

# A prospective study to assess the variation between cycloplegic acceptance and post mydriatic test in patients

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**Abstract—Introduction:** The pediatric eye exam must include cycloplegic refraction. After cycloplegic refraction, older children have a post-mydriatic test (PMT) to subjectively refine the refraction. **Aim:** Accuracy of the subjective refraction performed soon after cycloplegic refraction, termed cyclo-acceptance, was compared with the PMT. **Methodology:** **Prospective:** Indira Gandhi Eye Hospital & Research Centre, Gurugram, India. Patients ages up to 40 years, with no binocular anomalies, retinal and corneal anomalies. **Results:** Four hundred and eighteen eyes of 209 subjects were analyzed. The average of sphere after cycloacceptance were compared with the average of sphere at PMT in different age groups. The difference was found to be statistically significant by Wilcoxon signed rank test and paired *t*-test in emmetropic and hyperopic patients. The difference in sphere was not significant only in myopia of all degrees.

**Discussion:** The difference between hyperopes and myopes may be explained by variations in accommodative state.

**Conclusion:** PMT may be considered in hyperopes since there was low agreement between cycloplegic acceptance PMT.

**Index Terms—**cycloplegic refraction, post-mydriatic test, myopic, hyperopic, emmetropic

## I. INTRODUCTION

The static power of the eye and the accommodative power of the eye combine to form the refracting power of the eye. The amplitude of accommodation is the overall increase in plus power that accommodation causes. The smooth muscle fibres that are

parasympathetically innervated in humans have muscarinic receptors. Adrenoceptors have also been mentioned as existing.

An authentic method of getting a precise refraction is called cycloplegic refraction (CF). Cycloplegia is necessary for patients with refractive or accommodative esotropia, pseudo myopia, latent hyperopia, and anisometropia to receive the right refractive error diagnosis. Infants, toddlers, preschoolers, noncommunicative patients, and recalcitrant patients all require cycloplegic refraction<sup>5</sup>. When used in cycloplegic refraction, cycloplegic medicines cause complete paralysis of the ciliary muscle or accommodation muscle and enlarge the pupil. When the observer feels that accommodation is exceptionally active and will obstruct the precise retinoscopy, these are utilised for retinoscopic refraction. Both hypermetropes and small children experience this situation. Wet retinoscopy refers to retinoscopy that is performed after cycloplegic medications (such as cyclopentolate, atropine, etc.) have been given. The following cycloplegic drops are frequently used in clinical settings: atropine, tropicamide, cyclopentolate, homatropine, and phenylephrine. Atropine and/or cyclopentolate are typically used to refractively dilate children.

Cycloplegia reduces the eye's ability to accommodate by halting the ciliary muscle from contracting, which enables the measurement of the eye's static or objective refractive error. Utilizing cycloplegic medications is the most effective technique to induce paralysis or accommodation<sup>6</sup>. Because they prevent acetylcholine's muscarinic impact, cycloplegic

medications are often referred to as anticholinergic treatments. The iris sphincter and ciliary muscle's cholinergic activation, which contributes to mydriasis and cycloplegia, is inhibited by this impact. Cycloplegia reduces under- and overcorrection in myopes and hypermetropes by releasing the latent element in the former and relaxing the latter's accommodating spasm. The majority of researchers endorsed cycloplegic refraction as an effective treatment for childhood ametropia. For determining a child's refractive condition, cycloplegic and subjective refraction remain the gold standard. However, cycloplegia is constrained by the length of time required to reach full cycloplegia, its link to patient agitation, annoyance, and additional expense<sup>7</sup>. Cycloplegia reduces undercorrections in hyperopes and overcorrections in myopes by relaxing accommodating spasm and assisting in the discovery of the latent component in hypermetropes. For children with ametropia, the majority of practitioner advise cycloplegic refraction.

## II. AIM OF THE STUDY

- To find out and assess the mean difference between cycloacceptance and post mydriatic test in dioptries.
- Compare the variation in various refractive error (myopia & Hyperopia) and in different age groups (up to 40 years).

## III. REVIEW OF LITERATURE

- *Kothari M et al.* assessed the need of post mydriatic test (PMT) in children with mild to moderate compound myopic astigmatism. They performed subjective refraction before, immediately after cycloplegia and 3 days after cycloplegia. The refractive error was analyzed using two-tailed paired t test by dividing the refractive-errors into sphere, cylinder and axis. Spherical equivalent was analyzed separately. In this study eighty four eyes of 42 children aged 3 to 16 years (Mean 9.6, SD 3.2) were included. Finally in comparison to cycloplegic refraction, PMT was closer to non-cycloplegic refraction and differed by only 0.01 DS ( $\pm 0.9$ ) in sphere and 0.2 D ( $\pm 0.7$ ) in cylinder. So they concluded that PMT

is not warranted in children with compound myopic astigmatism.<sup>1</sup>

- *Nagarjan et al.* Compared endpoint of subjective cycloplegic refraction with artificial aperture and post-mydriatic test among adults with refractive error. For this study author add adult individuals between 18 and 35 years of with emmetropia and various degrees of ametropia. Individuals with known ocular pathology were excluded. Non-cycloplegic objective refraction was performed followed by subjective refraction. Cycloplegic objective refraction was performed followed by subjective refraction with custom designed artificial apertures. After a washout period of cycloplegic, PMT was performed. Fifty-nine eyes of thirty individuals with a mean ( $\pm$ SD) age of 23( $\pm 4$ ) years with a male: female ratio of 1:4 participated in this study. A comparison of measures of PMT and subjective refraction with 2, 3, 4, 5, and 6 mm aperture under cycloplegic effect using the Friedman test rendered a Chi square value ( $df = 5$ ) of 1.92 which was not statistically different ( $P = 0.86$ ). So author concluded that performing subjective refraction with an appropriate spherical and cylindrical endpoint under cycloplegic effect with appropriate aperture overcomes the necessity of PMT.<sup>2</sup>
- *Swaminathan M et al.* compared cycloacceptance versus postmydriatic test for pediatric refraction. Author include **children** ages 6 to 16, with no binocular anomalies and vision of 6/18 or better in each eye. Seven hundred eight eyes of 354 subjects were analyzed. The average of sphere (0.41) and spherical equivalent (0.00) after cycloacceptance were compared with the average of sphere (0.23) and spherical equivalent ( $-0.20$ ) at PMT. The difference was found to be statistically significant by paired *t*-test (0.02 and 0.04, respectively). The whole cohort was classified into low, moderate, and high myopia and hyperopia. The difference in sphere and spherical equivalent was significant only in hyperopia of all degrees. So author concluded PMT may be considered in hyperopes since there was low agreement between cycloplegic acceptances PMT.<sup>3</sup>

- *Khan T et al* compared Authenticity of Glasses Prescribed after Cycloplegic Refraction as Verified by Post Mydriatic Test (PMT). The study was conducted on 30 patients having refractive error with range of 5 to 15 years of age. Visual acuity of patient was taken by using log Mar Chart. Refraction was done with retinoscopy by cycloplegic refraction on patients. After few days patient was recalled for post mydriatic test to find authenticity of glasses prescribed after cycloplegic refraction. This study includes a total of 30 patients (comprising both right and left eyes). Out of 30 Patients 51.72% (16) were male and 48.28% (14) were females. Mean value, standard deviation (SD) and the 95% confidence interval (CI), for the total sample of cycloplegic refraction as verified by post mydriatic test were studied. Non-statistically significant differences in the cycloplegic refraction and post mydriatic refraction were found among the study groups ( $p > 0.05$ , Paired Sample Test). So author concluded that the authenticity of glasses prescribed to patient using cycloplegic refraction prescription is the same as verified by post mydriatic test refraction.<sup>4</sup>

- trial frame
- trial box
- vision chart
- cycloplegic eye drops (e.g. atropine, tropicamide, cyclopentolate, homatropine)

#### Material and methods:

This prospective, cross sectional study was conducted in the General Ophthalmology Department in a tertiary eyecare hospital of North India. Cooperative patients aged up to 40 years with refractive error  $\geq \pm 0.00$ , with astigmatism  $\leq -1.50$ DC, and having orthophoria with single binocular vision were included in the study. Patients having pathological myopia, glaucoma, retinal or corneal anomalies, squint or strabismus, or having any history of ocular surgery were excluded.

In the OPD, cycloplegia was attained after instilling Cycloplegic eye drop (tropicamide, cyclopentolate, homatropine) in the inferior cul-de-sac with 10 minutes gap between each instillation. Then careful objective wet refraction (cycloflash) was performed using Topcon RM 8000 auto refractometer. Minimum of 3 readings were taken using the autorefractor as per the standard operating protocol, and the average value was taken into consideration. On the same day, within next 30 minutes, recording of cycloplegic acceptance (cycloacceptance) by fogging technique was performed using trial frame, trial lens and LED snellen visual acuity chart. Then the patient was advised to re-visit again after 72hrs (3days) for the Post Mydriatic Test. On the day of PMT, the subjective acceptance was checked using fogging technique, and the final prescription was balanced using duochrome test to refine the monocular end point. The two variables i.e the Cycloacceptance and the PMT values were the assessed and compared to draw an outcome.

#### IV. METHODOLOGY

Study Design: Prospective cross sectional study

Sample size: 209 patients

Location of the study: Indira Gandhi Eye Hospital & Research Centre, Gurugram, Haryana.

Inclusion criteria:

1. All emmetropic and ametropic patients
2. Astigmatism less than or equal to -1.50D
3. Age upto 40 years
4. Orthophoric patient with normal binocular single vision.

Exclusion Criteria:

1. Pathological myopia
2. Patient with retinal anomalies.
3. Patients with corneal anomalies.
4. Patients with history of ocular surgery.
5. Patients with squint or strabismus.
6. Patients with glaucoma.

Tools required:

- Auto refractometer/ Retinoscope

#### V. RESULT

Four Hundred and Eighteen eyes of 209 patients age up to 40 years (Mean 19.85, SD 10.45) of which 93 were males and 116 were female included in the study. All the patients were divided into 12 different groups according to their age and refractive error. Data was entered and analyzed using SPSS version 25 software. Grouping are as follows:

Table 1: Grouping

EMMETROPIC	HYPEROPIC	MYOPIC
Age <10 years (G1)	Age <10 years (G1)	Age <10 years (G1)
Age 11 to 20 years (G2)	Age 11 to 20 years (G2)	Age 11 to 20 years (G2)
Age 21 to 30 years (G3)	Age 21 to 30 years (G3)	Age 21 to 30 years (G3)
Age 31 to 40 years (G4)	Age 31 to 40 years (G4)	Age 31 to 40 years (G4)

Data analysis for Emmetropic G1

Twenty eyes of 10 patients were examined. Out of them 3 were male and 7 were female. The median of Spherical Cycloplagic Acceptance was found to be  $0.6250 \pm 0.50$  (median± IQR) and Spherical PMT was  $0.250 \pm 0.50$  (table: 3).The normality of the data set was tested using Shapiro-Wilk test (table: 4).The data

did not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table 5&6). There was a significant difference in Spherical value between the groups (as  $P < 0.05$ ).

Mean Difference was 0.425DS

Table 2: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	20	100.0%	0	0.0%	20	100.0%
PMT_SPH	20	100.0%	0	0.0%	20	100.0%

Table 3: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	.6750	.07716
	Median	.6250	
	Variance	.119	
	Std. Deviation	.34508	
	Interquartile Range	.50	
	Skewness	-.197	.512
	Kurtosis	-.044	.992
PMT_SPH	Mean	.250	.0574
	Median	.250	
	Variance	.066	
	Std. Deviation	.2565	
	Interquartile Range	.5	
	Skewness	.000	.512
	Kurtosis	-2.235	.992

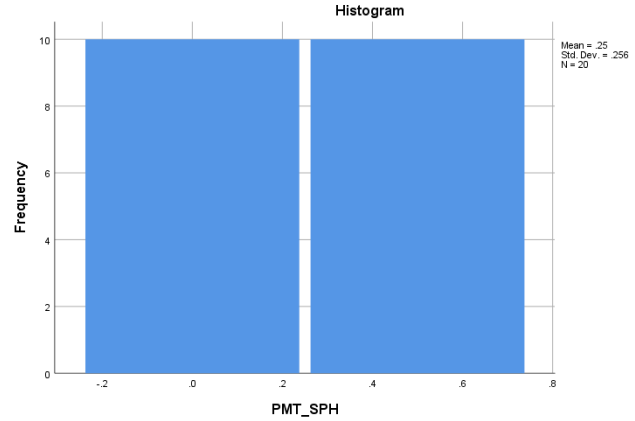
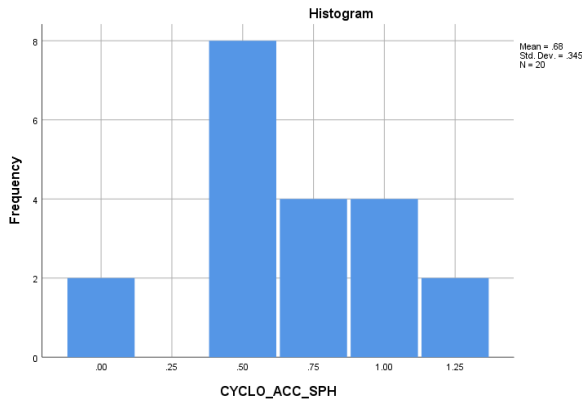


Table 4: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.206	20	.026	.909	20	.022
PMT_SPH	.335	20	.000	.641	20	.000

*Wilcoxon Signed Ranks Test*

Table 5: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	18	9.50	171.00
	Positive Ranks	0	.00	.00
	Ties	2		
	Total	20		

Table 6: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-3.862
Asymp. Sig. (2-tailed)	.000

Data analysis for Emmetropic G2

Twenty-eight eyes of 14 patients were examined. Out of them 5 were male and 9 were female. The median of Spherical Cycloplagic Acceptance was found to be  $1.00 \pm 0.50$  (median  $\pm$  IQR) and Spherical PMT was  $0.50 \pm 0.56$  (table: 8). The normality of the data set was tested using Shapiro-Wilk test (table: 9). The data did

not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 10&11). There was a significant difference in Spherical value between the groups (as  $P < 0.05$ ).

Mean Difference was 0.375DS

Table 7: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	28	100.0%	0	0.0%	28	100.0%
PMT_SPH	28	100.0%	0	0.0%	28	100.0%

Table 8: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	.8125	.09149
	Median	1.0000	
	Variance	.234	
	Std. Deviation	.48412	
	Interquartile Range	.50	
	Skewness	-.777	.441
	Kurtosis	-.633	.858
PMT_SPH	Mean	.4375	.05243
	Median	.5000	
	Variance	.077	
	Std. Deviation	.27743	
	Interquartile Range	.56	
	Skewness	-.690	.441
	Kurtosis	-.839	.858

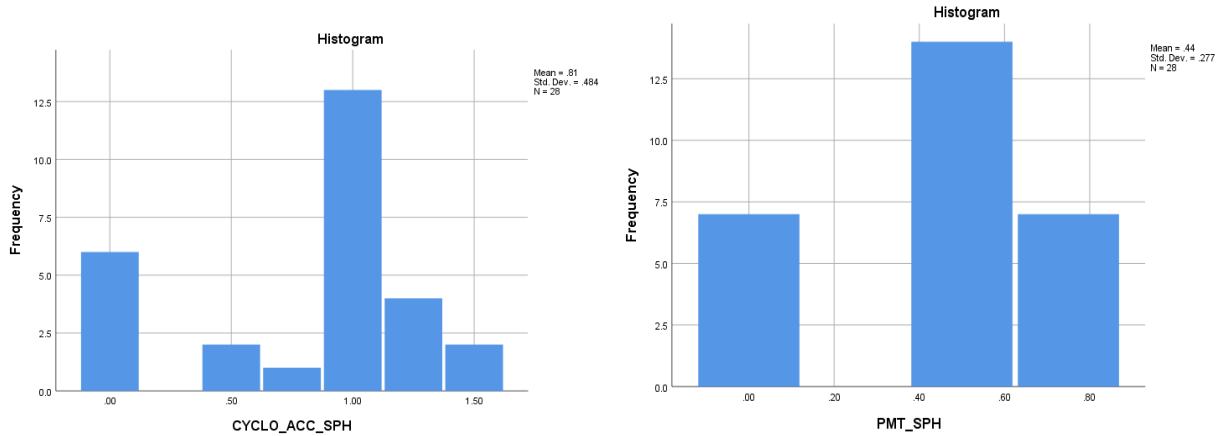


Table 9: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.329	28	.000	.813	28	.000
PMT_SPH	.339	28	.000	.769	28	.000

Wilcoxon Signed Ranks Test

Table 10: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	21	11.33	238.00
	Positive Ranks	2	19.00	38.00
	Ties	5		
	Total	28		

Table 11: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-3.088
Asymp. Sig. (2-tailed)	.002

Data analysis for Emmetropic G3

Thirty eyes of 15 patients were examined. Out of them 10 were male and 5 were female. The median of Spherical Cycloplagic Acceptance was found to be  $0.25 \pm 0.75$  (median± IQR) and Spherical PMT was  $0.00 \pm 0.25$  (table: 13).The normality of the data set was tested using Shapiro-Wilk test (table: 14).The data

did not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 15&16). There was a significant difference in Spherical value between the groups (as  $P < 0.05$ ).

Mean Difference was 0.291DS

Table 12: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	30	100.0%	0	0.0%	30	100.0%
PMT_SPH	30	100.0%	0	0.0%	30	100.0%

Table 13: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	.3417	.10753
	Median	.2500	
	Range	3.00	
	Interquartile Range	.75	
	Skewness	1.595	.427
	Kurtosis	5.087	.833
PMT_SPH	Mean	.0500	.05414
	Median	.0000	
	Variance	.088	
	Std. Deviation	.29653	
	Interquartile Range	.25	
	Skewness	-.149	.427
	Kurtosis	.039	.833

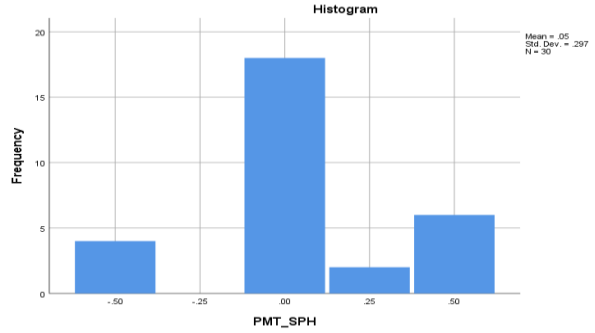
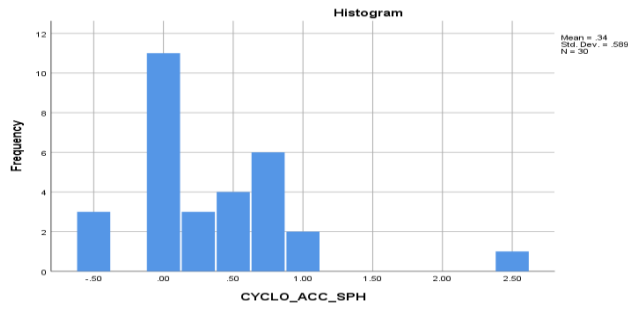


Table 14: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.186	30	.010	.843	30	.000
PMT_SPH	.300	30	.000	.799	30	.000

Wilcoxon Signed Ranks Test

Table 15: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	16	8.50	136.00
	Positive Ranks	0	.00	.00
	Ties	14		
	Total	30		

Table 16: Test Statistics

		PMT_SPH - CYCLO_ACC_SPH
Z		-3.564 <sup>b</sup>
Asymp. Sig. (2-tailed)		.000

Data analysis for Emmetropic G4

Forty-two eyes of 21 patients were examined. Out of them 11 were male and 10 were female. The median of Spherical Cycloplagic Acceptance was found to be  $0.875 \pm 0.50$  (median $\pm$  IQR) and Spherical PMT was  $0.50 \pm 0.50$  (table: 18).The normality of the data set was tested using Shapiro-Wilk test (table: 19).The data

did not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 20&21). There was a significant difference in Spherical value between the groups (as  $P < 0.05$ ).

Mean Difference was 0.399DS

Table 17: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	42	100.0%	0	0.0%	42	100.0%
PMT_SPH	42	100.0%	0	0.0%	42	100.0%

Table 18: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	.7381	.08560
	Median	.8750	
	Variance	.308	
	Std. Deviation	.55478	
	Interquartile Range	.50	
	Skewness	-.823	.365
	Kurtosis	.764	.717
PMT_SPH	Mean	.3393	.06308
	Median	.5000	
	Variance	.167	
	Std. Deviation	.40883	
	Interquartile Range	.50	
	Skewness	.056	.365
	Kurtosis	-.750	.717

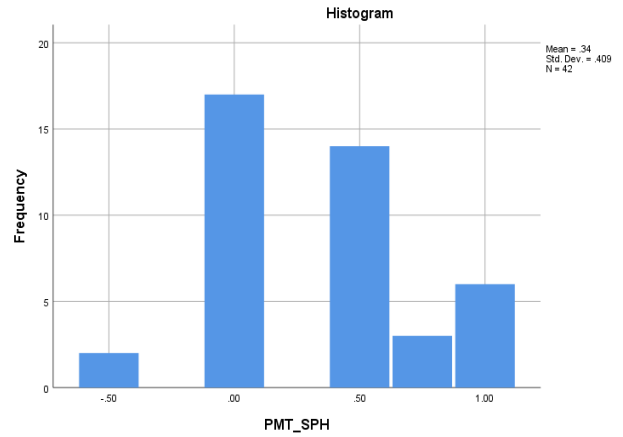
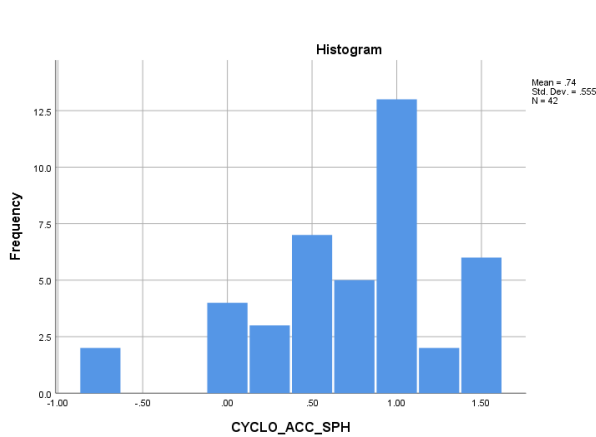


Table 19: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.182	42	.001	.915	42	.004
PMT_SPH	.249	42	.000	.875	42	.000

Wilcoxon Signed Ranks Test

Table 20: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	33	18.82	621.00
	Positive Ranks	2	4.50	9.00
	Ties	7		
	Total	42		

Table 21: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-5.137
Asymp. Sig. (2-tailed)	.000

Data analysis for Hyperopic G1  
 Sixteen eyes of 8 patients were examined. Out of them 2 were male and 6 were female. The median of Spherical Cycloplagic Acceptance was found to be  $2.375 \pm 3.88$  (median± IQR) and Spherical PMT was  $1.250 \pm 4.50$  (table: 23).The normality of the data set was tested using Shapiro-Wilk test (table: 24).The data

did not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 25&26). There was a significant difference in Spherical value between the groups (as  $P < 0.05$ ).

Mean Difference was 0.9058DS

Table 22: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	16	100.0%	0	0.0%	16	100.0%
PMT_SPH	16	100.0%	0	0.0%	16	100.0%

Table 23: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	2.9688	.64343
	Median	2.3750	
	Variance	6.624	
	Std. Deviation	2.57371	
	Interquartile Range	3.88	
	Skewness	.969	.564
	Kurtosis	-.453	1.091
PMT_SPH	Mean	2.063	.6920
	Median	1.250	
	Variance	7.663	
	Std. Deviation	2.7681	
	Interquartile Range	4.5	
	Skewness	1.219	.564
	Kurtosis	-.050	1.091

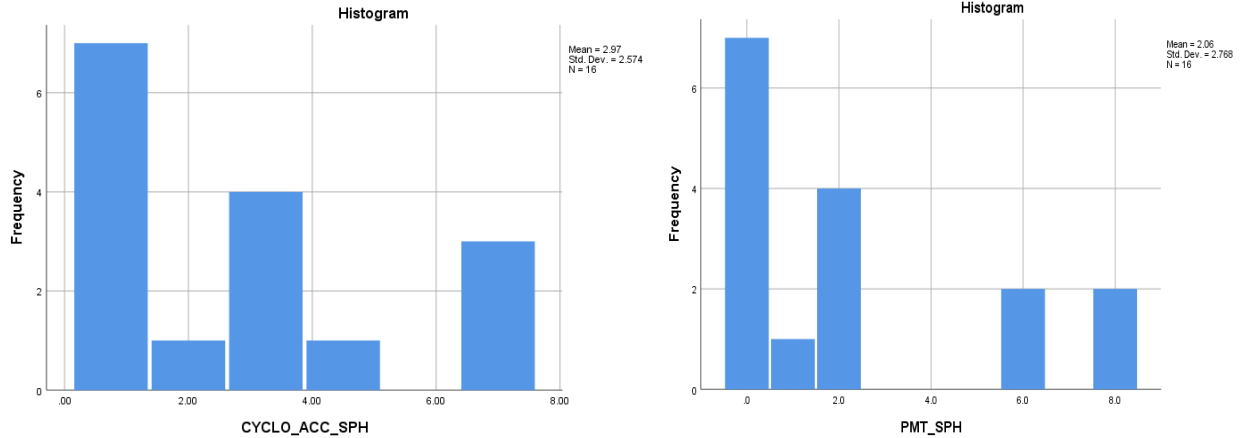


Table 24: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.215	16	.046	.796	16	.002
PMT_SPH	.331	16	.000	.733	16	.000

Wilcoxon Signed Ranks Test

Table 25: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	13	8.00	104.00
	Positive Ranks	1	1.00	1.00
	Ties	2		
	Total	16		

Table 26: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-3.254
Asymp. Sig. (2-tailed)	.001

Data analysis for Hyperopic G2

Twelve eyes of 6 patients were examined. Out of them 2 were male and 4 were female. The median of Spherical Cycloplagic Acceptance was found to be  $1.00 \pm 1.63$  (median± IQR) and Spherical PMT was  $0.75 \pm 1.190$  (table: 28).The normality of the data set was tested using Shapiro-Wilk test (table: 29).The data

follow a normal distribution so we ran a parametric test for analysis.

The two related variable were analysed. The Paired T test was performed (table: 30, 31&32). There was a significant difference in Spherical value between the groups (as  $P < 0.05$ ).

Mean Difference was 0.5417DS

Table 27: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	12	100.0%	0	0.0%	12	100.0%
PMT_SPH	12	100.0%	0	0.0%	12	100.0%

Table 28: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	1.2917	.28176
	Median	1.0000	
	Variance	.953	
	Std. Deviation	.97604	
	Interquartile Range	1.63	
	Skewness	.752	.637
	Kurtosis	-.250	1.232
PMT_SPH	Mean	.7083	.21283
	Median	.7500	
	Variance	.544	
	Std. Deviation	.73727	
	Interquartile Range	1.19	
	Skewness	.706	.637
	Kurtosis	-.086	1.232

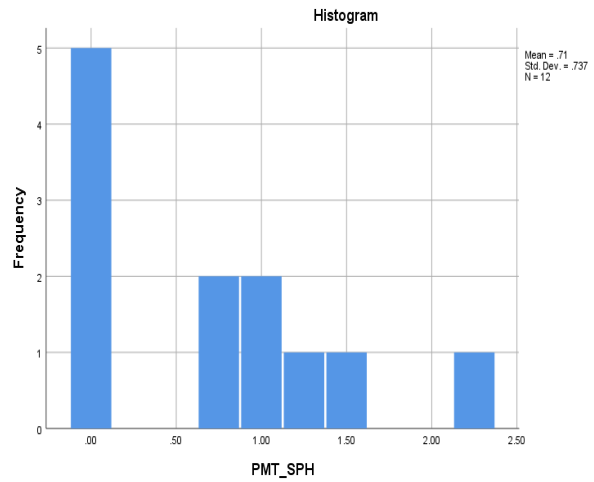
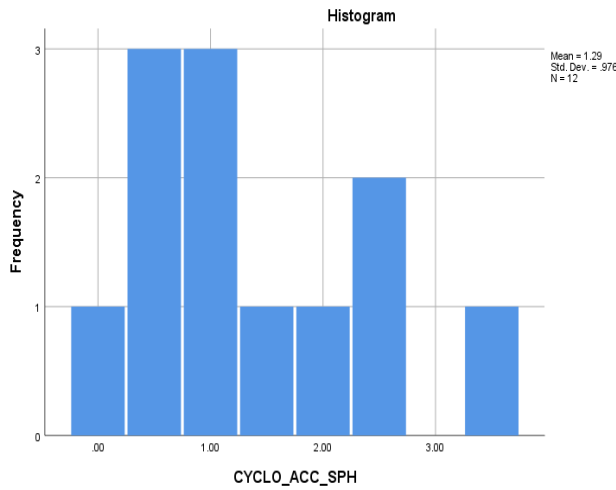


Table 29: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.201	12	.196	.931	12	.386
PMT_SPH	.248	12	.039	.866	12	.058

T-Test

Table 30: Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	CYCLO_ACC_SPH	1.2917	12	.97604	.28176
	PMT_SPH	.7083	12	.73727	.21283

Table 31: Paired Samples Correlations

Pair 1		N	Correlation	Sig.
Pair 1	CYCLO_ACC_SPH & PMT_SPH	12	.887	.000

Table 32: Paired Samples Test

Pair 1	CYCLO_ACC_SPH - PMT_SPH	Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower
Pair 1	CYCLO_ACC_SPH - PMT_SPH	.58333	.46872	.13531	.28552

Data analysis for Hyperopic G3

Twelve eyes of 6 patients were examined. Out of them 3 were male and 3 were female. The median of Spherical Cycloplegic Acceptance was found to be  $0.8750 \pm 1.38$  (median± IQR) and Spherical PMT was  $0.50 \pm 0.75$  (table: 34).The normality of the data set was tested using Shapiro-Wilk test (table: 35).The data

did not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 36&37). There was a significant difference in Spherical value between the groups (as  $P < 0.05$ ).

Mean Difference was 0.3541DS

Table 33: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	12	100.0%	0	0.0%	12	100.0%
PMT_SPH	12	100.0%	0	0.0%	12	100.0%

Table 34: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	1.0833	.35131
	Median	.8750	
	Variance	1.481	
	Std. Deviation	1.21699	
	Interquartile Range	1.38	
	Skewness	2.180	.637
	Kurtosis	6.069	1.232
PMT_SPH	Mean	.7292	.31451
	Median	.5000	
	Variance	1.187	
	Std. Deviation	1.08951	
	Interquartile Range	.75	
	Skewness	2.820	.637
	Kurtosis	8.894	1.232

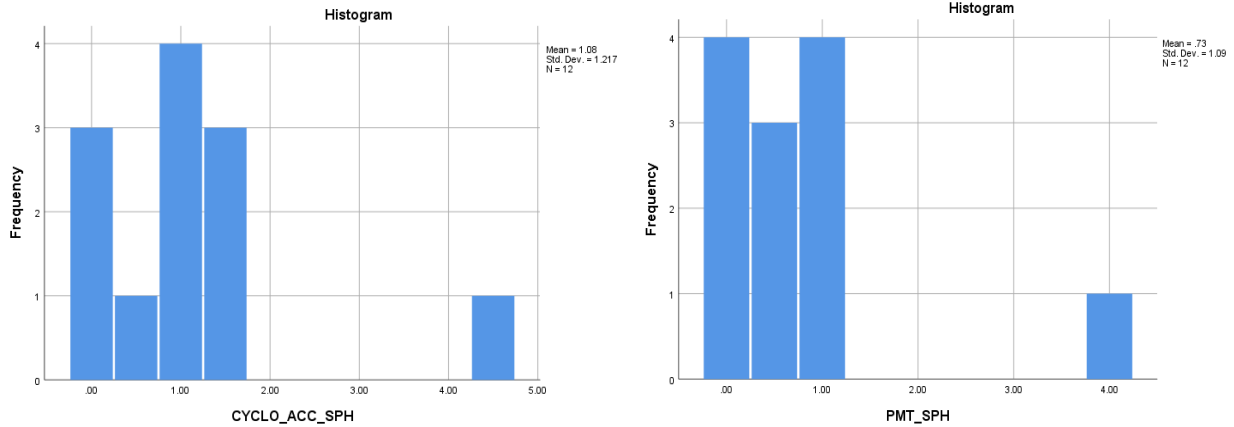


Table 35: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.283	12	.009	.754	12	.003
PMT_SPH	.326	12	.001	.618	12	.000

Wilcoxon Signed Ranks Test

Table 36: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	7	4.00	28.00
	Positive Ranks	0	.00	.00
	Ties	5		
	Total	12		

Table 37: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-2.388
Asymp. Sig. (2-tailed)	.017

Data analysis for Hyperopic G4

Twenty-four of 12 patients were examined. Out of them 5 were male and 7 were female. The median of Spherical Cycloplegic Acceptance was found to be  $0.8750 \pm 1.38$  (median± IQR) and Spherical PMT was  $0.50 \pm 0.75$  (table: 38).The normality of the data set was tested using Shapiro-Wilk test (table: 39).The data

did not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 40&41). There was a significant difference in Spherical value between the groups (as  $P < 0.05$ ).

Mean Difference was 0.3541DS

Table 38: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	24	100.0%	0	0.0%	24	100.0%
PMT_SPH	24	100.0%	0	0.0%	24	100.0%

Table 39: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	1.4688	.27432
	Median	1.1250	
	Variance	1.806	
	Std. Deviation	1.34389	
	Interquartile Range	2.13	
	Skewness	.964	.472
	Kurtosis	.696	.918
PMT_SPH	Mean	.854	.2052
	Median	.500	
	Variance	1.010	
	Std. Deviation	1.0052	
	Interquartile Range	1.5	
	Skewness	1.313	.472
	Kurtosis	.996	.918

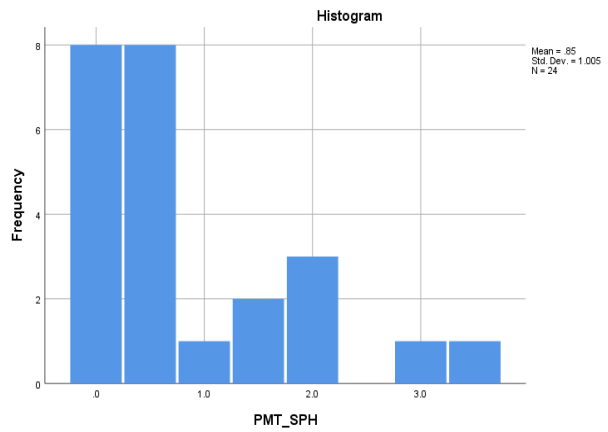
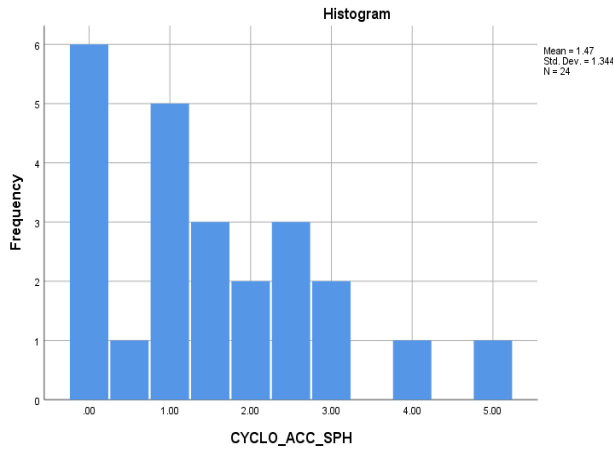


Table 40: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.190	24	.026	.898	24	.019
PMT_SPH	.304	24	.000	.802	24	.000

Wilcoxon Signed Ranks Test

Table 41: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	13	8.00	104.00
	Positive Ranks	1	1.00	1.00
	Ties	2		
	Total	16		

Table 42: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-3.254
Asymp. Sig. (2-tailed)	.001

Data analysis for Myopic G1

Fifty two eyes of 26 patients were examined. Out of them 13 were male and 13 were female. The median of Spherical Cycloplagic Acceptance was found to be  $-1.750 \pm 4.00$  (median± IQR) and Spherical PMT was  $-1.375 \pm 4.31$  (table: 44).The normality of the data set was tested using Shapiro-Wilk test (table: 45).The data

did not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 46&47). There was no significant difference in Spherical value between the groups (as  $P>0.05$ ). Mean Difference was 0.1202DS

Table 43: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	52	100.0%	0	0.0%	52	100.0%
PMT_SPH	52	100.0%	0	0.0%	52	100.0%

Table 44: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	-2.8221	.58471
	Median	-1.7500	
	Variance	17.778	
	Std. Deviation	4.21637	
	Interquartile Range	4.00	
	Skewness	-2.227	.330
	Kurtosis	5.588	.650
PMT_SPH	Mean	-2.9423	.58625
	Median	-1.3750	
	Variance	17.872	
	Std. Deviation	4.22748	
	Interquartile Range	4.31	
	Skewness	-2.272	.330
	Kurtosis	5.741	.650

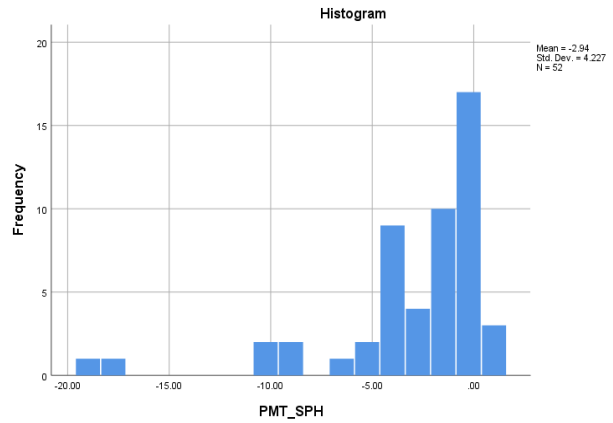
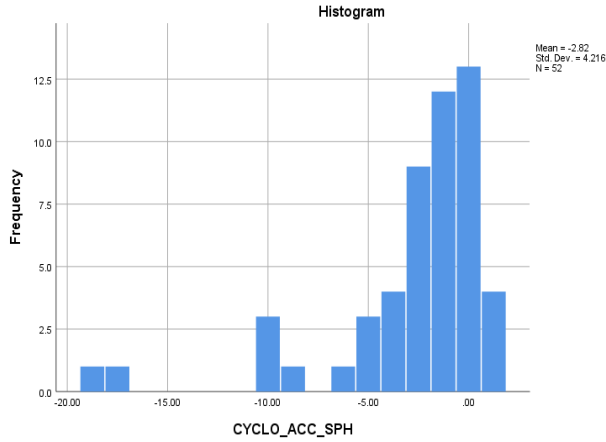


Table 45: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.214	52	.000	.756	52	.000
PMT_SPH	.189	52	.000	.732	52	.000

Wilcoxon Signed Ranks Test

Table 46: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	22	17.23	379.00
	Positive Ranks	10	14.90	149.00
	Ties	20		
	Total	52		

Table 47: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-2.184
Asymp. Sig. (2-tailed)	.090

Data analysis for Myopic G2

One hundred twenty two eyes of 61 patients were examined. Out of them 28 were male and 33 were female. The median of Spherical Cycloplagic Acceptance was found to be  $0.8750 \pm 1.38$  (median± IQR) and Spherical PMT was  $0.50 \pm 0.75$  (table: 49).The normality of the data set was tested using Kolmogorov-Smirnov test (table: 50).The data did not

follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 51&52). There was no significant difference in Spherical value between the groups (as  $P>0.05$ ).

Mean Difference was 0.1828DS

Table 48: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	122	100.0%	0	0.0%	122	100.0%
PMT_SPH	122	100.0%	0	0.0%	122	100.0%

Table 49: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	-3.1471	.23810
	Median	-2.7500	
	Variance	6.916	
	Std. Deviation	2.62991	
	Interquartile Range	2.31	
	Skewness	-1.254	.219
	Kurtosis	2.022	.435
PMT_SPH	Mean	-3.3299	.23801
	Median	-3.0000	
	Variance	6.911	
	Std. Deviation	2.62896	
	Interquartile Range	2.75	
	Skewness	-1.256	.219
	Kurtosis	1.998	.435

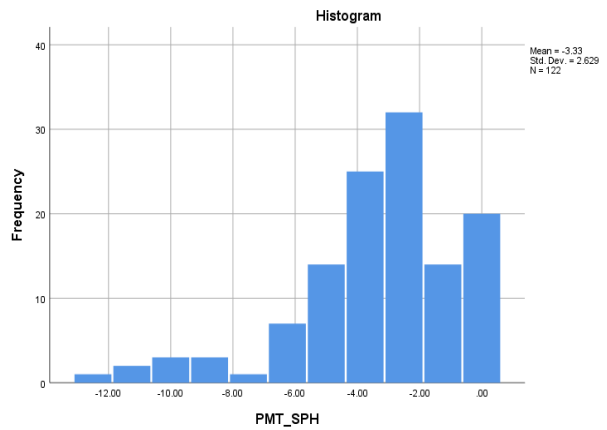
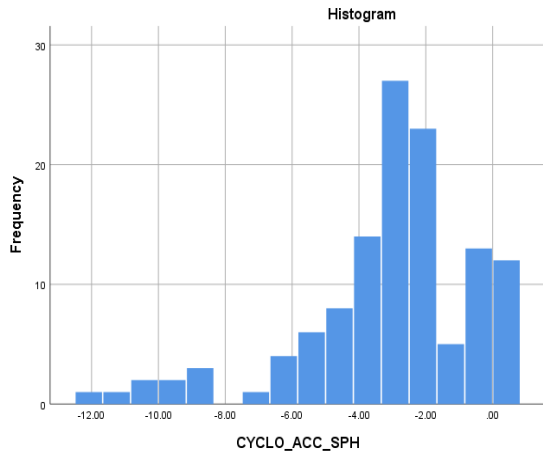


Table 50: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.143	122	.000	.904	122	.000
PMT_SPH	.141	122	.000	.898	122	.000

Wilcoxon Signed Ranks Test

Table 51: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	65	36.90	2398.50
	Positive Ranks	9	41.83	376.50
	Ties	48		
	Total	122		

Table 52: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-5.548
Asymp. Sig. (2-tailed)	2.884

Data analysis for Myopic G3

Forty six eyes of 23 patients were examined. Out of them 7 were male and 16 were female. The median of Spherical Cycloplagic Acceptance was found to be  $0.8750 \pm 1.38$  (median± IQR) and Spherical PMT was  $0.50 \pm 0.75$  (table: 54).The normality of the data set was tested using Shapiro-Wilk test (table: 55).The data

did not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 56&57). There was no significant difference in Spherical value between the groups (as  $P > 0.05$ ).

Mean Difference was 0.0761DS

Table 53: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	46	100.0%	0	0.0%	46	100.0%
PMT_SPH	46	100.0%	0	0.0%	46	100.0%

Table 54: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	-1.2065	.24907
	Median	-.5000	
	Variance	2.854	
	Std. Deviation	1.68927	
	Interquartile Range	2.38	
	Skewness	-.881	.350
	Kurtosis	.011	.688
PMT_SPH	Mean	-1.2826	.24642
	Median	-.5000	
	Variance	2.793	
	Std. Deviation	1.67133	
	Interquartile Range	2.56	
	Skewness	-1.030	.350
	Kurtosis	.303	.688

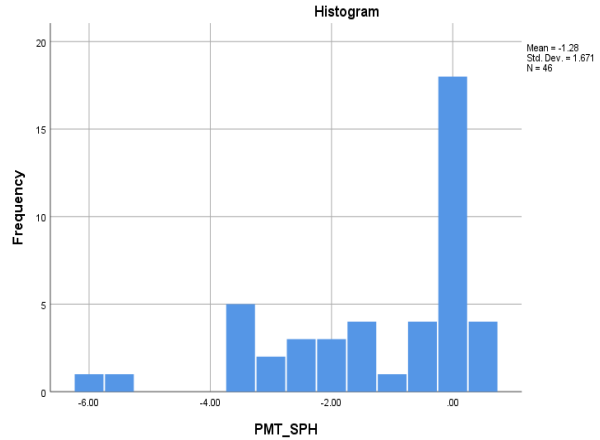
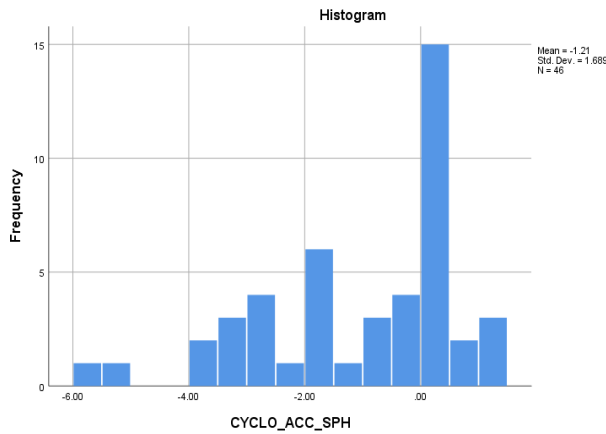


Table 55: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.197	46	.000	.893	46	.000
PMT_SPH	.235	46	.000	.844	46	.000

Wilcoxon Signed Ranks Test

Table 56: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	13	12.12	157.50
	Positive Ranks	7	7.50	52.50
	Ties	26		
	Total	46		

Table 57: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-2.046
Asymp. Sig. (2-tailed)	.407

Data analysis for Myopic G4

Fourteen eyes of 7 patients were examined. Out of them 4 were male and 3 were female. The median of Spherical Cycloplagic Acceptance was found to be  $0.8750 \pm 1.38$  (median  $\pm$  IQR) and Spherical PMT was  $0.50 \pm 0.75$  (table: 59). The normality of the data set was tested using Shapiro-Wilk test (table: 60). The data

did not follow a normal distribution so we ran a non-parametric test for analysis.

The two related variable were analysed. The Wilcoxon signed rank test was performed (table: 61&62). There was no significant difference in Spherical value between the groups (as  $P > 0.05$ ).

Mean Difference was 0.2321DS

Table 58: Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
CYCLO_ACC_SPH	14	100.0%	0	0.0%	14	100.0%
PMT_SPH	14	100.0%	0	0.0%	14	100.0%

Table 59: Descriptives

		Statistic	Std. Error
CYCLO_ACC_SPH	Mean	-.5536	.45481
	Median	.0000	
	Variance	2.896	
	Std. Deviation	1.70175	
	Interquartile Range	.38	
	Skewness	-2.257	.597
	Kurtosis	3.984	1.154
PMT_SPH	Mean	-.7857	.49438
	Median	.0000	
	Variance	3.422	
	Std. Deviation	1.84978	
	Interquartile Range	.56	
	Skewness	-2.393	.597
	Kurtosis	5.063	1.154

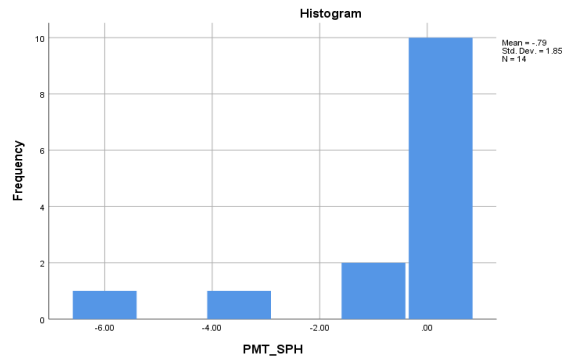
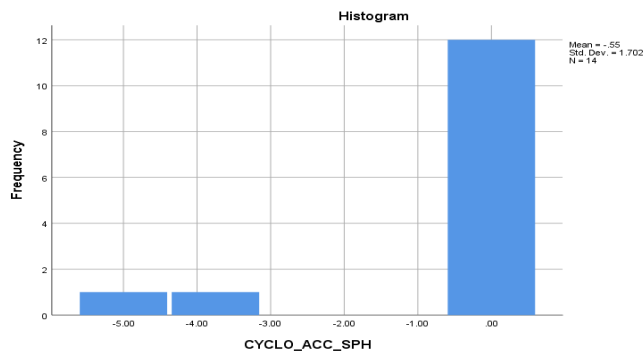


Table 60: Tess of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CYCLO_ACC_SPH	.413	14	.000	.572	14	.000
PMT_SPH	.365	14	.000	.572	14	.000

Wilcoxon Signed Ranks Test

Table 61: Ranks

		N	Mean Rank	Sum of Ranks
PMT_SPH - CYCLO_ACC_SPH	Negative Ranks	8	4.50	36.00
	Positive Ranks	0	.00	.00
	Ties	6		
	Total	14		

Table 62: Test Statistics

	PMT_SPH - CYCLO_ACC_SPH
Z	-2.588
Asymp. Sig. (2-tailed)	.197

## VI. DISCUSSION

A complete cycloplegic examination is a basic procedure in the diagnosis and management of various ophthalmic disorders, particularly in children who have higher amplitudes of accommodation acting as an obstacle against accurate refraction. In a typical paediatric clinic, cycloplegic refraction is routinely practiced for myopic cases, however calling the patient for PMT after 3 days may not be cost effective or feasible for patients if it doesn't add any further information that improves the final prescription.

In this study, it has been found that there is no significant difference between PMT value and cycloplegic acceptance value in myopic patients. The mean difference calculated has been found to be only 0.15D (0.12D, 0.18D, 0.07D, 0.23D in four groups respectively). In emmetropic patients the mean difference was found 0.37D (0.42D, 0.37D, 0.29D, 0.39D in four groups respectively). In hyperopic patients the mean difference was found 0.54D (0.90D, 0.54D, 0.35D, and 0.35D in four groups respectively) Kothari M et al. in their study found that there is an insignificant difference between non-cycloplegic refraction and PMT, and concluded that PMT is not warranted in children with compound myopic astigmatism. Nagarjan et al. in their study had concluded that the necessity of PMT can be fully overcome by using appropriate apertures while performing subjective refraction under cycloplegia. Swaminathan M et al. in their study found that the difference in cycloacceptance and PMT was significant only in hyperopes but not in myopes and concluded that PMT may be considered in hyperopes only.

It is a common practice in India to perform cycloplegic refraction on children, followed by an additional visit for PMT before generating spectacle prescription, but it seems there is a lack of evidence on the requirement to perform this test on all Individuals. However, some eyecare practitioner sometimes follow differing prescription guidelines for myopic children, and prescribes the least myopic correction i.e whatever the

patient accepts under cycloplegic conditions with red better response in duochrome test. This method can be deemed correct, since there is no significant difference between post cycloplegia refraction and PMT in this study as well as most of the studies conducted earlier on myopic patients.

## VII. CONCLUSION

This study concludes that there is non-significant comparison of visual factors related to cycloplegic refraction and refraction after post mydriatic test in myopic and emmetropic patients. There is no such better improvement in vision after post mydriatic test just a tonus allowance effect is cancelled. But in hyperopic patients there is a requirement of PMT, especially in young hyperopic patient (mean difference in Hyperopic G1 was 0.90D). However, more studies with larger sample size is recommended to come to a more definite conclusion.

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