12-month period. The findings demonstrate good treatment adherence, modest but statistically significant control of myopic progression, minimal axial elongation, and a favorable safety profile. The findings are consistent with results from major randomized trials, including the ATOM and LAMP studies [5-7], and

Table III: Spherical equivalent, axial length and cylindrical equivalent over time in participant myopic children

Variables		At baseline	At 2nd visit After 6 months	At 3rd visit After 12 months	p-value
Right eye	Mean Spherical equivalent (SE in D ±SD), (**n=94**)	- 3.90 (±3.23)	- 4.17 (±3.07)	- 4.17 (±3.23)	<.001
	Mean Axial length (AL in mm), (**n=94**)	24.16 (±1.45)	24.22 (±1.38)	24.29 (±1.44)	.113
	Mean Cylindrical equivalent (CE in D ±SD), (**n=67**)	- 2.32 (±1.61)	- 2.34 (±1.57)	- 2.35 (±1.57)	<.001
Left eye	Mean Spherical equivalent (SE in D ±SD), (**n=94**)	- 3.82 (±3.23)	- 4.12 (±3.23)	- 4.11 (±3.22)	<.001
	Mean Axial length (AL in mm), (**n=94**)	24.09 (±1.57)	24.13 (±1.56)	24.07 (±1.57)	.164
	Mean Cylindrical equivalent (CE in D ±SD), (**n=70**)	- 2.22 (±1.53)	- 2.20 (±1.51)	− 2.23 (±1.51)	<.001

***Paired t-test**

Table IV: Mean annual change in Myopia Progression and Axial length in the participants

Variables	Right eye (**n=94**)	p-value	Left eye (**n=94**)	p-value
Mean annual change in Myopia Progression (change of SE = SE after 12 months' treatment - SE at baseline)	[-4.17(±3.23)] - [- 3.90(±3.23)] = - 0.27 D	.001	[-4.11(±3.22)] - [- 3.82 (±3.23)] = - 0.29 D	.001
Mean annual change in Axial Length (axial growth = AL after 12 months' treatment - AL at baseline)	[24.29(±1.44)] - [24.16(±1.45)] = 0.13 mm	.113	[24.07(±1.57)] - [24.09(±1.57)] = - 0.02 mm	.164

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Table V: Reported adverse events over time in children who used atropine therapy (multiple response)

Variables	Frequency	Percentage
None	68/94	72.3
Itching/Burning/Irritation	8/94	8.6
Astigmatism	7/94	7.4
Redness	5/94	5.3
Headache	2/94	2.1
Photophobia	2/94	2.1
Blurred vision	1/94	1.1
Eye pain	1/94	1.1

support the clinical utility of 0.01% atropine as an initial modality for myopia control.

A high proportion of children (80.9%) adhered to atropine therapy for 12 months and beyond, indicating good acceptability of low-dose atropine among both children and caregivers. Only 19.1% of participants showed no or poor response and required escalation to a higher atropine concentration (0.05%) after completion of one year of therapy. This switching rate is comparable to previous reports [5-9], suggesting that while low-dose atropine is effective for many children, a subset, particularly those with faster baseline progression, may require stronger concentrations for adequate control. Early identification of non-responders is therefore essential to optimize individualized treatment strategies.

The demographic profile of the study population reflects the typical age group affected by progressive myopia, with a mean age of 9.57 years and most children between 8 and 13 years old. The slightly higher number of females (51.1%) and the predominance of urban residence (75.5%) align with epidemiological trends linking urbanization to higher myopia rates. A strong family history of myopia was seen in 84% of participants, emphasizing the role of genetics in childhood myopia development and progression.

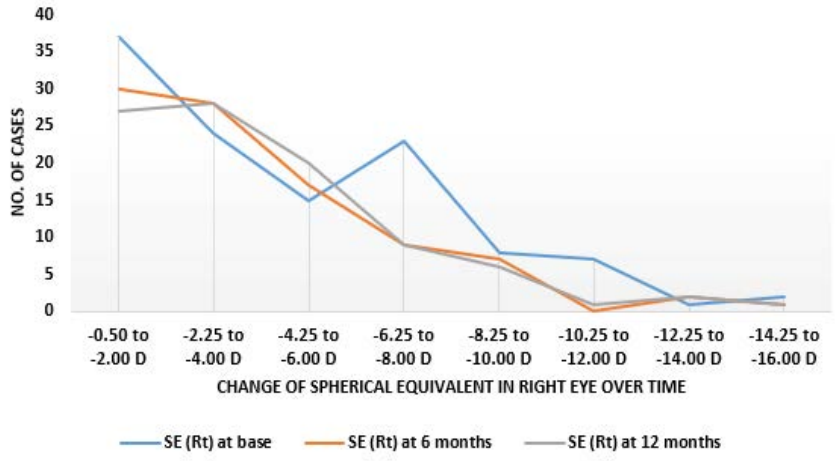

Figure 1: Mean change in SE from baseline and the 12 months of treatment (right eye).

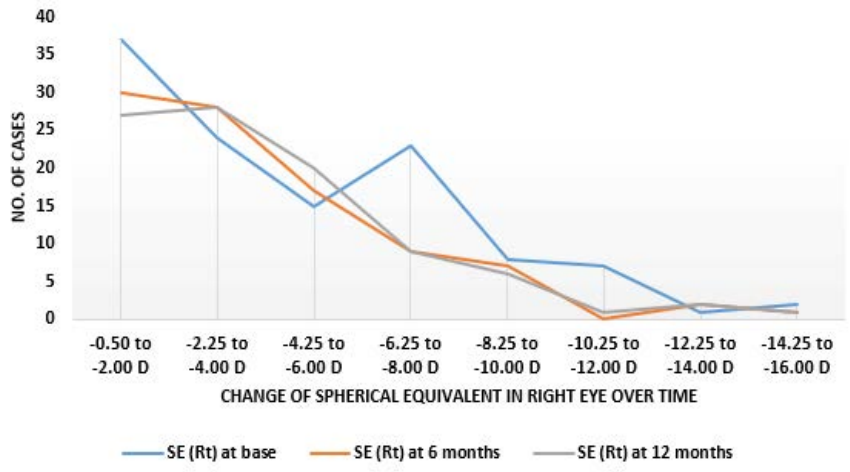

Figure 2: Mean change in SE from baseline and the 12 months of treatment (left eye)

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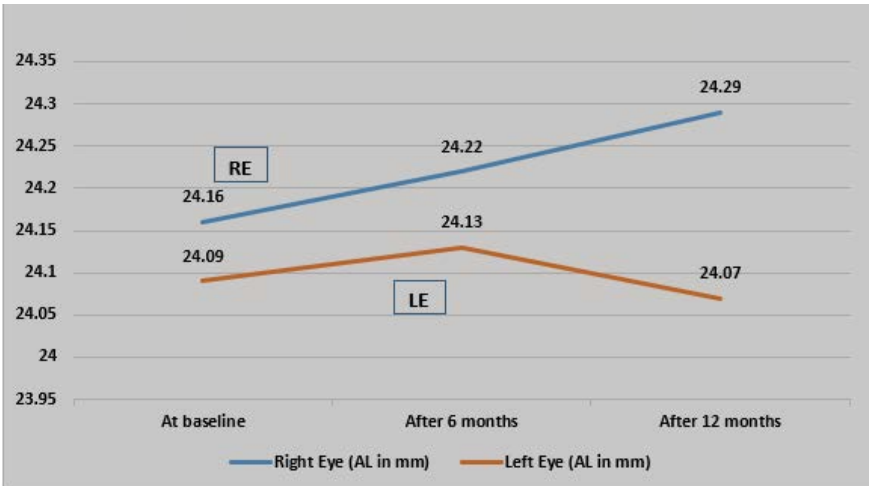

Figure 3: Mean change in AL from baseline, after 6 and 12 months of treatment (both eyes)

Clinico-behavioral analysis revealed that near-work activity was significantly associated with age, with a mean near-work duration of 8.14 ± 0.7 hours per week (p = 0.022). This finding supports existing evidence [13] that increased near-work demands contribute to myopia progression in school-aged children. In contrast, outdoor activity duration and screen time did not show statistically significant associations, although most children reported less than 1 hour of outdoor exposure per day. The lack of significance may be due to limited variability in outdoor activity levels across participants or the relatively small sample size, and it does not negate the well-established protective role of outdoor exposure reported in larger population-based studies.

Regarding refractive outcomes, there was a statistically significant reduction in the rate of progression of spherical equivalent (SE) in both eyes over the 12 months; however, the magnitude of progression was clinically modest. The mean annual myopic progression was −0.27 D in the right eye and −0.29 D in the left eye, which is lower than the expected natural progression rate of approximately −0.50 to −1.00 D per year in untreated children. This suggests that 0.01% atropine effectively slowed myopic progression in the majority of participants, consistent with findings from landmark trials such as ATOM2 and subsequent real-world studies [5-9].

Axial length (AL) changes further support the stabilizing effect of low-dose atropine. The mean annual axial elongation was 0.13 mm in the right eye and showed no significant change (0.02 mm) in the left eye. These changes were not statistically significant, indicating relative stability of axial growth during treatment. Given that axial elongation is a key structural correlate of myopia progression and long-term visual morbidity, the minimal axial growth observed is clinically meaningful, even in the absence of statistical significance.

Astigmatic changes (present as cylindrical equivalent in 67 cases), although statistically significant, were minimal in magnitude and unlikely to be clinically consequential. The observed changes may reflect measurement variability or normal refractive development rather than a direct adverse effect of atropine.

Importantly, 0.01% atropine demonstrated an excellent safety profile. More than 70% of children reported no adverse effects. The most common side effects—itching, burning, irritation, mild redness, and transient astigmatic complaints—were mild and self-limiting. Photophobia and headache were infrequent, and only isolated cases of blurred vision and eye pain were reported. No child discontinued treatment due to adverse events, highlighting the tolerability of low-dose atropine and its suitability for long-term use in children, as reported in other studies [14].

Despite these encouraging findings, the study has certain limitations. The absence of a control group limits direct comparison with untreated progression rates. Behavioral factors such as near-work and outdoor activity were based on self-reported data, which may be subject to recall bias. Additionally, longer follow-up would be valuable to assess sustained efficacy, rebound effects, and long-term axial growth patterns beyond 12 months.

Conclusion

This study showed that prolonged use of 0.01% atropine eye drops in children with progressive myopia resulted in significant reduction in annual myopic progression, minimal axial elongation, low incidence of mild adverse effects, and a good treatment adherence. These findings support the use of low-dose atropine as a safe and effective initial strategy for myopia control, with dose escalation reserved for individuals who do not respond. Future studies with longer follow-up and comparative treatment arms are warranted to further refine personalized myopia management protocols.

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Conflicts of interest : None.

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