

# Reliability of Cycloplegic Autorefractor Measurements to determine Spherical and Astigmatic Refractive Errors in Young Children

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## Abstract

**Background:** This paper mainly focuses on the reliability study of cycloplegic autorefractor measurements over other methods in young children.

## Material and Method

In a prospective study, 200 school children aged 8 to 15 years were evaluated for refractive errors in a period of one year. Non-cycloplegic autorefraction, followed by cycloplegic conventional retinoscopy and cycloplegic autorefraction was performed. Cyclopentolate eye drops (1 %) are used for this purpose. Fundus examination was performed in all children to exclude any posterior segment pathology. Post-mydriatic assessment was performed after one week.

## Results

Post-mydriatic test values are used as gold standard. There is a no significant difference between cycloplegic autorefractor spherical power, cylindrical power and axis measurements against Post mydriatic test values. The difference is statistically significant in case of non -cycloplegic autorefraction.

## Conclusion

Autorefraction with cycloplegia can be substituted for the conventional cycloplegic retinoscopy for both spherical and astigmatic refractive errors in young children.

Note: This study was conducted by first author at Department of Ophthalmology, Rangaraya Medical College, Kakinada, India in the year 2002-2003.

## INTRODUCTION

Conventional cycloplegic retinoscopy is widely used method to determine the refractive errors in patients of all age groups. Ophthalmologists and opticians in India are increasingly using Non-cycloplegic autorefractor measurements to determine refractive errors in patients of all age groups. Their reliability is questionable especially in young children.

The present study is an attempt to determine the reliability of cycloplegic automated refractor measurements as an effective substitute for conventional cycloplegic retinoscopy

in young children.

## MATERIAL AND METHODS

It is a prospective study involving 200 school children aged 8 to 15 years. They were evaluated for refractive errors over a period of one year. Visual acuity is tested using Snellen's acuity chart. Automated refraction was performed prior to the administration of cycloplegics. It is followed by cycloplegic conventional retinoscopy and cycloplegic autorefraction. 4% lignocaine topical drops were used to minimise the irritation with cyclopentolate eye drops. 1% cyclopentolate eye drops was used for the purpose. Cyclopentolate eye drops were administered at 0 minutes, after 5 minutes and after 20 minutes. The pupillary reflex and dilatation were inspected at 35 minutes from the first

drop of administration. After adequate papillary dilatation (6 mm or more), cycloplegic conventional retinoscopy followed by cycloplegic autorefractometry was performed.

## RETINOSCOPY

Conventional retinoscopy was performed with the help of streak retinoscope to determine both spherical and cylindrical measurements.

## AUTOMATED REFRACTION

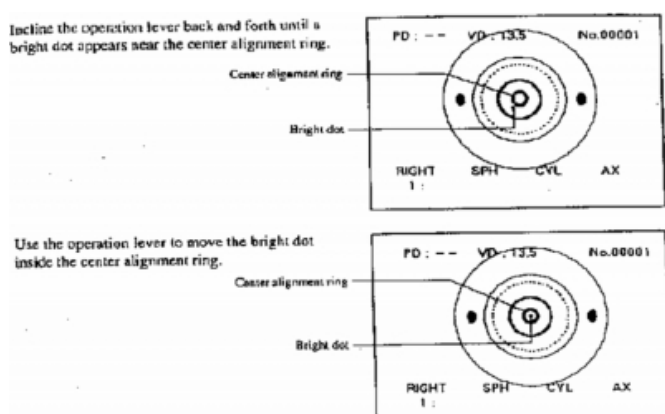
Canon Autorefractor R-50m was used in the study. This instrument has automatic mode (5 readings) and  $\pm 0.25D$  increments.

## PROCEDURE

The child is comfortably seated in front of the Autorefractor. Instrument is adjusted so that the pupil is concentric with the inner alignment. The operation lever is fine adjusted until a clear bright dot appears in the centre of the inner alignment.

**Figure 1**

Figure 1



When the bright dot is clearest in the centre alignment ring and eye is in proper focus, measurement starts automatically. After measurements are made, the standard value will be automatically calculated and displayed within brackets. The measurement in the other eye was done in the similar way. After both eyes are measured, the results were printed automatically. Autorefractor readings were taken before and after cycloplegia.

## FUNDUS EXAMINATION

Fundus examination with direct ophthalmoscope was performed in all children to exclude any posterior segment Pathology.

## POST-MYDRIATIC TEST

After recording visual acuity in both eyes, post-mydratic test was performed. Different spherical and cylindrical combinations were used based on retinoscopy values, to provide best possible visual acuity in both eyes separately. Finally, pinhole test is performed with these glasses on. If there is improvement in visual acuity, the whole process is repeated for best possible visual acuity. The final spherical and cylindrical values are recorded. These post-mydratic test values are taken as gold standard.

The Data was inputted into excel sheet and analysed. The spherical and astigmatic measurements obtained by non-cycloplegic autorefractometry, cycloplegic autorefractometry and cycloplegic retinoscopy are compared with values of post-mydratic test.

## RESULTS

We used Chi test to test the level of significance. Post-mydratic test values were taken as gold standard and compared with that of cycloplegic autorefractometry measurements, non-cycloplegic autorefractometry measurements and conventional cycloplegic retinoscopy.

**Figure 2**

Table 1: Percentage of measurements in 400 eyes of spherical power by two methods that agree

Measurements	$\pm 0.25D$	$\pm 0.50D$
Cycloplegic auto refraction verses Post Mydratic Test	70% (280 eyes)	97% (388 eyes)
Cycloplegic retinoscopy verses Post Mydratic Test	93% (372 eyes)	98% (392 eyes)
Non-Cycloplegic auto refraction verses Post-Mydratic Test	52% (208 eyes)	70% (280 eyes)

In our study 70% of cycloplegic autorefractometry spherical measurements agreed within  $\pm 0.25 D$  of post-mydratic test values and 97% agreed within  $\pm 0.50D$

93% of Cycloplegic retinoscopy spherical power measurements agreed within  $\pm 0.25 D$  of post-mydratic test values and 98% agreed within  $\pm 0.50 D$ .

52% of non-cycloplegic autorefractometry spherical power measurements agreed within  $\pm 0.25 D$  of post-mydratic test values and 70% within  $\pm 0.50 D$ .

There is a significant difference between cycloplegic autorefractometry spherical power measurements and

Cycloplegic retinoscopy values with in the range of  $\pm 0.25D$  ( $P < 0.001$ ), but not with in the range of  $\pm 0.50D$  ( $P = 0.8398$ ).

There is a significant difference between non-cycloplegic autorefractor spherical power measurements and Cycloplegic retinoscopy values with in the range of  $\pm 0.25D$  ( $P < 0.001$ ) and also with in the range of  $\pm 0.50D$  ( $P < 0.001$ ).

**Figure 3**

Table 2: Percentage of measurements in 400 eyes of cylindrical power by two methods that agree

Measurements	$\pm 0.25D$	$\pm 0.50D$
Cycloplegic auto refraction verses Post Mydriatic Test	95% (380 eyes)	98% (391 eyes)
Cycloplegic retinoscopy verses Post Mydriatic Test	96% (384 eyes)	99% (396 eyes)
Non-Cycloplegic auto refraction verses Post-Mydriatic Test	85% (339 eyes)	89% (356 eyes)

In our study 95% of cycloplegic autorefraction cylindrical power measurements agreed within  $\pm 0.25 D$  of post-mydriatic test values and 98% within  $\pm 0.50 D$ .

96% of cycloplegic retinoscopy cylindrical power measurements agreed within  $\pm 0.25 D$  of post-mydriatic test values and 99% within  $\pm 0.50D$

85% of non-cycloplegic autorefraction cylindrical power measurements agreed within  $\pm 0.25 D$  of post-mydriatic test values and 89% within  $\pm 0.50 D$ .

There is no significant difference between cycloplegic autorefractor cylindrical power measurements and Cycloplegic retinoscopy values with in the range of  $\pm 0.25D$  ( $P = 0.838$ ) and also with in the range of  $\pm 0.50D$  ( $P = 0.801$ ).

There is a significant difference between non-Cycloplegic autorefractor cylindrical power measurements and Cycloplegic retinoscopy values with in the range of  $\pm 0.25D$  ( $P = 0.02$ ) and also with in the range of  $\pm 0.50D$  ( $P = 0.04$ ).

**Figure 4**

Table 3: Percentage of measurements in 400 eyes of cylindrical axis by two methods that agree

Measurements	$\leq 10^\circ$	$11^\circ$ to $20^\circ$
Cycloplegic auto refraction verses Post Mydriatic Test	95% (380 eyes)	98% (392 eyes)
Cycloplegic retinoscopy verses Post Mydriatic Test	73% (292 eyes)	88% (352 eyes)
Non-Cycloplegic auto refraction verses Post-Mydriatic Test	75% (300 eyes)	89% (356 eyes)

In our study 95% of cycloplegic autorefraction cylindrical axis measurements agreed within  $\leq 10^\circ$  of post-mydriatic test values and within  $20^\circ$  in 98% of eyes.

73% of cycloplegic retinoscopy cylindrical axis measurements agreed within  $\leq 10^\circ$  of post-mydriatic test values and within  $20^\circ$  in 91% of eyes.

75% of non-cycloplegic autorefraction cylindrical axis measurements agreed within  $\leq 10^\circ$  of post-mydriatic test values and within  $20^\circ$  in 89% of eyes.

There is a significant difference between cycloplegic autorefractor cylindrical axis measurements and Cycloplegic retinoscopy values with in the range of  $\leq 10^\circ$  ( $P < 0.001$ ) and also with in the range of  $11^\circ$  to  $20^\circ$  ( $P = 0.033$ ).

There is a significant difference between non-cycloplegic auto refractor cylindrical axis measurements and post-mydriatic test values with in the range of  $\leq 10^\circ$  ( $P = 0.639$ ) and also with in the range of  $11^\circ$  to  $20^\circ$  ( $P = 0.831$ ).

## DISCUSSION

There is remarkable agreement between Cycloplegic autorefractor spherical power measurements and Cycloplegic retinoscopy with in the range of  $\pm 0.50D$  is comparable.

Non-cycloplegic autorefractor spherical power measurements and Cycloplegic retinoscopy with in the range of  $\pm 0.5D$  are not comparable.

There is remarkable agreement between Cycloplegic autorefractor cylindrical power measurements and Cycloplegic retinoscopy with in the range of  $\pm 0.25D$  is comparable.

Out of the all the methods used, cycloplegic autorefractor cylindrical axis measurements is the best. It is even better

than cycloplegic retinoscopy with in the range of  $\leq 20^\circ$ .

Non-cycloplegic autorefractor cylindrical axis measurements also can be comparable with cycloplegic retinoscopy values.

There are a few published studies concluding that the most reliable measure of spherical and astigmatic refractive error was cycloplegic autorefraction followed by non-cycloplegic autorefraction and cycloplegic subjective refraction<sup>1, 2, 3, 5, 6</sup>.

## CONCLUSION

Cycloplegic autorefraction spherical and cylindrical measurements can be substituted for conventional cycloplegic retinoscopy in young children. It is even better than conventional cycloplegic retinoscopy for cylindrical axis measurements.

The least reliable measure was non-cycloplegic auto refraction. Despite the cost of equipment, autorefraction with cycloplegia can be comparable to conventional cycloplegic retinoscopy in accuracy in children, can be run by an ophthalmic technician and therefore eliminates the ophthalmologist's examination time required for retinoscopy. Autorefraction without cycloplegia cannot substitute for the conventional cycloplegic retinoscopy in young children.

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