ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 08 | August - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A STUDY ON EFFICACY OF TOPICAL 0.01% ATROPINE EYEDROPS IN MYOPIA OF AGE GROUP 5-15 YEARS

Ophthalomology

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ABSTRACT

Background: Increasing prevalence of myopia, especially in East and South Asia, has prompted the need for effective interventions to curb progression and prevent complications like retinal detachment and myopic maculopathy. Among various strategies, low-dose atropine (0.01%) eye drops have shown promising results with minimal side effects. **Methods:** A prospective interventional study was conducted at the Department of Ophthalmology, Basaveshwara Teaching and General Hospital, Kalaburagi, from May 2023 to October 2024. A total of 170 myopic children (≥ -2.00 D) aged 5–15 years were enrolled through simple random sampling. Participants received one drop of 0.01% atropine in each eye nightly. Clinical evaluations, including visual acuity, axial length (A-scan), anterior chamber depth, lens thickness, intraocular pressure (Goldmann tonometry), keratometry, slit lamp and fundus examination, were conducted at baseline and at diagnosis, 3, 6, and 9 months. **Results:** The treatment was well tolerated, with no adverse effects noted on anterior or posterior segment findings in any participant. Slit lamp and fundus examinations remained normal throughout the study. Visual acuity improved significantly: at diagnosis, only 24.71% of right eyes and 50% of left eyes had 6/6 vision, which increased to 100% in both eyes by the end of the study. Axial length changes were minimal, indicating effective control of elongation—a key marker of myopia progression. The mean axial lengths stabilized from baseline (RE: 23.96 ± 1.19 mm; LE: 24.21 ± 1.22 mm) to 9 months (RE: 23.93 ± 1.21 mm; LE: 24.11 ± 1.13 mm). No significant changes were observed in anterior chamber depth, lens thickness, or intraocular pressure, reinforcing the structural and functional ocular safety of the intervention. **Conclusion:** Topical 0.01% atropine eye drops are a safe, effective, and well-tolerated treatment for slowing the progression of myopia in children aged 5–15 years. This study supports the routine clinical use of low-dose atropine in pediatric myopia management and underscores the importance of early intervention to mitigate future vision-threatening complications.

KEYWORDS

INTRODUCTION

Myopia, commonly known as nearsightedness, is a prevalent refractive error that affects a significant proportion of the pediatric population worldwide. The increasing prevalence of myopia among children has prompted the exploration of effective strategies for its management, with a particular focus on slowing the progression of the condition to reduce the risk of associated ocular complications in adulthood, such as retinal detachment, myopic maculopathy, and glaucoma.[1]

Among the numerous pharmacological and non-pharmacological interventions available, low-dose atropine eye drops have emerged as one of the most effective and well-tolerated options for controlling myopia progression. Atropine, in recent years, its application at significantly lower concentrations, particularly 0.01%, has garnered considerable attention for its ability to retard axial elongation and prevent the rapid advancement of myopia in children.

By modulating biochemical pathways involved in ocular growth, atropine effectively reduces the axial elongation responsible for the progression of myopia. Additionally, emerging evidence suggests that low-dose atropine may have neuroprotective properties, further contributing to its efficacy in myopia management.[2]

Large-scale, randomized controlled trials such as the Atropine for the Treatment of Myopia (ATOM) studies and the Low-Concentration Atropine for Myopia Progression (LAMP) studies have provided robust evidence supporting the use of low-dose atropine in children aged 5 to 15 years. These trials have reported significant reductions in both axial elongation and myopic progression, with minimal impact on pupil size and accommodation.

Furthermore, the long-term safety and tolerability of 0.01% atropine have been well established. This makes 0.01% atropine an ideal option for children requiring prolonged treatment. [3]

Despite the strong evidence supporting the use of 0.01% atropine, certain challenges remain in its widespread adoption. Further research is warranted to elucidate the precise mechanisms underlying its myopia-controlling effects and to explore potential biomarkers for predicting treatment response. [4]

As the prevalence of myopia continues to rise, early identification and timely initiation of atropine therapy, coupled with appropriate lifestyle modifications, hold the potential to mitigate the burden of myopia-related complications and preserve long-term visual health in the pediatric population. [4]

The aim of this study was to evaluate a study on efficacy of topical 0.01% atropine eye drops in myopia of age group 5-15 years.

MATERIALS AND METHODS

The study was designed as an interventional study to evaluate the efficacy of topical 0.01% atropine eye drops in 172 children with myopia aged 5-15 years conducted at the Department of Ophthalmology, Basaveshwara Teaching and General Hospital, attached to Mahadevappa Rampure Medical College, Kalaburagi, conducted over a period of 18 to 24 months, from May 1, 2023 to October 31, 2024. This timeline ensured adequate follow-up and comprehensive data collection at 3-month, 6-month, and 9-month intervals. All participants received the intervention of topical 0.01% atropine eye drops. The primary study parameters included:

- Visual acuity using Snellen's chart
- Axial length using A-scan
- Anterior chamber depth and lens thickness
- Intraocular pressure (IOP) using Goldmann applanation tonometry
- Keratometry (K1 and K2 values)
- Slit lamp examination
- Fundus examination using indirect ophthalmoscopy

After confirming the diagnosis of myopia, participants were administered topical 0.01% atropine eye drops, with one drop in each eye every night. Follow-up visits were scheduled at 3-month, 6-month, and 9-month intervals for reassessment and monitoring.

Data was collected using a structured proforma. Each visit included repeat assessments of visual acuity, axial length, anterior chamber depth, lens thickness, intraocular pressure, and fundus examination results. Adverse events and patient compliance were also documented.

RESULTS

Out of the total participants, 91 (53.53%) were female and 79 (46.47%) were male, showing a slight female predominance. The slit lamp examination of both eye remained normal in all 170 participants throughout the study duration. The fundus examination of both eyes revealed normal findings in all participants at all stages of the study. At diagnosis, only 24.71% of right eyes and 50% of left eyes had 6/6 vision. By 6 months, 100% of right eyes and 74.71% of left eyes reached 6/6. At the 9-month mark, 100% of left eyes and 75.29% of right eyes maintained 6/6 vision. At baseline, the mean axial length was 23.96 mm (RE) and 24.21 mm (LE). Slight reductions were observed by the 3rd month, and stability was maintained through the 6th and 9th months. Anterior chamber depth (ACD) remained stable in both eyes throughout the study period. At diagnosis, the ACD measured 24.00 mm in the right eye and 23.96 mm in the left. Minor fluctuations were observed over the follow-up intervals, with a slight increase by 9 months. The right eye ACD increased marginally from 23.88 mm at baseline to 24.00 mm at 9 months. Lens thickness measurements revealed no significant changes across the study period. For the right eye, the thickness fluctuated slightly from 23.91 mm at diagnosis to 23.99 mm at 9 months, and similarly for the left eye. Intraocular pressure (IOP) values remained stable in both eyes across the study duration. At baseline, mean IOP was 15.27 mmHg (RE) and 15.43 mmHg (LE). Minor fluctuations were noted during follow-ups, with no significant rise at any point. Keratometry readings (K1) remained consistent throughout the treatment period, indicating stable corneal curvature. In the right eye, mean K1 ranged narrowly from 42.41 to 42.54 D, while the left eye ranged from 42.38 to 42.53 D. The K2 keratometry readings, which reflect the steeper meridian of corneal curvature, remained stable throughout the study. In the right eye, values ranged from 42.29 D to 42.63 D, while in the left eye they fluctuated narrowly between 42.13 D and 42.54 D. There was a slight increase in myopia at the 3-month follow-up (−3.24 D RE, −3.18 D LE), which remained stable through the 9-month period. At baseline, only 24.71% of right eyes had 6/6 vision compared to 50% of left eyes. By the 6-month mark, 100% of right eyes and 74.71% of left eyes achieved 6/6 acuity. At 9 months, all left eyes and 75.29% of right eyes maintained 6/6 vision.

Table 1: Serial Assessment of Unaided Visual Acuity in Right and Left Eyes (n=170)

Time	Visual Acuity	RE Frequency	RE %	LE Frequency	LE %
Diagnosis	6/6	42	24.71%	85	50.00%
	6/9	128	75.29%	85	50.00%
3 Month	6/6	128	75.29%	85	50.00%
	6/9	42	24.71%	85	50.00%
6 Month	6/6	170	100.00%	127	74.71%
	6/9	0	0.00%	43	25.29%
9 Month	6/6	128	75.29%	170	100.00%
	6/9	42	24.71%	0	0.00%

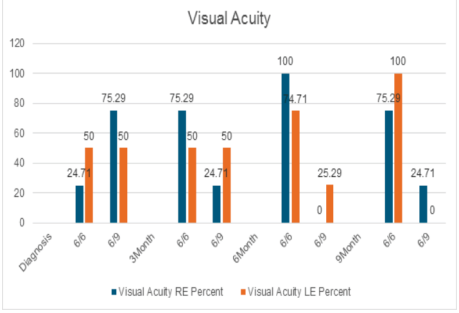
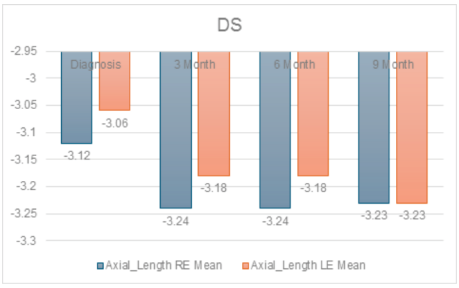


Table 2: Changes in Spherical Refractive Error (DS) Over Time (n=170)

Time	DS RE (Mean ± SD)	DS LE (Mean ± SD)
Diagnosis	-3.12 ± 0.80 D	-3.06 ± 0.54 D
3 Month	-3.24 ± 0.79 D	-3.18 ± 0.62 D
6 Month	-3.24 ± 0.79 D	-3.18 ± 0.62 D
9 Month	-3.23 ± 0.79 D	-3.23 ± 0.61 D



DISCUSSION

Demographic analysis revealed a nearly equal gender distribution, with females comprising 53.53% and males 46.47% of the sample. Previous literature, including studies by Yam et al. (2019) and Simonavičiūtė et al. (2024), suggests that gender does not significantly influence treatment response, although some have reported marginally faster progression in girls, possibly linked to earlier puberty [5, 6].

Regarding age, the study focused on the 5–15 year group, a critical window for myopia onset and progression. This aligns with epidemiological data from studies like the CHAMP-UK and Jethani (2021), which emphasized early intervention in school-aged children to reduce the risk of developing high myopia [7, 8]. Our findings corroborate this, with stabilization of axial length and refractive error noted even in younger children.

In the present study, the mean axial length in the right eye was 23.96 mm at diagnosis and remained stable at 23.93 mm through the 9-month follow-up. Similarly, the left eye showed a minimal reduction from 24.21 mm to 24.11 mm. The ATOM2 study, which compared different atropine concentrations over five years, found that 0.01% atropine limited axial length increase to 0.41 mm compared to 0.62 mm in the placebo group [9].

One of the hallmark outcomes in this study was the stabilization of refractive error and improvement in visual acuity. At baseline, the mean spherical equivalent was -3.12 D (RE) and -3.06 D (LE), which slightly increased to -3.23 D in both eyes by the end of 9 months. These findings are consistent with those from major clinical trials. In the ATOM2 trial, the 0.01% atropine group showed a mean myopia progression of -0.72 D over five years, substantially lower than placebo (-1.83 D) [9]. Likewise, the LAMP study demonstrated an annual myopic shift of -0.49 D in children treated with 0.01% atropine compared to -0.82 D in the placebo group [10].

Visual acuity also improved significantly. At diagnosis, only 24.71% of right eyes had 6/6 vision, which increased to 100% by the 6-month mark and remained above 75% at 9 months. For the left eye, 50% of patients had 6/6 vision at baseline, progressing to 100% by 9 months.

IOP remained within normal physiological limits throughout the study duration. The mean IOP in the right eye increased slightly from 15.27 mmHg at baseline to 15.71 mmHg at 9 months, while the left eye rose from 15.43 mmHg to 15.63 mmHg. These findings mirror those of Sharma et al. (2022), who also reported no significant IOP elevation in atropine-treated children [11].

Slit lamp examinations for both eyes remained normal in 100% of cases at all follow-up intervals. Similarly, fundus evaluations revealed no retinal or optic nerve abnormalities. This is consistent with the findings by Sanwaliya et al. (2020), who observed no adverse anterior or posterior segment findings in children treated with low-dose atropine for up to two years [12].

Anterior chamber depth (ACD) showed only minor fluctuations, with the right eye ranging from 23.88 mm to 24.00 mm and the left eye from 23.95 mm to 24.00 mm. Similar stability was observed in lens thickness, which showed minimal change from 23.91 mm to 23.99 mm (RE) and 23.95 mm to 24.03 mm (LE) over 9 months. These observations are supported by the Moriche-Carretero et al. (2023) study, which found no significant changes in ACD or lens thickness over five years of atropine use in European children [13].

In our study, keratometry (K1 and K2) values remained remarkably stable over the 9-month period. K1 values in the right eye ranged from 42.41 D to 42.54 D, and in the left eye from 42.38 D to 42.53 D.

Similarly, K2 values fluctuated between 42.29 D and 42.63 D in the right eye and 42.13 D to 42.54 D in the left eye. Findings are in line with results from Moriche-Carretero et al. (2023), who reported no keratometric changes in children using atropine over five years [13].

Limitations

- Short Follow-Up Duration
- Single-Center Design
- Lack of Control Group
- Pupil Size Measurement Omitted
- Subjective Reporting Not Included

CONCLUSION

Compared with existing global and Indian literature, the outcomes of this study strongly support the role of low-dose atropine as a first-line treatment for myopia management. The results are particularly reassuring in an Indian pediatric population, where concern about drug efficacy and tolerability in dark irides has often been raised. The once-daily dosing regimen, absence of significant side effects, and ease of administration further enhance its suitability for long-term pediatric use. Early intervention in school-aged children may not only prevent high myopia but also reduce the future burden of vision-threatening complications. Thus, this study contributes meaningfully to the growing body of evidence supporting pharmacological control of childhood myopia and lays a foundation for future multi-center, long-term studies in the Indian context.

Source of Funding: None
Conflict of Interest: None

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