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# COMPARISON BETWEEN AUTOREFRACTION AND RETINOSCOPY FOR SUBJECTIVE CORRECTION IN CHILDREN

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**Abstract:** *The study's objective was to compare the accuracy of retinoscopy and autorefraction for subjective correction in children. The study was conducted in the Department of Ophthalmology at Nishtar Medical Hospital from June 2021 to May 2022, and it was a prospective study. The study included 60 children aged between 6 to 15 years who had asthenopic symptoms and blurring of vision. The children were given cyclopentolate 1% eyedrops thrice at intervals of 10 minutes to achieve cycloplegia. After an hour of instilling eye drops, cycloplegic retinoscopy, and autorefractometry were performed. Three values of each technique were recorded, and the average was calculated. After three days, binocular and monocular subjective refraction was performed until the best-corrected visual acuity (BCVA) was achieved. Results showed that 40.8% (49 eyes) were hypermetric, and 50% (60 eyes) were myopic based on subjective refraction. Comparison of spherical error by subjective refraction and retinoscopy showed that myopic eyes had a mean of -1.36 ± .98 and -1.08± .82 on subjective correction and retinoscopy, respectively (P=.07), and hypermetropic eyes had a mean of 2.5± .22 and 2.45± .22 on subjective correction and retinoscopy, respectively (P=0.07). Comparison of spherical error by subjective refraction and autorefractometer showed myopic eyes had a mean value of -1.51 ± 1.3 on autorefraction (P=.0001) while hypermetropic eyes had a mean of 2.39± .37 on autorefraction (P=0.0001). Mean cylindrical error values by retinoscopy were -.0729± .304, and by the subjective method, were -.167± .384 (P =0.0007). Mean cylindrical error values by autorefraction were .207± .487 compared to -.167± .384 by the subjective method (P =0.0088). In conclusion, conventional retinoscopy is the most accurate and reliable method for estimating the refractive status. However, autorefraction also has acceptable accuracy and can be used for cylindrical correction.*

**Keywords:** Autorefraction, Retinoscopy, Subjective Correction

## Introduction

Refractive error is among the common causes of visual impairment, particularly in school-going children (Bourne et al., 2021). Subjective refraction and retinoscopy are the gold standard for assessment of refractive status. However, automated refractometers have recently been increasingly used to assess refractive status. It is crucial to accurately measure refractive status in children as overestimation or underestimation of error causes accommodative stress, which increases the risk of amblyopia (Lei et al., 2023). Several methods, such as photorefraction, autorefractometry, retinoscopy, and subjective refraction, are used to measure refractive errors (Mukash et al., 2021). Both auto refractometry and retinoscopy are reliable techniques for assessment of refractive errors. Yet, retinoscopy is time-consuming, technique-sensitive, requires patience, and may be affected by interobserver variability to some extent (Nafea and Abed, 2023). Recently, autorefraction has been used more frequently than retinoscopy as it is a well-tolerated, simple, and less time-consuming technique. There may be discrepancies among the final objective corrective achieved with retinoscopy, autorefraction (AR), and subjective refraction accepted by the patient. The previous studies are inconclusive regarding determining the most accurate technique for subjective correction (Kedia and Baruah, 2022; Magome et al., 2021; Mukash et al., 2021). These discrepancies can be due to various factors such as the age of the patients, differences in autorefractors, the experience of the operator performing retinoscopy, and cycloplegic use (Mohana Priya et al.).
Though autorefractometry is routinely used in developed countries, it is relatively less frequent in poor countries. Most of the data on this topic is from developed countries; literature on comparative analysis of retinoscopy and autorefractometry in local populations is scarce. Thus, this study aims to compare the accuracy of retinoscopy and autorefraction for subjective correction in children.

## Methodology

The prospective study was conducted in the Department of Ophthalmology, Nishtar Medical Hospital, from June 2021 to May 2022. The study included children aged between 6 to 15 years having asthenopic symptoms and blurring of vision. Children with abnormal fundus findings, media opacities, and blurred vision were excluded because of causes other than refractive errors. Informed consent of the guardian was taken. The ethical board of the hospital of the hospital approved the study.
A total of 60 children (120 eyes) were included in the study. All participants underwent an ophthalmological examination to rule out ocular comorbidities. Findings of anterior and posterior segment examination were recorded. Snellen's chart was used for testing visual acuity. Pinhole

acuity and uncorrected visual acuity were recorded for each eye. Cyclopentolate 1% eyedrops, instilled thrice at intervals of 10 minutes, was used to achieve cycloplegia. Cycloplegic retinoscopy and auto refractometry were performed after an hour of instilling eye drops. Three values of each technique were recorded, and the average was calculated. After 3 days, binocular and monocular subjective refraction was performed until the best corrected visual acuity (BCVA) was achieved.
SPSS version 23.0 was used for data analysis. Characteristics like sex, age, findings of AR, retinoscopy, and subjective refraction were presented in tabulated form as mean (SD) and frequency (percentage). The chi-square test was used to compare the techniques. The method close to subjective refraction was considered accurate. P value < 0.05 was considered statistically significant.

## Results

The mean age of the participants was 10.49 ±4.1 years. There were 59.6% females and 40.4% males. Based on subjective refraction, 40.8% (49 eyes) were hypermetric, and 50% (60) were myopic. The mean positive sphere accepted subjectively was 2.3 ±.22 dioptres, and the mean negative sphere accepted subjectively was -1.27± .96 dioptres. Regarding cylindrical power estimation, 16% of eyes accepted positive cylinders, and 43.3% accepted negative cylinders.

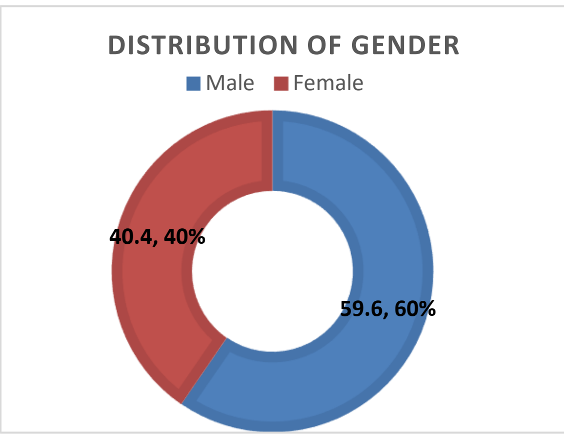


**Figure 1: Distribution of gender in the study population**

Comparison of spherical error by subjective refraction and retinoscopy showed that myopic eyes had a mean of -1.36 ±.98 and -1.08±.82 on subjective correction and retinoscopy, respectively (P=.07) (Table I), and hypermetropic eyes had a mean of 2.5±.22 and 2.45±.22 on subjective correction and retinoscopy respectively (P=.07). Comparison of spherical error by subjective refraction and autorefractometer showed myopic eyes had mean value of -1.51 ±1.3 on autorefraction (P=.0001) (Table I). In contrast, hypermetropic eyes had a mean of 2.39± .37 on autorefraction (P=.0001) (Table II). Mean cylindrical error values by retinoscopy were -.0729±.304; by subjective method, they were -.167±.384 (P =.0007). Mean cylindrical error values by autorefraction were .207±.487 compared to -.167±.384 by subjective method (P =0.0088) (Table III). Subjectively, 36% and 88.3% of eyes accepted AR and retinoscopy sphere estimates, respectively. 72.5% of eyes accepted AR cylinder estimates, and 48.3% accepted retinoscopy cylinder estimates. 75% of eyes accepted axis estimates by AR, and 55% accepted axis estimates by retinoscopy.
An intracluster correlation between AR and retinoscopy with subjective refraction showed that retinoscopy had a higher correlation for spherical power estimation. AR had a higher correlation for axis and cylindrical power estimation.

**Table I Spherical error in myopic eyes**

| Method | Mean | 95% CI | P-value |
|---|---|---|---|
| Retinoscopy | -1.08±.82 | -1.28 to -.872 | 0.07 |
| AR | -1.51 ±1.3 | -1.9 to -1.23 | 0.0001 |
| Subjective | -1.36 ±.98 | -1.48 to -1.03 | - |

**Table II Spherical error in hypermetropic eyes**

| Method | Mean | 95% CI | P-value |
|---|---|---|---|
| Retinoscopy | 2.5±.22 | 2.48 to 2.59 | 0.07 |
| AR | 2.39± .37 | 2.29 to 2.49 | 0.0001 |
| Subjective | 2.5±.22 | 2.44 to 2.56 | |

**Table III Cylindrical error through different methods**

| Method | Mean | 95% CI | P-value |
|---|---|---|---|
| Subjective | -.167±.384 | -.211 to-.094 | - |
| Retinoscopy | -.0729±.304 | -.145 to -.042 | 0.0007 |
| AR | .207±.487 | -.28 to -.134 | 0.0088 |

## Discussion

Studies show incomplete neutralization of accommodative effort during non-cycloplegic retinoscopy and noncycloplegic autorefraction reduces accuracy, particularly in children with high accommodative reserve (Gu et al., 2022; Rubio et al., 2019). A study reported that excess accommodation in children is a potential cause of the increase in the prevalence of myopia. (Huang et al., 2020) Minus over-correction in glasses forces children to exert excessive accommodative effort, causing myopia progression (Lei et al., 2023). To counter this, a comparison in the current study was done after achieving cycloplegia.
Spherical error in myopic eyes had comparable values through subjective refraction and retinoscopy, while autorefraction overestimated myopia compared to subjective refraction. Retinoscopy and subjective refraction had comparable values for hypermetropic eyes, while autorefraction underestimated hypermetropia. A study compared the accuracy of autorefraction with subjective refraction for diagnosing refractive error. It was found that autorefractors caused minus over-correction leaves to overestimate myopia (Nisha et al., 2023). In the current study, 36% and 88.3% of eyes accepted AR and retinoscopy sphere estimates, respectively. 72.5% of eyes accepted AR cylinder estimates, and 48.3% accepted retinoscopy cylinder estimates. 75% of eyes accepted axis estimates by AR, and 55% accepted axis estimates by retinoscopy. These findings suggest that retinoscopy has more accuracy for estimating spherical powers, while AR has more accuracy for estimating cylinder powers.
These findings align with the results of previous studies, which reported that refraction methods, including auto refraction, are suitable for cylindrical components but have poor agreement with sphere components (Khan et al., 2023; Samanta et al., 2022). A previous study reported that

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retinoscopy and subjective refraction had a higher agreement for sphere power components, and retinoscopy and autorefraction had comparable agreement for axis and cylinder power (Eltagoury and Ghoneim, 2023). Another comparative study of autorefraction with subjective refraction showed that autorefraction correlates with subjective refraction to estimate cylindrical power (Cheng and Woo, 2021). The current study showed that AR and retinoscopy had comparable accuracy. Another study suggested that AR had higher sensitivity for hypermetropia and higher sensitivity and specificity for myopia under cycloplegia (Wilson et al., 2020). Another study concluded that the third generation of AR (Nidek ARK-900) had superior diagnostic accuracy in children compared to retinoscopy. They added that it is simpler and less time-consuming as well (Jahn et al., 2020).

The current study compared the accuracy of retinoscopy and autorefraction for subjective correction in children. Though both methods had comparable diagnostic accuracy, retinoscopy had a higher correlation with subjective refraction for spherical power and was better correlated for cylindrical power and axis.

## Conclusion

Conventional retinoscopy is the most accurate and reliable method for estimating refractive status. However, autorefraction also has acceptable accuracy and can be used for cylindrical correction.

## Declarations

**Data Availability statement**
All data generated or analyzed during the study are included in the manuscript.
**Ethics approval and consent to participate**
Approved by the department Concerned.
**Consent for publication**
Approved
**Funding**
Not applicable

## Conflict of interest

The authors declared absence of conflict of interest.

## Author Contribution

***MUHAMMAD ASFAND YAR***
*Coordination of collaborative efforts.*
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*Data entry and Data analysis, drafting article*
***RASHID NAWAB***
*Manuscript revisions, critical input.*
*Coordination of collaborative efforts.*
***MUHAMMAD RASHAD QAMAR RAO***
*Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript*
*Data acquisition, analysis.*
***NAUSHERWAN AADIL***
*Review of manuscript*
***SAJJJAD HUSSAIN***
*Review of manuscript*

## References

Bourne, R., Steinmetz, J. D., Flaxman, S., Briant, P. S., Taylor, H. R., Resnikoff, S., Casson, R. J., Abdoli, A., Abu-Gharbieh, E., and Afshin, A. (2021). Trends in prevalence of blindness and distance and near vision impairment over 30 years: an analysis for the Global Burden of Disease Study. *The Lancet global health* **9**, e130-e143.

Cheng, D., and Woo, G. C. (2021). Instant vision assessment device for measuring refraction in low vision. *Clinical and Experimental Optometry* **104**, 780-787.

Eltagoury, M., and Ghoneim, E. (2023). Pediatric cycloplegic refraction. *Medical hypothesis, discovery & innovation in optometry* **4**, 25-33.

Gu, F., Gao, H. M., Zheng, X., Gu, L., Huang, J., Meng, J., Li, J., Gao, L., Wang, J., and Zhang, R. (2022). Effect of cycloplegia on refractive error measure in Chinese school students. *Ophthalmic Epidemiology* **29**, 629-639.

Huang, P.-C., Hsiao, Y.-C., Tsai, C.-Y., Tsai, D.-C., Chen, C.-W., Hsu, C.-C., Huang, S.-C., Lin, M.-H., and Liou, Y.-M. (2020). Protective behaviors of near work and time outdoors in myopia prevalence and progression in myopic children: a 2-year prospective population study. *British Journal of Ophthalmology* **104**, 956-961.

Jahn, S. W., Plass, M., and Moinfar, F. (2020). Digital pathology: advantages, limitations, and emerging perspectives. *Journal of Clinical Medicine* **9**, 3697.

Kedia, P., and Baruah, M. (2022). A study on non-cycloplegic and cycloplegic streak retinoscopy and autorefractometry in children. *International Journal of Research in Medical Sciences* **10**, 919.

Khan, M. A., Perera, N., Doukas, F. F., Catran, A. J., Ling, D. L., Agar, A., and Francis, I. C. (2023). Are you practicing refraction in ophthalmology: instructive or outdated? A prospective study and literature review. *Clinical and Experimental Optometry* **106**, 290-295.

Lei, Y., Chen, X., Cheng, M., Li, B., Jiang, Y., Xu, Y., and Wang, X. (2023). Comparisons of objective and subjective refraction with and without cycloplegia using binocular wavefront optometer with autorefraction and retinoscopy in school-age children. *Graefe's Archive for Clinical and Experimental Ophthalmology* **261**, 1465-1472.

Magome, K., Morishige, N., Ueno, A., Matsui, T.-A., and Uchio, E. (2021). Prediction of cycloplegic refraction for noninvasive screening of children for refractive error. *Plos one* **16**, e0248494.

Mohana Priya, M., Ravi, S., and Anuradha, P. Comparison of Autorefractors and Retinoscopy with Subjective Corrections in Myopia and Hypermetropia.

Mukash, S. N., Kayembe, D. L., and Mwanza, J.-C. (2021). Agreement between retinoscopy, autorefractometry, and subjective refraction for determining refractive errors in Congolese children. *Clinical Optometry*, 129-136.

Nafea, R. D., and Abed, S. A. (2023). The Cycloplegic Autorefraction Related with Retinoscopy Patients (Article Review). *Central Asian Journal of Medical and Natural Science* **4**, 937-942.

Nisha, K., Ganapathy, S., Puthumangalathu Savithri, S., Idaguri, M., Mohanachandran, P., Vinekar, A., Chandra, P., Kulkarni, S., and Dogra, M. (2023). A novel method to improve inter-clinician variation in the diagnosis of retinopathy of prematurity using machine learning. *Current Eye Research* **48**, 60-69.

Rubio, M., Hernández, C. S., Seco, E., Perez-Merino, P., Casares, I., Dave, S. R., Lim, D., Durr, N. J., and Lage, E. (2019).

[Citation: Yar, M.A., Zahid, A.H., Nawab, R., Rao, M.R.Q., Aadil, N., Hussain, S. (2023). Comparison between autorefraction and retinoscopy for subjective correction in children. *Biol. Clin. Sci. Res. J.*, **2023***: 604*. doi: https://doi.org/10.54112/bcsrj.v2023i1.608]

Validation of an affordable handheld wavefront autorefractor. *Optometry and Vision Science* **96**, 726-732.

Samanta, A., Shetty, A., and Nelson, P. C. (2022). Better one or two? A systematic review of portable automated refractors. *Journal of Telemedicine and Telecare* **28**, 404-411.

Wilson, L. B., Melia, M., Kraker, R. T., VanderVeen, D. K., Hutchinson, A. K., Pineles, S. L., Galvin, J. A., and Lambert, S. R. (2020). Accuracy of autorefraction in children: a report by the American Academy of Ophthalmology. *Ophthalmology* **127**, 1259-1267.

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