

Practice Patterns of Subjective Refraction Among Eye Care Practitioners in Delhi NCR

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ABSTRACT

Background: Subjective refraction is integral to accurate spectacle prescription, but evolving technologies and practice settings may influence how optometrists perform refraction in India. Understanding these patterns in a high-demand urban region like Delhi NCR can help guide training, standardization, and quality of refractive services.

Methods: We conducted a cross-sectional, self-administered questionnaire survey among optometrists in Delhi NCR working in clinical settings (hospitals, eye clinics) and retail optical outlets. Inclusion criteria were a bachelor's or master's degree in optometry from India and at least one year of clinical experience. The questionnaire collected data on demographic characteristics, objective refraction methods (retinoscopy vs. autorefractor), approaches to subjective refraction (instrument choice, starting point), use of cycloplegic refraction and agents, and utilisation of the duochrome test.

Results: Of 115 respondents (50 males, 65 females), 86 (75%) were in clinical practice and 29 (25%) in retail settings. Retinoscopy was used by 62 (54%) as the primary objective method, while 53 (46%) relied on autorefractors. In retail settings, autorefractor preference was higher (≈approximately 72%) compared to 63% retinoscopy in clinical setups. Trial frames were employed by 112 (97.4%) respondents for subjective refinement; only 3 (2.6%) used phoropters. Cycloplegic refraction was undertaken exclusively in clinical practice: 62 of 86 (72%) respondents reported routine use. The most commonly used agents were atropine (mean deduction 1.75 D), homatropine (0.75 D). Duochrome testing was infrequently applied, and practitioners typically initiated subjective refraction using retinoscopy or autorefraction values, adjusting for myopia or hyperopia.

Conclusions: In the Delhi NCR region, optometrists predominantly use autorefractors in retail settings and retinoscopy in clinics, but essentially all rely on trial frames for subjective refinement. Cycloplegic refraction is limited to clinical environments, and duochrome testing is rarely used. These findings reveal notable variability in refraction practice across settings, underscoring the need for standardized guidelines and enhanced training to ensure consistency and quality in refractive care.

KEYWORDS: Subjective refraction, Retinoscopy, Autorefractor, Cycloplegia, Practice patterns, Optometry.

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INTRODUCTION

Subjective refraction remains the gold standard for determining refractive error and prescribing accurate optical correction.¹ Precise refraction not only ensures optimal visual acuity but also minimizes visual discomfort and improves patient visual satisfaction.^{2,3} Objective methods such as retinoscopy, introduced as a core skill in optometry training, provide an essential starting point for estimating refractive error but require subjective refinement to finalize prescriptions.⁴

With the introduction of autorefractors and wavefront aberrometers in the late 20th century, automated approaches became increasingly common in clinical practice; however, their role has largely remained supplementary.⁵⁻⁷ Practice patterns continue to vary widely between professional groups and regions, influenced by socioeconomic conditions, institutional settings, and access to advanced technology.⁸⁻¹¹ The clinical importance of accurate cylindrical correction, binocular balancing, and management of specific populations such as children and the elderly has been well established in previous studies.¹²⁻¹⁵ Despite the increasing use of automated devices, research indicates that objective techniques alone cannot replace clinician guided subjective refinement, particularly in eyes with irregular corneas, higher-order aberrations, or accommodation-related issues.¹⁶⁻¹⁹ Classical methods such as duochrome and Jackson cross-cylinder testing remain integral components of accurate subjective refraction.²⁰⁻²²

In India, available literature has primarily focused on the educational and comparative aspects of refraction techniques, with limited data on real-world clinical practice patterns.³¹⁻³³ Given the increasing demand for refractive services in urban regions such as the Delhi National Capital Region (NCR)- where both clinical and retail optometry practices coexist. Understanding current trend is essential for standardizing procedures and improving quality of care³⁶⁻³⁹.

This study aimed to evaluate the current practice patterns of objective and subjective refraction among eye care practitioners in Delhi NCR, focusing on the methods, instruments, and cycloplegic techniques used in day-to-day practice.

METHODS

Study Design

This was a cross-sectional, descriptive questionnaire-based survey designed to assess the current practice patterns of subjective and objective refraction among eye care practitioners in the Delhi National Capital Region (NCR), India. The study design was chosen to provide a representative overview of routine refraction practices in varied clinical and retail settings.

Setting

The study was conducted across multiple eye care settings within Delhi NCR, including private hospitals, multi-specialty eye clinics, and optical or retail outlets. Data collection took place over a period of three months.

Selection of Participants

Participants were recruited through purposive sampling. Inclusion criteria were:

1. A bachelor's or master's degree in optometry obtained from a recognized institution in India.
2. A minimum of one year of clinical experience in optometry practice.
3. Active involvement in refraction and visual assessment as part of routine professional responsibilities.

Optometry interns, ophthalmologists, and ophthalmic assistants were excluded to ensure that the sample represented independently practicing optometrists with at least four years of professional training. A total of 115 eligible participants completed the survey.

Interventions

No clinical interventions were performed in this study. The research was limited to self-reported information on existing clinical practices related to objective and subjective refraction.

Methods of Measurement

The data were collected using a structured, self-administered questionnaire developed by the investigators. The questionnaire comprised both closed- and open-ended questions, focusing on the following domains:

- Demographic information (age, gender, years of experience, and type of practice setting).
- Methods of objective refraction (retinoscopy or autorefractor).
- Techniques of subjective refraction (starting reference, fogging, binocular balancing, and duochrome use).
- Utilization of cycloplegic agents, including the type of drug used and mean deduction values.
- Preference for diagnostic tools such as trial frames or phoropters.

The questionnaire was pre-tested among ten optometrists for clarity and reliability, with minor wording adjustments made before distribution. Internal consistency was acceptable, with a Cronbach's alpha value greater than 0.6.

Data Collection and Processing

Printed questionnaires were distributed in person by the research team to optometrists across practicing area. Completed forms were collected within two weeks. Data were manually entered into Microsoft Excel (Microsoft Corp., Redmond, WA, USA) and subsequently analyzed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA).

Loss of Data

Most of the distributed questionnaires were returned, yielding a 91% response rate among those approached. Incomplete or ambiguous responses (<2%) were excluded from specific variable analyses but retained for demographic summaries. No participants lost follow-up, as this was a single-contact survey-based study.

Outcome Measures

- Primary Outcome: To determine the prevalent methods and patterns of subjective refraction practiced by optometrists in Delhi NCR.
- Secondary Outcomes: To assess (1) differences in current refraction practices between clinical and retail settings, (2) the frequency and type of cycloplegic use, (3) the prevalence of duochrome and binocular balancing techniques, and (4) the preferred diagnostic tools for subjective refraction.

Statistical Methods Used

Descriptive statistics, including frequencies, percentages, means, and standard deviations, were computed for all quantitative variables. Subgroup comparisons (e.g., clinical vs. retail settings, gender, and experience levels) were explored using crosstabulation and chi-square tests, where applicable. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 115 optometrists participated in the study, comprising 50 males (43%) and 65 females (57%). Among them, 86 (75%) practiced in clinical settings and 29 (25%) in optical retail outlets. Half of the participants (n = 57, 50%) reported less than five years of professional experience, while 26 (23%) had five to fourteen years, and 12 (10%) had more than fifteen years of experience (Table 1).

Table 1. Demographic distribution of participants (N = 115)

Characteristic	Category	n (%)
Gender	Male	50 (43)
	Female	65 (57)
Practice setting	Retail outlet	29 (25)
	Clinical setup	86 (75)
Years of experience	< 5 years	57 (50)
	5–14 years	26 (23)
	> 15 years	12 (10)

n: no of participants

Regarding objective refraction methods, 62 practitioners (54%) primarily used retinoscopy, whereas 53 (46%) relied on autorefractors. Practitioners in retail settings showed a higher dependence on autorefractors, while those in clinical setups predominantly used retinoscopy (Table 2).

Table 2. Preferred methods of objective refraction

Method of objective refraction	Retail (n = 29)	Clinical (n = 86)	Total (n = 115)
Retinoscopy	8 (28%)	54 (63%)	62 (54%)
Autorefractor	21 (72%)	32 (37%)	53 (46%)

n: no of participants

For subjective refraction, almost all participants (97.4%) used trial frames, and only three (2.6%) reported using phoropters. The average fogging value applied after retinoscopy was +0.75 D, and +0.50 D when the starting reference was derived from autorefractors, both being lower than the standard recommendation of +1.50 D.

Table 3. Cycloplegic agents used among clinical practitioners (n = 62)

Agent	Practitioners using agent	Mean deduction (D)
Atropine	49 (79%)	1.75 D
Homatropine	52 (84%)	0.75 D
Tropicamide	53 (85%)	Nil

D: diopter

Cycloplegic refraction was exclusively performed by practitioners in clinical settings. Among the 86 clinical practitioners, 62 (72%) reported routine use of cycloplegic agents (Table 3). The most frequently used agents were atropine sulfate, homatropine

hydrobromide, cyclopentolate hydrochloride, and tropicamide, with mean deduction values of 1.75 D and 0.75 D for atropine and homatropine, respectively. None of the practitioners from retail outlets reported performing cycloplegic refraction. The choice of cycloplegic drugs preferred by an optometrist shown below in figure 1.

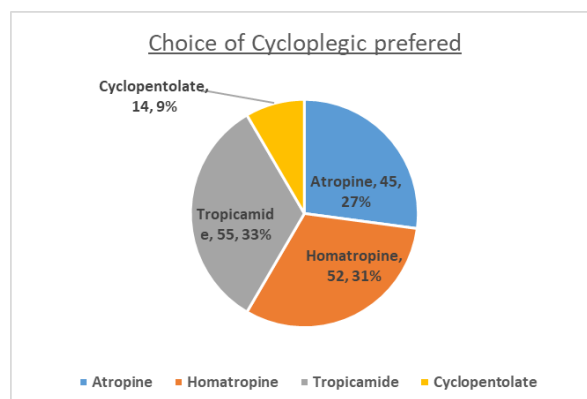


Figure 1: Choices of Cycloplegic preferred by the optometrist

The duochrome test was rarely utilized across both settings. The starting point for subjective refraction was most commonly based on either retinoscopy or autorefractor readings, adjusted according to the refractive status (myopic or hyperopic) of the patient.

DISCUSSION

The findings of this study indicate that eye care practitioners in Delhi NCR predominantly rely on trial frames and subjective refinement, supported by autorefractor readings, reflecting the established view that subjective refraction remains the gold standard despite technological advancements.^{1,2} Consistent with Harris, subjective refraction is the cornerstone of clinical practice, allowing clinicians to refine prescriptions beyond objective measurements.¹⁸ Jorge et al. highlighted that while retinoscopy and autorefraction serve as useful starting points, the accuracy of the final prescription is ultimately dependent on subjective refinement.² More recently, Jacobs et al revisited the concept of fogging in the context of the increasing prevalence of myopia, particularly in Asian populations.³⁵ Their findings highlight the need to redefine certain clinical techniques, reflecting evolving refractive error trends across generations and influencing practice patterns accordingly.³⁴

In line with global findings, Hashemi et al. reported significant discrepancies between autorefractor and subjective refraction, especially in pseudophakic and elderly patients, emphasizing the limitations of relying solely on automated methods.⁷ Similarly, Kozlov et al. and Sinha showed that objective refraction tends to underestimate refractive errors in young adults, reinforcing the need for clinician-led subjective adjustments.^{8,9} This is particularly relevant in the NCR context, where practitioners frequently encounter both pediatric and geriatric populations.

Cylinder refinement practices observed in our study are consistent with literature supporting Jackson cross-cylinder testing and duochrome verification. Gantz et al. cautioned against using the duochrome test before cylindrical correction, suggesting its role is more confirmatory,³ a finding echoed by Naqvi et al., who reported variability in duochrome reliability across refractive error types and lighting conditions.¹¹ These results reflect why NCR practitioners apply the duochrome test judiciously, as part of the subjective refinement rather than as a primary tool.

Emerging technologies, such as algorithm-based subjective refraction, have shown promising accuracy. Venkataraman et al. reported good reproducibility, yet clinical adoption remains limited compared to traditional techniques.⁴ Jost et al. validated a global rubric for clinical skills in subjective refraction, emphasizing the importance of standardized training to improve reliability and reduce inter-practitioner variability.⁵ Self-refraction methods, though convenient, remain less reliable, with Babu et al. reporting moderate agreement with cycloplegic subjective refraction in young adults.⁶ Jones and Meyer reaffirmed that retinoscopy provides a critical objective baseline that supports, but does not replace, subjective assessment.¹²

Cycloplegia continues to play an important role, particularly in pediatric and latent hyperopia cases, as emphasized by Kaur and Gurnani.¹⁰ While autorefractors enhance efficiency, their readings often require subjective adjustment to achieve optimal visual outcomes, a practice reflected among NCR practitioners. Wavefront aberrometry and other advanced technologies, though increasingly available in tertiary centers, have not supplanted clinician-led subjective refraction.¹⁶⁻¹⁷ Limitations include reliance on self-reported data and geographic restriction to Delhi NCR, which may not fully capture national practice patterns.

Summary of literature

Author (Year)	Focus	Key Findings	Relevance to Present Study
Harris (2007) (18)	Mechanism of subjective refraction	Established as gold standard	Supports reliance on subjective refinement
Jorge et al. (2005) (2)	Retinoscopy vs. Autorefraction	Objective useful, subjective essential	Aligns with NCR practice pattern
Gantz et al. (2015) (3)	Duochrome testing	Limited role before cylinder correction	Explains cautious use among NCR practitioners
Venkataraman et al. (2020) (4)	Algorithm-based refraction	Promising, limited adoption	Emerging, not routine in NCR
Jost et al. (2022) (5)	Training rubric	Standardization improves reliability	Suggests educational policy need
Babu et al. (2022) (6)	Self-refraction	Moderate accuracy, not clinically sufficient	Supports clinician-led methods
Hashemi et al. (2023) (7)	Auto vs subjective in geriatrics	Large discrepancies in pseudophakia	Reinforces NCR reliance on subjective
Kozlov et al. (2024) (8)	Young adults	Subjective more accurate	Consistent with NCR findings
Sinha (2024) (9)	Subjective vs objective	Objective underestimates error	Validates NCR approach
Kaur & Gurnani (2025) (10)	Cycloplegic vs non-cycloplegic	Cycloplegia crucial in children	Highlights importance in pediatric practice
Naqvi et al. (2025) (11)	Duochrome reliability	Variable by error type & lighting	Explains NCR practitioner variability
Jones & Meyer (2021) (12)	Retinoscopy fundamentals	Essential baseline for refraction	Supports autorefractor with subjective refinement

CONCLUSION

In the Delhi NCR region, optometrists predominantly use autorefractors in retail settings and retinoscopy in clinics and rely on trial frames for subjective refinement. Cycloplegic refraction is limited to clinical environments. These findings reveal notable variability in refraction practice across settings, underscoring the need for standardized guidelines and enhanced training to ensure consistency and quality in refractive care. Standardized instruction in both traditional and modern techniques can help reduce variability, improve prescription accuracy, and optimize patient outcomes. Future multicentric observational studies are warranted to explore regional variations in practice.

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