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A comparative study on slow down progression of myopia using atropine 0.01% in children

Deepika S[1], Syeda Sadia Ikram[1,*], Sanjeev Kumar Puri[1]

[1] *Dept. of Optometry, Saveetha College of Allied Health Sciences, Thandalam, Tamil Nadu, India*

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ABSTRACT

Aim: The aim of the study was to determine the efficacy of lower concentration of Atropine 0.01% in promoting unaided visual acuity and slowing down the progression of myopia in children over 6 months.
Settings and Designs: It was a hospital-based comparative study in the outpatient department of Ophthalmology, AL, LT, ACD, PPD, SPD, PGP were taken by Lenstar and Lensometer.
Materials and Methods: The Comparative study was performed on 60 children from 9 to 15 years age group with initial myopic spherical equivalence from 0.5 to 6.00 D. The children were screened for visual acuity for distance and near using Snellen's chart. Cycloplegic Refraction was done to know the presence of Refractive Errors. This study was approved by IRB Ethical Committee. (SCAHS/IRB/2022/JULY/420).The inclusion criteria include Ammetropic children with no binocular vision anomalies and no history of ocular disease. The primary outcome was the rate of myopic progression after 6 months. The participants were instructed to use Atropine 0.01% eye drops during night times for 6 months and the rate of myopic progression and the spherical equivalence, axial length, lens thickness, anterior chamber depth, photopic and scotopic pupil diameter were re-assessed to compare the progression of myopia in the children.
Results: Sixty children enrolled for six months study in which the mean progression of myopia was found to be within 0.27D and axial elongation shows 0.23 mm changes respectively, whereas there were no significant changes in the anterior chamber depth, lens thickness, photopic and scotopic pupil diameter before and after assessment in children.
Conclusion: Spherical power, Axial Length, Anterior Chamber Depth, Lens Thickness, Photopic Pupil Diameter and Scotopic Pupil Diameter all showed significant progression from pre to post stages, with the average post reading deviating by 0.25 from the normal limits.

1. Introduction

Early onset myopia in childhood is associated with high myopia >6D in adult life. The incidence of myopia increasing worldwide with half the global population predicted to be affected by 2050.[1] Presently, the three different methods that have the greatest efficacy are Orthokeratology, and atropine specially designed soft lenses. This review will focus only on atropine.[2] Atropine appears to have the strongest clinical effect on reducing the rate of myopic progression.

2. Materials and Methods

The comparative study was performed on 60 children of 9 to 15 years age group with initial myopic spherical equivalence from 0.5D to 6.00D. The children were screened for visual acuity for distance and near using Snellen's visual acuity chart. Cycloplegic refraction was done to know the existence of refractive errors. This study was approved by IRB Ethical Committee (SCAHS/IRB/2022/JULY/420).

* *Corresponding author.*
E-mail address: sadiyaikram20@gmail.com (S. S. Ikram).

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The inclusioncriteria include Ammetropic children with no binocular vision anomalies and no history of ocular disease. The primary outcome was the rate of myopic progression after 6 months**.** The participants were instructed to use Atropine 0.01% eye drops during night times for 6 months and the rate of myopic progression and the spherical equivalence, axial length, lens thickness, anterior chamber depth, photopic and scotopic pupil diameter were re-assessed to compare the progression of myopia in the children.

3. Results

Sample of 60 patients was included in this study. Comparison of pre and post recordings of Spherical power,cylindrical power, Axial Length, Anterior Chamber Depth, Lens Thickness, Photopic and Scotopic Pupil Diameter was done. The following tables and figures support the analysis. The mean progression of myopia was found to be within 0.27D and axial elongation shows 0.23 mm changes respectively, whereas there were no significant changes in the anterior chamber depth, lens thickness, photopic and scotopic pupil diameter before and after evalution in children.

3.1. Comparison of spherical power

This section explores the comparison of pre and post readings of Spherical power of myopic Children. Paired samples t-test is applied to find the significant increase frompre to post readings of Spherical power of myopic Children.

Null hypothesis $H_0$1: There is no significant difference increase frompre to postreadings of Spherical power of myopic Children.

Table 1: Comparison of spherical power

		Mean	S.D	t value
Spherical power	Pre (OD)	-3.66	1.311	6.584** (p = .000)
	Post (OD)	-3.93	1.358	
Spherical power	Pre (OS)	-3.72	1.683	4.513** (p = .000)
	Post (OS)	-3.99	1.583	

** Significant at 1% level

It is noted from the Table 1, the t-values 6.584 (p = .000) and 4.513 (p = .000) are significant 1% level and the null hypothesis $H_0$1 is rejected. Therefore there is significant increase frompre to post readings of Spherical power of myopic Children. It is noted that mean Spherical power (OD) in the post stage is -3.93 which has increased from the mean Spherical power (OD) in the pre stage (-3.66). Also it is noted that mean Spherical power (OS) in the post stage is -3.99 which has increased from the mean Spherical power (OS) in the pre stage (-3.72). So it is concluded that the Spherical power of the myopic Children has not rapid, which seems to be very much lesser than one (1) diopter.

3.2. Comparison of cylindrical power

This section explores the comparison of pre and post readings of cylindrical power of myopic Children. Paired samples t-test is applied to find the significant increase frompre to post readings of cylindrical power of myopic Children.

Null hypothesis $H_0$2: There is no significant difference increase frompre to postreadings of cylindrical power of myopic Children.

Table 2: Comparison of cylindrical power

		Mean	S.D	t value
Cylindrical power	Pre (OD))	-0.97	1.155	0.323 (p = .748)
	Post (OD)	-0.92	0.901	
Cylindrical power	Pre (OS)	-0.82	0.945	0.436 (p = .664)
	Post (OS)	-0.78	0.979	

It is noted from the Table 2, the t-values 0.323 (p = .748) and 0.436 (p = .664) are insignificant at 5% level and the null hypothesis $H_0$2 is accepted. Therefore there is no significant increase frompre to post readings of Cylindrical power of myopic Children. So it is concluded that the cylindrical power of the myopic Children has not increased significantly from per to post stages.

3.3. Comparison of axial length

This section explores the comparison of pre and post readings of Axial Length of myopic Children. Paired samples t-test is applied to find the significant increase frompre to post readings of Axial Length of myopic Children.

Null hypothesis H03: There is no significant difference increase frompre to post readings of Axial Length of myopic Children.

Table 3: Comparison of axial length

		Mean	S.D	t value
Axial Length	Pre (OD)	24.55	0.922	5.860** (p = .000)
	Post (OD)	24.78	0.881	
Axial Length	Pre (OS)	24.57	0.914	4.841** (p = .000)
	Post (OS)	24.78	0.882	

** Significant at 1% level

It is noted from the Table 3, the t-values 5.860 (p = .000) and 4.841 (p = .000) are significant at 1% level and the null hypothesis $H_0$1 is rejected. Therefore there is significant increase frompre to post readings of Axial Length of myopic Children. It is noted that mean Axial Length (OD) in the post stage is 24.78 which has increased from the mean Axial Length (OD) in the pre stage (24.55). Also it is noted that mean Axial Length (OS) in the post stage is 24.78 which has increased from the mean Axial Length (OS) in the pre stage (24.57). So it is concluded that the Axial Length of the myopic Children has increased significantly from per to post

stages. Though there is significant difference noted between pre and post Axial length among subjects, the progression from pre to post is OD(0.23), OS(.21) is slow not rapid, post average axial length seems to be very much in the normal limit of 22-25.

3.4. Comparison of anterior chamber depth

This section explores the comparison of pre and post readings of Anterior Chamber Depth of myopic Children. Paired samples t-test is applied to find the significant increase frompre to post readings of Anterior Chamber Depth of myopic Children

Null hypothesis $H_0$4: There is no significant difference increase frompre to postreadings of Anterior Chamber Depth of myopic Children.

Table 4: Comparison of anterior chamber depth

		Mean	S.D	t value
Anterior Chamber Depth	Pre (OD)	3.48	0.281	2.180* (p = .033)
	Post (OD)	3.59	0.358	
Anterior Chamber Depth	Pre (OS)	3.52	0.312	1.686 (p = .097)
	Post (OS)	3.61	0.405	

* Significant at 5% level

It is noted from the Table 4, the t-values 2.180 (p = .033) is significant at 5% level, $H_0$4 is rejected and 1.686 (p = .097) is insignificant at 5% level, the null hypothesis $H_0$1 is accepted. Therefore there is significant increase frompre to post readings of Anterior Chamber Depth (OD) of myopic Children. It is noted that mean Anterior Chamber Depth (OD) in the post stage is 3.59 which has increased from the mean Anterior Chamber Depth (OD) in the pre stage (3.48). So it is concluded that the Anterior Chamber Depth (OD) of the myopic Children has increased significantly from per to post stages. Though there is significant difference noted between pre and post Anterior Chamber Depthamong subjects, the progression from pre to post is OD(0.11) is slow not rapid, post average anterior chamber depth seems to be very much in the normal limit of 3-4.

3.5. Comparison of lens thickness

This section explores the comparison of pre and post readings of Lens Thickness of myopic Children. Paired samples t-test is applied to find the significant increase frompre to post readings of Lens Thickness of myopic Children.

Null hypothesis $H_0$5: There is no significant difference increase frompre to postreadings of Lens Thickness of myopic Children.

It is noted from the Table 5, the t-values 3.399 (p = .001) and 3.391 (p = .002) are significant at 1% level and the null hypothesis $H_0$5 is rejected. Therefore there is significant increase frompre to post readings of Lens

Table 5: Comparison of lens thickness

		Mean	S.D	t value
Lens thickness	Pre (OD)	3.34	0.248	3.399** (p = .001)
	Post (OD)	3.52	0.427	
Lens thickness	Pre (OS)	3.39	0.290	3.391** (p = .002)
	Post (OS)	3.59	0.509	

** Significant at 1% level

Thickness of myopic Children. It is noted that mean Lens Thickness (OD) in the post stage is 3.52 which has increased from the mean Lens Thickness (OD) in the pre stage (3.34). Also it is noted that mean Lens Thickness (OS) in the post stage is 3.59 which has increased from the mean Lens Thickness (OS) in the pre stage (3.39). So it is concluded that the Lens Thickness of the myopic Children has increased significantly from per to post stages. Though there is significant difference noted between pre and post Lens Thickness among subjects, the progression from pre to post is OD (0.18) and OS(.2) is slow not rapid, post average lens thickness seems to be very much in the normal limit of 3-4.

3.6. Comparison of photopic pupil diameter

This section explores the comparison of pre and post readings of Photopic Pupil Diameter of myopic Children. Paired samples t-test is applied to find the significant increase from pre to post readings of Photopic Pupil Diameter of myopic Children.

Null hypothesis $H_0$6: There is no significant difference increase frompre to postreadings of Photopic Pupil Diameter of myopic Children.

Table 6: Comparison of photopic pupil diameter

		Mean	S.D	t value
Photopic Pupil Diameter	Pre (OD)	4.92	0.980	3.236** (p = .001)
	Post (OD)	5.26	1.0737	
Photopic Pupil Diameter	Pre (OS)	5.00	0.995	3.215** (p = .002)
	Post (OS)	5.42	1.108	

** Significant at 1% level

It is noted from the Table 6, the t-values 3.236 (p = .001) and 3.215 (p = .002) are significant at 1% level and the null hypothesis $H_0$1 is rejected. Therefore, there is significant increase from pre to post readings of Photopic Pupil Diameter of myopic Children. It is noted that mean Photopic Pupil Diameter (OD) in the post stage is 5.26 which has increased from the mean Photopic Pupil Diameter (OD) in the pre stage (4.92). Also it is noted that mean Photopic Pupil Diameter (OS) in the post stage is 5.42 which has increased from the mean Photopic Pupil Diameter (OS) in the pre stage (5.00). So it is concluded that the Photopic Pupil Diameter of the myopic Children has increased significantly from per to post stages. Though

there is significant difference noted between pre and post Photopic Pupil Diameter among subjects, the progression from pre to post is OD (0.34) and OS (.42) is slow not rapid, post average Photopic Pupil Diameter seems to be very much in the normal limit of 4-6.

3.7. Comparison of scotopic pupil diameter

This section explores the comparison of pre and post readings of Scotopic Pupil Diameter of myopic Children. Paired samples t-test is applied to find the significant increase from pre to post readings of Scotopic Pupil Diameter of myopic Children.

Null hypothesis $H_0$7: There is no significant difference increase from pre to post readings of Scotopic Pupil Diameter of myopic Children.

Table 7: Comparison of scotopic pupil diameter

		Mean	S.D	t value
Scotopic Pupil Diameter	Pre (OD)	5.90	1.228	3.589** (p = .000)
	Post (OD)	6.24	0.812	
Scotopic Pupil Diameter	Pre (OS)	5.99	0.916	3.437** (p = .001)
	Post (OS)	6.25	0.797	

* Significant at 5% level ** Significant at 1% level

It is noted from the Table 7, the t-values 3.589 (p = .000) and 3.437 (p = .001) are significant at 1% level and the null hypothesis $H_0$7 is rejected. Therefore there is significant increase from pre to post readings of Scotopic Pupil Diameter of myopic Children. It is noted that mean Scotopic Pupil Diameter (OD) in the post stage is 6.24 which has increased from the mean Scotopic Pupil Diameter (OD) in the pre stage (5.90). Also it is noted that mean Scotopic Pupil Diameter (OS) in the post stage is 6.25 which has increased from the mean Scotopic Pupil Diameter (OS) in the pre stage (5.99). So it is concluded that the Scotopic Pupil Diameter of the myopic Children has increased significantly from per to post stages. Though there is significant difference noted between pre and post Photopic Pupil Diameter among subjects, the progression from pre to post is OD (0.34) and OS (.26) is slow not rapid, post average Scotopic Pupil Diameter has increased to an extent of 0.25 than the normalized limit (4-6).

4. Discussion

Myopia progression usually occurs due to excessive axial length elongation of the eye.[3,4]Excessive axial growth can occur at a very young age and implies that children should receive atropine treatment as young as possible to reduce this offset.[5] it is important to use an atropine concentration by the individual to control myopia growth.[6]Increased UV exposure may increase collagen cross-linking within the Sclera nearby limiting scleral growth during myopia progression.[7] The greater change in pupil diameter may be due to better absorption of the drug, greater collagen cross-linking within the sclera, and superior effect on controlling myopia progression.[8,9] Therefore delaying the onset of myopia and initiating intervention to stop or retard myopia progression from childhood to adolescence are important goals.[10]

The first report of atropine treatment for myopia was by wells in the nineteenth century.[11] Since, then, several other studies also have evaluated the efficacy of atropine in preventing childhood myopic progression.[12] In one of the studies author Wei Haun Chau et al 2006 indicated that one nighty dose of one% atropine night drops achieved a reduction in progression of low and childhood myopia compared with the placebo group which is both statistically and clinically significant over a 2 year period. 77 % reduction in mean progression of myopia compared with placebo treatment.[11] it also showed that no serious adverse effects were observed. Our electrophysiological assessment of a subset study patients in which multifocal electro retinography results indicated that long-term use had little effect on retinal function.[13]

The previous study done by author shu Yi mm et al 2015 concluded that there was a reaction of myopia in the treatment group no change in mean axial length compare with the mean increase of approximately 0.32 mm in control group.[14] According to their experience there are potential hazards associated with atropine treatment including potential toxicity to the retina and lens. Due to long term dilation of pupil and exportation to you UV light and the potential influence on body systems. Photophobia due to access is the main address effect in summer.[11,15,16] The another study was done by the author Jason. c said that the effect of nightly atropine 0.01 %another[10] drops in significantly reduced myopic progression from diverse ethnic backgrounds.[17] Atropine 0.01 percentage has no initial hyperopic shift and minimal effect on accommodation.[11] potential measurement errors should be balanced and not affect the overall results.

This is similar to our study there is a reduction in myopic progression. Atropine appears to exert an anti -myopic effect through a non-accommodative mechanism by passing the lens and ciliary body to act on receptors within the retina.[18] The identification of the potential site of action for atropine the M4 subtype of muscarinic receptor[19]may allow a more of targeted therapy with fewer side. Effects in conclusion a 0.01% atropine significantly reduced the myopic Progression over 1 year with minimal side effects.[17]

5. Conclusions

Significant progression from pre to post stages has noticed in Spherical power, Axial Length of the myopic Children, Anterior Chamber Depth, Lens Thickness and Photopic Pupil Diameter and Scotopic Pupil Diameter among the myopic Children. However significant difference is not

found in cylindrical power. Though there is significant difference noted between pre and post spherical power among subjects, the progression from pre to post is slow not rapid, which seems to be very much lesser than one (1) diopter. In case of Axial Length, Anterior Chamber Depth, Lens Thickness and Photopic Pupil Diameter the progression observed from pre to post stages are significant, the progression is slow and within the normal limits. In case of Scotopic Pupil Diameter, progression is slow and the average post reading is deviated by 0.25 from the normal limits.

6. Conflict of Interest

The authors declare no relevant conflict of interest with respect to research, authorship and or publication of this article

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None.

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Author biography

Deepika S, Student

Syeda Sadia Ikram, Lecturer https://orcid.org/0000-0003-3538-1918

Sanjeev Kumar Puri, Professor https://orcid.org/0000-0003-2553-4482

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