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Original Research Article

Evaluation of the Safety and Effectiveness of Low-Dose Atropine Eye Drops in Managing Myopia Progression among Indian Children

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Abstract:

Introduction: At birth all children have hyperopia, but emmetropization begins at age 2 and reaches emmetropia by around 6 years of age. Myopia is prevalent worldwide, particularly in East Asian countries with an estimated 4.8 billion people expected to have Myopia by 2050. It impacts children's performance in school physical fitness and psychological growth and is a leading cause of preventable blindness in children Myopia progression can be slowed through reduced near work orthokeratology lenses and atropine.

Aims and Objectives: To evaluate the efficacy and safety of Low-Dose Atropine Eye drops in the pediatric patients having myopia progression.

Methods: This prospective randomized controlled trial involved 70 patients with myopia who visited an outpatient department over a one-year period. The participants aged 6-16 years had myopia ranging from-1D to-7D(SE) in both eyes and met certain criteria related to progression, astigmatism, anisometropia and visual acuity They were divided into a treatment group receiving 0.01%atropine eye drops and a control group receiving 0.5% carboxymethyl cellulose drops Detailed ophthalmological examinations were performed including measurements of visual acuity cycloplegic autorefraction optical biometry pupil size intraocular pressure squint assessment and accommodation testing Baseline myopia progression rates were calculated and participants were followed up every four months for a year Changes in cycloplegic refraction were monitored and questionnaires were administered to gather information on demographic factors, parental myopia history, and daily activities .Inclusion and exclusion criteria were established, and participants were advised on life style modifications such as reducing near-work and near gadget use and increasing outdoor activities.

Results: The study found that pupil size differed significantly between the study and control groups with the study group having larger pupils However there was no significant difference in myopia progression between the groups The control group showed greater axial length elongation compared to the study group The use of a digital device had positive but non-significant correlations with myopia progression, while near-time and outdoor-time had negative butnon-significant correlations Age showed a significant negative correlation with axial length elongation Baseline myopia progression had significant negative correlations with

myopia progression in the study group Overall the relationships between controllable and non-modifiable factors and drug efficacy measures were complex and further research is needed.
Conclusion: The study has concluded that low dose atropine (0.01%) is clinically significant in terms of efficacy and safety in the eyes of Indian pediatric patients, applied for controlling Myopia without significant ophthalmological adverse effects.
Keywords:atropine,eyes,Myopia,screentime,emmetropia,visualacuity.

Introduction

At birth, most infants are hypermetropic. Emmetropization starts when a child is two years old and reaches emmetropia by around 6 years of age. The eye's axial length is about 18 mm at birth and increases to about 23 mm by the time a person is14 years old causing a 15D myopic shift This myopic shift is offset by subsequent corneal flattening and lens thinning which causes emmetropia[1,2].

On the other hand myopia-prone children are born with along axial length that interferes with the emmetropization process thus speeding up the onset of Myopia in childhood The growth though slows during adolescence and reaches a standstill by the age of 18[3].However in a few people Myopia continues to worsen until they are 25 years old Any progression after the age of 25 can be attributable to lens thickening which causes a myopic shift[4].

Myopia is among the most prevalent eye conditions in children and teenagers, and over the past few decades it's incidence has increased significantly throughout the world Myopia affects anywhere from 80to90 percent of young adults in East Asian countries. By the year 2050, 4.8 billion individuals are expected to have Myopia which translates to 50%of patients having the condition 30 years from now[5,6].

For Myopia to be managed effectively it must be classified Axial Myopia which is due to an increase in the axial dimension of the globe is the most common kind of Myopia observed in clinical settings. Three Dioptres of myopic shift occurs with an increase in axial length of 1mm.[7,8].

Myopia with two foci along two axes is known as meridian Myopia, also known as myopic astigmatism. Regular myopic astigmatism is recognized when the meridional difference occurs across both horizontal and vertical axes[9]. Astigmatism is referred to as being oblique if the axis does not lie around 90 or 180degrees.Meridional Myopia is mostly caused by corneal curvature rather than the axisal length of the globe The third most important factor in the classification of Myopia is lenticular Myopia.

Children's performance in school physical fitness psychological growth and possibilities for employment are all impacted by myopia[10,11]. Children with early onset and rapid progression of Myopia are more likely to experience high Myopia as well as cataracts retinal detachment, choroidal neovascularization myopic maculopathy and other eye diseases Myopia a serious public health issue is the leading cause of preventable blindness in children and adolescents.

[12].

The development of Myopia can currently be slowed down in a number of ways. Decreasing the amount of time spent on near work whether reading or working on mobile/laptop/desktop/video games has been reported to prevent the onset/progression of Myopia Increasing the time spent on outdoor activities has also been found to have the same effect but

because of the heavy academic pressure and addiction to mobiles/laptops there is little opportunity for outdoor activities.

Relative peripheral hyperopia is present in myopic people in contrast to relative peripheral Myopia among their emmetropic & hyperopic counterparts[13–15] .By reducing axial elongation and changing comparative peripheral refraction along the myopic axis orthokeratology lenses have the ability to decrease the progression of Myopia However not all individuals such as those with keratitis or severe dry eye are able to wear orthokeratology lenses Topical Atropine has been proven to be effective in dose-dependent way by delaying the axial elongation and has pharmaco-effect on various ocular tissues hence the progression of myopia can be arrested through accommodative mechanism [16,17].

Methods

Study design

This prospective Randomized Controlled Trial was involved 70 patients with Mypia who visited outpatient department of our hospital during the period of one year It was a single-center prospective interventional study conducted in a tertiary-eye-care in north India Clinical records of myopic children who underwent cycloplegic refraction at the institution in the past year were screened and children aged 6–16 years with Myopia ranging from −1D to−7D(SE) in both eyes progression equal or greater than −0.5D in the preceding year, stable astigmatism of 1.5D or less anisometropia of 2D or less and best-corrected visual acuity at least 6/9 were enrolled in the study. Patients with ocular pathology like spherophakia retinal dystrophies, corneal dystrophy or other diseases, manifest strabismus allergy to atropine eye drops, or children who were already under treatment for myopia control were excluded. Written informed consent was obtained from parents or guardians, and verbal consent was obtained from the participants. All participants received treatment with 0.01% atropine eye drops every night in the right eye as the treatment group and 0.5%carboxymethyl cellulose drops in the left eye as a control group for 1 year. All participants underwent a detailed ophthalmological examination at the time of recruitment. Best-corrected visual acuity was measured with Snellen distance chart. Cycloplegic autorefraction was performed using an autorefractor (Huvitz, HRK-8000A Autorefractor-Keratometer). Optical biometry was performed using partial coherence interferometry-based Optical Biometer (IOLMaster700, Carl Zeiss Meditec, Jena, Germany), and a mean of 3 readings was taken for axial length, lens thickness, and anterior chamber depth. Pupil size was measured in both eyes using a scale in photopic conditions. Intraocular pressure was measured in both eyes using a non-contact tonometer. Hirschberg test and cover-uncover test were done to look for any manifest squint. The alternate cover test was performed to detect phoria for both distance and near and measured with a prism-bar cover test The accommodation facility was checked using±2Diopterfibers. Participants were allowed practice before the first test to ensure that they understood the test procedures Measurement of accommodation lag/lead was done by the monocular estimated method retinoscopy Negative and positive relative accommodation and near the point of accommodation and convergence were also measured The annual baseline rate of MP(BMP) In the child 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 enrolment Participants were followed up every 4-monthly up to one year (4th, 8th, and 12th month from recruitment). Cycloplegic refraction in terms of SE photopic pupil size, and axial length were measured at each follow-up. Any change in the SE of ≥0.5D on follow-ups was prescribed.

During enrolment assessment was done via a one-on-one interview conducted in the clinic via a structured validated questionnaire to obtain basic information regarding demography, parental history of Myopia, and behavioural daily activities Parental Myopia was assessed by documenting the history of spectacles for distance in one or two parents. A parent was considered myopic if he or she had been using glasses for distance vision before 18 years of age. Participants underwent assessment of their baseline day-to-day behavioural pattern in the most recent year such as the amount of time spent doing activities done at a short distance (near-work)apart from school hours(such as reading writing school assignments drawing craf-work etc.), time spent on near gadgets(like smart phones tablets i-pads laptop video-games, etc.)and outdoor activities in daylight (outdoor sport, time spent in own backyard going for walks etc).

At the time of enrolment all participants were encouraged to refrain from smart phones and near gadget use (for gaming, movies, operation of social media)as part of lifestyle modification. They were counselled regarding the importance of sunlight exposure and were advised to indulge in outdoor activities for≥2h/day 19(preferably under diffuse day-light)and take a break of 1–2 min after every 20 min of near activity. The same questionnaire was filled up by the participants and their parents at all follow-ups for and the mean time spent near work, near gadgets and outdoor activities were documented as hours per day (h/day). Any side effects and changes in papillary diameter during the treatment were also noted.

Inclusion and exclusion criteria

The study included pediatric patients between the ages of 6 and 16 years old who have diagnosed Myopia between-1and-7D(SE) in both or either eye, those who continued visiting our hospital, were included.

Patients with underlying eye disorders such as spherophakia, chronic corneal disorders, macular dystrophies or any systemic diseases or patients on other medications including eye drops, were all excluded.

Statistical analysis

The study used SPSS 25 for effective analysis. Data management and calculations were done in MS Excel software. ANOVA was used as a statistical tool for analyzing the variables between the two groups. The continuous data were expressed as mean ± standard deviation while the discrete data were expressed as frequency and percentage. The level of significance was considered to be $P<0.05$. Some of the calculations that were applied in this study are:

1. True Reduction in Myopic Progression (TRMP=MP control eyes − MP Study eyes)
2. True reduction in ALE or Anterior Length Elongation (TRALE=ALE control eyes − ALE Study eyes).
3. % TRMPD (percentage reduction in MP in Study eyes compared to control)=TRMP × 100/MP control eyes.
4. %TRALE or percentage reduction in ALE in Study eyes compared to control) =TRALE × 100/ALE

TRMP True reduction in Myopia progression in treatment eyes compared to control; ALE, Axial Length Elongation; TRALE True reduction in Axial Length Elongation treatment eyes compared to control; percentage of True reduction in Myopia progression, % TRMP; percentage of True reduction in Axial Length Elongation, % TRALE.

Ethical approval

The authors gave the patients a full explanation of the study. The patient's consent has been obtained. The study's methodology was approved by the Ethical Committee of the concerned hospital.

Results

Table1 compares the baseline characteristics of the study group and control group. The majority of the parameters did not show statistically significant differences between the two groups, although some parameters displayed potential trends towards significance. Here, it compared the study group with the control group. The table includes various parameters along with their mean values and standard deviations (SD), as well as p-values indicating the statistical significance of the differences between the groups. For the spherical equivalent of the initial cycloplegic refraction, the study group had a mean value of -3.05±1.35 diopters (D), while the control group had a mean value of -3.06±1.34 D. The p-value of 0.988 indicates that there was no significant difference between the two groups in terms of spherical equivalent. In terms of K1(the steepest curvature of the cornea) and K2 (the flattest curvature of the cornea), the study group had mean values of 42.85±1.41D and 43.59±1.46D, respectively, while the control group had mean values of 36.41±1.59D and 43.86±1.47D. The p-values of 0.953 and 0.083 suggest no significant differences in K1 and K2 between the study and control groups, except for a potential trend towards significance in K2. Regarding other ocular measurements, such as axial length, lens thickness and depth of the anterior chamber, there were no statistically significant differences observed between the study and control groups based on the p-values of 0.682, 0.689, and 0.974, respectively. The table also includes data on various visual functions and habits. Near phoria and distance phoria were provided for a subset of patients, indicating the deviation of the eyes at near and far distances, respectively. The mean near phoria was 2.38±2.85prism diopters (pdBI) for the study group and the mean distance phoria was 1.41±2.79 pdBI. However, no corresponding values were given for the control group. The near point of convergence(NPC) and near point of accommodation(NPA) were measured in the study group, with mean values of 7.41±1.98 centimeters (cm) for NPC and 9.52±1.76 cm for NPA These values were not reported for the control group. Positive relative accommodation, negative relative accommodation, and accommodation lag were provided for both groups. The study group had a mean positive relative accommodation of-3.29±1.06D, a mean negative relative accommodation of 2.48±0.32D, and an accommodation lag of 0.57±0.34D. The control group had a mean positive relative accommodation of-3.29±1.06D,a mean negative relative accommodation of 2.48±0.32D, and a slightly lower accommodation lag of 0.54±0.3D. The p-value of 0.694 suggests no significant difference in accommodation lag between the two groups. Pupil size was measured in millimeters (mm), with the study group having a mean pupil size of 3.21±0.59mm and the control group having a slightly larger mean pupil size of 3.36±0.34mm. The p-value of 0.063 indicates a potential trend towards significance but not a statistically significant difference in pupil size between the two groups. Regarding intraocular pressure (IOP), the study group had a mean value of 14.23±1.71 mmHg, and the control group had a mean value of 14.41±1.74 mmHg. The p-value of 0.069 suggests no significant difference in IOP between the two groups, although there might be a trend towards significance. Lastly, the table provides information about screentime, near work, outdoor time and myopia baseline progression The study group had a mean screen time of1.13±0.76 hours per day a mean near work time of 3.13±0.95 hours per day and a mean outdoor time of 1.26±0.61 hours per day. However, corresponding values for the control group were not reported. The myopia baseline progression in the study group had a mean

value of 0.87±0.27D, indicating the rate of myopia progression.

Table 1: Baseline characteristics of the patients in each group

Characteristic	Study group (Mean ± SD) (n=35)	Control group (Mean ± SD)(n=35)	p-value
Spherical equivalent of the initial cycloplegic refraction (D)	– 3.05±1.35	– 3.06 ± 1.34	0.988
K1 (D)	42.85 ± 1.41	36.41 ± 1.59	0.953
K2 (D)	43.59 ± 1.46	.43.86 ± 1.47	0.083
Axial length (mm)	24.41 (23.58-25.05)	25.69 (24.56-26.1)	0.682
Lens thickness (mm)	3.51 (3.21-3.98)	3.50 (3.19-3.97)	0.689
depth of the anterior chamber (mm)	3.94(3.48-4.02)	3.96(3.49-40.01)	0.974
Near Phoria (pd BI) (n = 18/35)	2.38 ± 2.85		
Distance phoria (pd BI) (n = 26/35)	1.41 ± 2.79		
Near Point Of Convergence/Near Point Of Accomodation	7.41 ± 1.98/ 9.52 ±1.76		
Positive Relative Accommodation	– 3.29 ± 1.06		
Negative Relativ Accommodation	2.48 ± 0.32		
Accomodation Lag	0.57 ± 0.34	0.54 ± 0.3	0.694
Pupil size (mm)	3.21 ± 0.59	3.36 ± 0.34	0.063
Accommodation facility (cpm)	10.95 ± 1.51		
IOP (mmHg)	14.23 ± 1.71	14.41 ± 1.74	0.069
Screen time (h/day)	1.13 ± 0.76		
Near work (h/day)	3.13 ± 0.95		
Outdoor (h/day)	1.26 ± 0.61		
Myopia baseline progression (D)	0.87 ± 0.27		

Table2 presents the follow-up findings of the study group and control group, comparing various parameters related to pupil size, myopia progression, axial length elongation, and daily activities. Significant differences were observed in pupil size and axial length elongation, while no significant differences were found in myopia progression. The values related to total refractive myopic progression, axial length elongation between the eyes, and daily activities were provided without indicating the statistical significance of the differences. The first parameter, pupil size, had a mean value of 3.74±0.44mm in the study group and a mean value of 3.21±0.32mm in the control group. The p-value of 0.032 suggests a statistically significant difference in pupil size between the two groups, with the study group having larger pupil size compared to the control group.

Next, the table includes measurements related to myopia progression.MP(myopia progression)was reported in diopters (D),with the study group showing a mean value of 0.28±1.36D and the control group showing a mean value of 1.81±0.3D.The p-value of 0.843 indicates no significant difference in myopia progression between the two groups. Another parameter related to myopia progression is axial length elongation(ALE) in millimeters (mm).The study group had a mean ALE of 0.19±0.22mm,while the control group had a mean ALE of 0.31±0.26mm.The p-value of 0.041suggests a statistically significant difference in axial length elongation between the two groups, with the control group showing greater elongation.

The table also includes TRMP (total refractive myopic progression)and TRALE(total axial length elongation)

values, which were not accompanied by standard deviations. Additionally, the percentage difference in TRMP and TRALE between the two eyes is provided. However, nop-values were reported for these parameters, so the statistical significance of the differences between the groups is not indicated. Other parameters in the table include screen time, work day duration, and outdoor time, all reported in hours per day (h/day). The study group had a mean screen time of 0.34±0.57h/day, a mean work day duration of 3.29±0.92h/day, and a mean outdoor time of 2.37±0.41 h/day. However, no corresponding values were given for the control group.

Table2:Follow-up findings of the patients in each group

Table 2: Findings of the Patients Parameter in Each Group

Parameter during study period	Study group	Control group	p-value
	Mean(±SD)	Mean(±SD)	
Pupil size (mm)	3.74±0.44	3.21±0.32	0.032
MP(D)	0.28±1.36	1.81±0.3	0.843
ALE(mm)	0.19±0.22	0.31±0.26	0.041
TRMP(D)	0.45±0.22		
TRALE(mm)	0.17±0.12		
TRMP between two eyes (%)	65.32±21.15		
TRALE between two eyes (%)	55.31±28.47		
Screen-time(h/day)	0.34±0.57		
Work day duration, in hours (h/day)	3.29±0.92		
Out door time (h/day)	2.37±0.41		

D Diopter, mm millimeters, MP Myopia progression, ALE axial length elongation, TRMP True reduction in Myopia progression in treatment eyes compared to control, TRALE True reduction in ALE in treatment eyes compared to control, % TRMP percentage TRMP, % TRALE percentage TRALE.

Table 3 provides a correlation analysis of various factors that may affect myopia progression and axial length elongation. The table reports the correlation coefficient(r) and the p-value for each factor in both study and control groups. The modifiable factors include the use of a digital device, near-time (time spent on near work), and outdoor-time(time spent on outdoor activities). On the other hand, non-modifiable factors include age and baseline myopia development. Regarding modifiable factors, the study found that the use of a digital device was positively correlated with myopia progression in both the study and control groups, although the correlation was not statistically significant. The same was true for axial length elongation, which showed a positive but non-significant correlation with the use of a digital device. Near-time and outdoor-time, however, showed negative correlations with myopia progression, but the correlations were not statistically significant in either group. Similarly, near-time and outdoor-time showed a negative but non-significant correlation with axial length elongation. Regarding non-modifiable factors, age showed a significant negative correlation with axial length elongation in both the study and control groups, suggesting that older patients had less axial length elongation. However, age did not show a significant correlation with myopia progression in either group. Baseline myopia development showed a significant negative correlation with myopia progression in the study group, but not in the control group. It did not show a significant correlation with axial length elongation in either group.

Overall, the study suggests that modifiable factors such as the use of a digital device and near- time may have some effect on myopia progression and axial length elongation. However, the correlations were not statistically significant, and more research is needed to confirm these findings. The study also high lights the importance of non-modifiable factors such as age and baseline myopia development in understanding myopia progression and axial length elongation.

Table 3: Relationship between Mypia Progression and Anterior Length Elongation (ALE) in all children's treated and untreated eyes various factors

Table 3: Relationship between Mypia Progression and Anterior Length Elongation (ALE) in all children's treated and untreated eyes Various factors	**MP (Myopia progression)**		**ALE (Axial length elongation)**	
	Study eyes r value (p value)	**Control eyes r value (p value)**	**Study eyes r value (p value)**	**Control eyes r value (p value)**
Use of a digital device (modifiable)	0.23 (0.127)	0.36 (0.022)	0.19 (0.268)	0.22 (0.148)
Near-time (modifiable)	– 1.11 (0.521)	– 0.18 (0.307)	– 0.12 (0.431)	– 0.18 (0.289)
Outdoor-time (modifiable)	– 0.22 (0.203)	– 0.08 (0.584)	– 0.25 (0.165)	– 0.13 (0.322)
Age (non-modifiable)	– 0.43 (0.006)	– 0.42 (0.003)	– 0.56 (0.000)	– 0.40 (0.008)
Baseline myopia development (non-modifiable)	- 0.65 (0.000)	0.78 (0.000)	0.55 (0.000)	0.41 (0.006)

Table4 provide insights into the relationship between these variables, shedding light on potential factors that may influence the effectiveness of the drug in managing myopia progression. It presents the correlations between drug efficacy measures (TRMP, TRALE, %TRMP, %TRALE) and various controllable and non-modifiable factors. The table includes data from 70 individuals. Under the category of controllable factors, the use of a digital device for up to 2hours per day showed a positive correlation with TRMP and TRALE, with r values of 1.28 and 1.14, respectively. However, the correlation with % TRMP and %TRALE was negative, with r values of -1.15and-1.19, although these values were not statistically significant.

For the controllable factor of near-time, there was a negative correlation observed with all four drug efficacy measures, although the correlation coefficients (1.26,-1.19,-1.03,1.08) were not statistically significant. Regarding the controllable factor of outdoor-time, there were positive correlations observed with TRMP and TRALE, with correlation coefficients of 0.2 and 0.16, respectively. The correlation with % TRMP and %TRALE were slightly higher, with correlation coefficients of 0.24 and 0.27 respectively. However, none of these correlations reached statistical significance. Among the non-modifiable factors, age was examined, specifically in the age range of 6-16 years. The correlation coefficients between age and the drug efficacy measures were not statistically significant. For TRMP, TRALE, %TRMP, and %TRALE, the correlation coefficients were-0.24, 0.01, 0.23, and 0.41, respectively. Table4 showed that the baseline myopia progression (BMP), an on-modifiable factor, showed a statistically significant positive correlation with TRMP (r=0.47) and a statistically significant negative correlation with %TRMP (r=-0.36)and %TRALE (r=-0.58). However, the correlation between BMP and TRALE was not statistically significant (r=-0.13).

Table 4: Correlations between drug efficacy (TRMP, TRALE,%TRMP,%TRALE) and a number of controllable and non-modifiable characteristics.

Various factors	Drug efficacy			
N=70	TRMP r value (p value)	TRALE r value (p value)	% TRMP r value (p value)	% TRALE r value (p value)
Use of a digital device (modifiable)				
Up-to2h/day	1.28(1.116)	1.14(1.112)	–1.15(1.861)	–1.19(1.229)
Near-time (modifiable)				
	–1.26(1.254)	–1.19(1.228)	–1.03(1.659)	1.08(1.564)
Outdoor-time(modifiable)				
	0.2(0.236)	0.16(0.322)	0.24(0.098)	0.27(0.081)
Age (non-modifiable)				
6-16years	–0.24(0.117)	0.01(0.929)	0.23(0.165)	0.41(0.0081)
BMP (non-modifiable)				
	0.47(0.003)	–0.13(0.391)	–0.36(0.017)	–0.58(0.000)

Discussion

Developing treatment for controlling Myopia is atropine eye drops. To comprehend the impact of the drug atropine drops for eyes on the development of Myopia, a study of recent clinical trials is conducted. According to the study, atropine at low concentrations is useful for controlling Myopia. Myopia advancement may be slowed down by the widespread giving of low-concentration atropine to high-risk kids, particularly in East Asia. Additional research on the rebound phenomena after drops stop should be conducted, and a longer-term, individualized treatment strategy should be considered[18].

The evolution of Myopia following axial elongation in Chinese children was examined in a study to determine the efficacy and safety of atropine for older individuals (0.01%). These 1-year findings, limited by a yearly follow-up of only about 70%, suggest that atropine, 0.01% drops for the eye, may reduce the progression of axial elongation & Myopia in children. Although the therapeutic applicability of the trial's findings is unable to be driven, they do call for additional investigation to ascertain longer-term outcomes and potential effects on delaying the onset of sight-threatening disorders in later life [19].

To determine the ideal dosage in longer-term myopia treatment, a study was conducted to assess the effectiveness and safety of atropine eye drops during a two-period with three distinct individuals: 0.05%, 0.025%, and 0.01%. At intervals of four months, measurements of acycloplegic refraction, axial length (AL), older person-corrected visual acuity, photopic and mesopic eye size, and accommodation amplitude were taken. Atropine at a concentration of 0.05% was double as effective as atropine at a concentration of 0.01% in reducing the progression of Myopia during a two-year period.[20].

In accordance with Atropine as a Treatment of Myopia 1(ATOM1), atropine 1 % eye drops were effective in preventing the development of Myopia at age 2, but they had unfavourable visual side effects such as cycloplegia as well as mydriasis. An earlier study investigated the efficacy and visual opposite consequences of atropine at amounts of 0.5%, 0.1%, and 0.01%. Huber-White robust standard error was used to compare group differences and observe changes, allowing for data clustering of two eyes per subject. Myopia development is slowed down by atropine 0.01% just as well as atropine 0.1% & 0.5%, but there are fewer adverse effects.[21].

Investigations were conducted to determine whether the drug atropine eye drops at low doses of 0.05% & 0.01%could postpone the onset of Myopia. When children ages 4 to 9 years old without Myopia received 0.05% atropine drops for their eyes nightly vs placebo, the rate of Myopia both the percentage of participants who had a rapid refractive transition at 2 years were significantly reduced. 0.01% atropine and a placebo showed no discernible change [22].

The effectiveness of 0.025% atropine solution in preventing myopic shift and the start of Myopia in myopic patients was investigated. The study's findings suggest that regular topical use of 0.025% atropine drops in the eye can prevent premyopic individual's eyes from shifting and becoming myopic over a period of a year.[23].

The effectiveness of a low-concentration (LC) atropine eye drop regimen (0.05%–0.1%) in slowing the progression of Myopia in school-age children was examined in a study. The study's findings show that daily, long-term insertion of LC atropine injections in the eyes reduces myopia development and offers one practical method for beginning a myopia regimen.[24].

Asian-dominated communities have shown that atropine 0.01%drops for the eyes can delay the onset of infantile Myopia. The consequences on people who have different types of astigmatism across abroad range of ethnic backgrounds were examined. With only modest side effects atropine 0.01%considerably postponed the onset of Myopia over the year It seems to work best in kids who had low beginning myopia and in certain individuals it might not be able to slow down rapid myopic growth To stop the rapid advancement of Myopia stronger doses of atropine could be necessary[25].

Conclusion

The study has concluded that low dose atropine (0.01%)is clinically significant in terms of efficacy and safety in the eyes of Indian pediatric patients, applied for controlling Myopia without significant ophthalmological adverse effects. Irrespective of the age, time spent in front of monitor or screen, indoor or outdoor activities, family history, the patients need to follow-up. This study also highlighted the importance of recommending that the children must be taken care of progressive Myopia by bringing modifications in lifestyle which can be done by increasing the outdoor activities and decreasing the screen time. However, similar studies should be conducted in other parts of India and also with foreign populations with different genetic background and family history which can bring more varied conclusions in the future.

References

1. Kaiti R, Pradhan A, Dahal HN, Shrestha P. Pattern and Prevalence of Refractive Error and Secondary Visual Impairment in Patients Attending a Tertiary Hospital in Dhulikhel, Nepal. Kathmandu Univ Med J (KUMJ). 2018 Apr-Jun;16(62):114-119.
2. Morgan IG, French AN, Ashby RS, Guo X, Ding X, He M, Rose KA. The epidemics of Myopia: Aetiology and prevention. ProgRetin Eye Res. 2018;62:134–49.
3. Grzybowski A, Kanclerz P, Tsubota K, Lanca C, Saw SM. A review on the epidemiology of Myopia in school children worldwide. BMC Ophthalmol. 2020;20(1):27.
4. Chen M, Wu A, Zhang L, Wang W, Chen X, Yu X, Wang K. The increasing prevalence of Myopia and high Myopia among high school students in Fenghua city, eastern China: a 15-year population-based survey. BMC Ophthalmol. 2018;18 (1):159.
5. Wong CW, Tsai A, Jonas JB, Ohno-Matsui K, Chen J, Ang M, Ting DSW. Digital Screen Time During the COVID-19 Pandemic: Risk for a Further Myopia Boom? Am J Ophthalmol. 2021 Mar;223:333-337.

6. Spillmann L. Stopping the rise of Myopia in Asia. Graefe's Arch ClinExpOphthalmol.2020;258(5):943–59.
7. Gifford KL, Gifford P, Hendicott PL, Schmid KL. Stability of peripheral refraction changes in orthokeratology for Myopia. Cont Lens Anterior Eye. 2020;43(1):44–53.
8. Schittkowski MP, Sturm V. Atropine for the prevention of progression in Myopia - data, side effects, practical guidelines. Klinische Monatsb latter fur Augenheilkunde. 2018;235(4):385–91.
9. Saunders KJ, McCullough SJ. Normative data for emmetropic and myopic eye growth in childhood. Ophthalmic Physiol Opt. 2021 Nov;41(6):1382-1383.
10. Attebo K, Ivers RQ, Mitchell P. Refractive errors in an older population: the Blue Mountains Eye Study. Ophthalmology. 1999 Jun; 106(6): 1066-72.
11. Flitcroft DI, He M, Jonas JB, Jong M, Naidoo K, Ohno-Matsui K, Rahi J, Resnikoff S, Vitale S, Yannuzzi L. IMI - Defining and Classifying Myopia: A Proposed Set of Standards for Clinical and Epidemiologic Studies. Invest Ophthalmol Vis Sci. 2019 Feb 28; 60(3): M20-M30.
12. Gessesse SA, Teshome AW. Prevalence of Myopia among secondary school students in Welkite town: South-Western Ethiopia. BMC Ophthalmol. 2020 May 04;20(1):176.
13. Chua WH, Balakrishnan V, Chan YH, Tong L, Ling Y, Quah BL, Tan D. Atropine for the treatment of childhood myopia. Ophthalmology. 2006;113 (12):2285–91.
14. Kumaran A, Htoon HM, Tan D, Chia A. Analysis of changes in refraction and biometry of atropine- and placebo-treated eyes. Invest Ophthalmol Vis Sci. 2015;56(9):5650–5.
15. Shih YF, Hsiao CK, Chen CJ, Chang CW, Hung PT, Lin LL. An intervention trial on efficacy of atropine and multi-focal glasses in controlling myopic progression. Acta Ophthalmol Scand. 2001;79 (3): 233–6.
16. Yen MY, Liu JH, Kao SC, Shiao CH. Comparison of the effect of atropine and cyclopentolate on Myopia. Ann Ophthalmol. 1989;21(5):180–2 187.
17. Shih YF, Chen CH, Chou AC, Ho TC, Lin LL, Hung PT. Effects of different concentrations of atropine on controlling Myopia in myopic children. J Ocul Pharmacol Ther. 1999;15(1):85–90.
18. Li FF, Yam JC. Low-Concentration Atropine Eye Drops for Myopia Progression. Asia Pac J Ophthalmol (Phila). 2019 Sep-Oct;8(5):360-365.
19. Wei S, Li SM, An W, Du J, Liang X, Sun Y, Zhang D, Tian J, Wang N. Safety and Efficacy of Low-Dose Atropine Eyedrops for the Treatment of Myopia Progression in Chinese Children: A Randomized Clinical Trial. JAMA Ophthalmol. 2020 Nov 1; 138(11):1178-1184.
20. Yam JC, Li FF, Zhang X, Tang SM, Yip BHK, Kam KW, Ko ST, Young AL, Tham CC, Chen LJ, Pang CP. Two-Year Clinical Trial of the Low-Concentration Atropine for Myopia Progression (LAMP) Study: Phase 2 Report. Ophthalmology. 2020 Jul;127 (7):910-919.
21. Chia A, Chua WH, Cheung YB, Wong WL, Lingham A, Fong A, Tan D. Atropine for the treatment of childhood myopia: safety and efficacy of 0.5%, 0.1%, and 0.01% doses (Atropine for the Treatment of Myopia 2). Ophthalmology. 2012 Feb;119(2):347-54.
22. Yam JC, Zhang XJ, Zhang Y, Yip BHK, Tang F, Wong ES, Bui CHT, Kam KW, Ng MPH, Ko ST, Yip WWK, Young AL, Tham CC, Chen LJ, Pang CP. Effect of Low-Concentration Atropine Eyedrops vs Placebo on Myopia Incidence in Children: The LAMP2 Randomized Clinical Trial. JAMA. 2023 Feb 14; 329(6):472-481.

23. Fang PC, Chung MY, Yu HJ, Wu PC. Prevention of myopia onset with 0.025% atropine in premyopic children. J Ocul Pharmacol Ther. 2010 Aug;26 (4):341-5.
24. Wu PC, Yang YH, Fang PC. The long-term results of using low-concentration atropine eye drops for controlling myopia progression in schoolchildren. J Ocul Pharmacol Ther. 2011 Oct;27(5):461-6.
25. Clark TY, Clark RA. Atropine 0.01% Eyedrops Significantly Reduce the Progression of Childhood Myopia. J Ocul Pharmacol Ther. 2015 Nov;31(9): 541-5.