The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 6, 2025

POSITIVE PREDICTIVE VALUE OF BORRONE'S METHOD IN ESTIMATING NARROW ANGLES TAKING GONIOSCOPY AS GOLD STANDARD

Dr. Danish Rafique[*1], Dr. Munib Ur Rehman[2], Dr. Samia Andleeb[3]

[*1] *Post Graduate Trainee (FCPS Ophthalmology), Allama Iqbal Memorial Teaching Hospital, Sialkot.*
[2] *Associate Professor, Department of Ophthalmology (Study Supervisor), Allama Iqbal Memorial Teaching Hospital, Sialkot.*
[3] *Senior Registrar, Department of Ophthalmology, Allama Iqbal Memorial Teaching Hospital, Sialkot.*

[*1]dr11161@yahoo.com

DOI: https://doi.org/10.5281/zenodo.18859713

Keywords
Narrow-Angle Glaucoma, Angle-Closure Glaucoma, Gonioscopy, Anterior Chamber, Diagnostic Techniques and Procedures, Predictive Value of Tests, Borrone Method

Article History
Received: 10 June 2025
Accepted: 18 June 2025
Published: 30 June 2025

Corresponding Author: *
Dr. Danish Rafique

Abstract

Background: *Narrow-angle glaucoma is often undiagnosed until advanced stages. Gonioscopy is the gold standard but is time-consuming. Borrone's method offers a simpler alternative, yet data are limited. This study evaluated its positive predictive value compared with gonioscopy.*

Objectives: *To determine the positive predictive value of Borrone's method in estimating narrow angles taking gonioscopy as gold standard in patients with angle closure glaucoma.*

Duration: *10-01-2025 to 31-05-2025*

Methodology: *After obtaining written informed consent, patients presenting to the Ophthalmology outpatient ward of Allama Iqbal Memorial Teaching Hospital, Sialkot with symptoms of angle closure were assessed using Borrone's method. Gonioscopic assessment was performed by a senior ophthalmologist unaware of Borrone's findings to determine positive predictive value. Data were recorded and analyzed using SPSS version 27.0.*

Results: *The study included 139 participants (mean age 50.37±10.99 years), with 34 (24.5%) aged 18–45 and 105 (75.5%) aged 46–70. Females numbered 80 (57.6%) and males 59 (42.4%). Borrone's method identified 130 true positives (93.5%) and 9 false positives (6.5%). PPV by age and gender ranged 91.2–95.0% with no significant difference between subgroups.*

Conclusion: *Borrone's method demonstrated a high positive predictive value (93.5%) for estimating narrow-angle glaucoma when compared with gonioscopy as the gold standard. Stratification by age and gender showed no significant differences, indicating its reliability across demographic groups as an effective, non-invasive screening tool for narrow angles.*

INTRODUCTION

Glaucoma is a major cause of irreversible blindness worldwide and ranks as the second leading cause of blindness after cataracts. Most cases are attributed to primary open-angle glaucoma, while approximately one-fourth result from primary angle-closure glaucoma (PACG).[1] PACG is responsible for around 26% of glaucoma-related blindness globally.[2,3] It occurs when the drainage angle in the anterior

chamber narrows either by appositional contact or adhesions (synechiae), eventually leading to complete occlusion. This blockage raises intraocular pressure (IOP), causing glaucomatous optic neuropathy characteristic of PACG.[3]

Multiple risk factors contribute to the development of PACG, including older age, female sex, certain ethnic backgrounds such as East Asian and Inuit populations, family history, genetic predisposition, short axial length, thick or anteriorly positioned lens (high lens vault), flat cornea, and smaller corneal diameter.[5] Detecting PACG is challenging due to its often asymptomatic presentation in early stages.[6] Early identification of angle closure is crucial for timely intervention and prevention of irreversible vision loss.[7]

Gonioscopy remains the gold standard for evaluating the anterior chamber angle (ACA), providing direct visualization of angle structures.[8,9] It is cost-effective, can be rapidly performed using a slit lamp, allows dynamic observation of the angle quadrant, and distinguishes between synechial and appositional closure through indentation.[10] Additional imaging modalities, including ultrasound biomicroscopy (UBM) and anterior segment optical coherence tomography (AS-OCT), are also used to assess ACA and guide appropriate glaucoma management.[11]

Borrone's method has emerged as a practical alternative for screening narrow angles.[12] This technique uses low-intensity erythritol-based green light, which induces pupil constriction without altering anterior chamber depth measurements. Its design ensures high sensitivity, specificity, reliability, and reproducibility for detecting narrow angles, making it a potentially efficient tool in clinical and community-based glaucoma screening.[12]

Evidence on the diagnostic accuracy of Borrone's method is limited to a single international study.[12] This study aimed to assess the positive predictive value of Borrone's method in detecting narrow angles, using gonioscopy as the gold standard. It sought to determine whether Borrone's method could function as a simple, reliable, and accessible screening tool for narrow-angle glaucoma, or if its accuracy was insufficient, thereby guiding decisions about its adoption in both clinical practice and community-based eye care programs.

METHODOLOGY

This cross-sectional survey was conducted in the Department of Ophthalmology, Allama Iqbal Memorial Teaching Hospital, Sialkot after ethical review and synopsis approval. A total of 139 cases were included, calculated with a 95% confidence level and 5% margin of error, assuming an expected positive predictive value of 90% for Borrone's method in diagnosing narrow angles using gonioscopy as the gold standard.[12] Ethical review committee approval was taken

Narrow angles were defined according to Borrone's method as a peripheral anterior chamber depth of ≤50% of the adjacent corneal thickness. Gonioscopy-defined narrow angles were labelled using Shaffer's classification, with grades 0–2 considered narrow. True positives were narrow angles detected by Borrone's method and confirmed on gonioscopy, whereas false positives were narrow angles labelled by Borrone's method but not confirmed on gonioscopy. Non-probability consecutive sampling was used. Inclusion criteria were patients of both genders aged 18–70 years with angle-closure glaucoma on gonioscopy. Exclusion criteria included patients with prior refractive or phacorefractive surgery, ocular trauma, previously diagnosed narrow-angle spectrum, iridotomy, or corneal opacities preventing evaluation.

After obtaining informed written consent, patients presenting to the outpatient ward with symptoms of primary angle glaucoma were assessed using Borrone's method. The slit lamp illumination arm was set at a 30-degree angle with 1.6X magnification through a red filter. A vertical light slit of 4 mm length and minimal width was used to visualize the peripheral anterior chamber cut at the temporal corneal periphery. Patients labelled with narrow angles by Borrone's method were included, and demographic data were recorded. Gonioscopic assessment was performed by a senior ophthalmologist who was unaware of Borrone's findings to determine the positive predictive value. All measurements were recorded by the resident to avoid bias, and confounding variables were controlled through exclusion.

All data were entered and analyzed using SPSS version 27. Numerical variables, such as age, were presented as mean ± SD, while categorical variables,

including gender and narrow-angle status, were presented as frequency and percentage. The positive predictive value of Borrone's method compared with gonioscopy was calculated and presented as frequency and percentage. Data were stratified by age and gender to control for effect modifiers, and post-stratification chi-square tests were applied, with $p \leq 0.05$ considered statistically significant. PPV was calculated using below formula:-

$$PPV = \frac{\text{True Positive}}{\text{True Positive + False Positive}} \times 100$$

RESULTS

The study included a total of 139 participants with a mean age of 50.37±10.99 years. Among them, 34 participants (24.5%) were aged between 18 and 45 years, while the majority, 105 participants (75.5%), were aged between 46 and 70 years. Regarding gender distribution, 80 participants (57.6%) were female, and 59 participants (42.4%) were male, indicating a slightly higher representation of females in the study population. Data is given in Table 1.

Table 2 presents the confirmation of narrow-angle glaucoma using Borrone's method, with gonioscopy considered as the gold standard. Out of 139 participants, 130 were confirmed to have narrow-angle glaucoma (true positives), representing 93.5%, while 9 participants were false positives (6.5%). These results indicate that Borrone's method has a high accuracy in predicting narrow-angle glaucoma when compared with gonioscopy.

The positive predictive value (PPV) of Borrone's method for detecting narrow-angle glaucoma was further analyzed after stratifying participants by age and gender. When stratified by age, among the 34 participants aged 18–45 years, 31 were true positives and 3 were false positives, yielding a PPV of 91.2%. In the 46–70 years age group (n=105), 99 were true positives and 6 were false positives, resulting in a PPV of 94.3%. The difference in PPV between the two age groups was not statistically significant (p=0.522) as shown in Table 3.

Similarly, stratification by gender showed that among 59 male participants, 54 were true positives and 5 were false positives, giving a PPV of 91.5%. Among 80 female participants, 76 were true positives and 4 were false positives, yielding a PPV of 95.0%. The observed difference between males and females was also statistically insignificant (p=0.411) as given in Table 4.

Table 1: Demographic Characteristics of Patients Included in the Study

Characteristics	Total (139)
Age (years)	50.37±10.99
• 18-45 years	34 (24.5%)
• 46-70 years	105 (75.5%)
Gender	
• Male	59 (42.4%)
• Female	80 (57.6%)

Table 2: Confirmation of Narrow Angle Glaucoma via Borrone's Method taking Gonioscopy as Gold Standard n=139

Narrow Angle Glaucoma	Frequency (n)	Percentage (%)
Yes *(True Positive)*	130	93.5 %
No (False Positive)	9	6.5 %
Total	139	100.0 %

Positive Predictive value = $\frac{\text{True positive}}{\text{}} \times 100$

$$\text{Positive Predictive value} = \frac{\text{True Positive}}{\text{True Positive + False Positive}} \times 100$$

$$\text{Positive Predictive value} = \frac{130}{130+9} \times 100$$

Positive Predictive value = 93.5 %

Table 3: PPV of Narrow Angle Glaucoma via Borrone's Method taking Gonioscopy as Gold Standard Stratified for Age

Age	Gonioscopy		Total	PPV	P-value
	True Positive (n=130)	False Positive (n=9)			
18-45 years (n=34)	31 91.2%	3 8.8%	34 100.0%	91.2%	0.522
46-70 years (n=105)	99 94.3%	6 5.7%	105 100.0%	94.3%	
Total	130 93.5%	9 6.5%	139 100.0%		

Chi-square test, observed difference was statistically insignificant, PPV: Positive Predictive Value

Table 3: PPV of Narrow Angle Glaucoma via Borrone's Method taking Gonioscopy as Gold Standard Stratified for Gender

Gender	Gonioscopy		Total	PPV	P-value
	True Positive (n=130)	False Positive (n=9)			
Male (n=59)	54 91.5%	5 8.5%	59 100.0%	91.5%	0.411
Female (n=80)	76 95.0%	4 5.0%	80 100.0%	95.0%	
Total	130 93.5%	9 6.5%	139 100.0%		

Chi-square test, observed difference was statistically insignificant, PPV: Positive Predictive Value

DISCUSSION

Narrow-angle glaucoma is a significant cause of irreversible vision loss, often remaining undetected until advanced stages.[13] Gonioscopy is considered the gold standard for identifying narrow angles, but it is time-consuming, requires expertise, and may not be feasible for mass screening.[14,15] Various non-invasive techniques have been proposed to estimate anterior chamber angles, including Borrone's method, which offers a simpler alternative.[16,17] However, published data on its diagnostic accuracy are limited.[12] To address this gap, the present study was planned to evaluate the positive predictive value of Borrone's method in detecting narrow-angle glaucoma, using gonioscopy as the gold standard.

In the present study, we evaluated the positive predictive value (PPV) of Borrone's method in estimating narrow angles, using gonioscopy as the gold standard. Out of 139 participants, 130 eyes were true positives and 9 eyes were false positives, resulting in an overall PPV of 93.5%. Stratification by age revealed a PPV of 91.2% in participants aged 18–45 years and 94.3% in those aged 46–70 years.

Similarly, when stratified by gender, PPV was 91.5% for males and 95.0% for females. The differences between age and gender groups were statistically insignificant, indicating consistent performance of Borrone's method across demographic variables.

Comparing our findings with existing literature, Piero et al.[12] conducted a study in Chile involving 32 patients (64 eyes) who met inclusion criteria. Using gonioscopy as the gold standard, 16 eyes were identified with narrow angles and 48 with open angles. The sensitivity and specificity of Borrone's method were calculated using a selected cutoff point, showing a sensitivity of 96% and specificity of 91% with 95% confidence intervals. These findings demonstrate that Borrone's method is highly reliable and reproducible in detecting narrow iridocorneal angles, particularly in high-volume outpatient ophthalmology settings.

The results of our study are in line with Piero et al.,[12] showing a similarly high PPV and confirming the accuracy of Borrone's method in clinical practice. While our study included a larger sample (139 participants), the PPV remained consistently high across age and gender groups, reinforcing the utility of Borrone's method as a non-invasive, efficient screening tool. Despite limited published data, our findings provide additional evidence supporting the adoption of Borrone's method, particularly in settings where gonioscopy may not be feasible for routine screening.

CONCLUSION

Borrone's method demonstrated a high positive predictive value (93.5%) for estimating narrow-angle glaucoma when compared with gonioscopy as the gold standard. Stratification by age and gender showed no significant differences, indicating its reliability across demographic groups as an effective, non-invasive screening tool for narrow angles.

LIMITATIONS & RECOMMENDATIONS

This study's strengths include a relatively large sample size (139 participants) and systematic comparison of Borrone's method with gonioscopy as the gold standard, providing robust data on its positive predictive value across age and gender. Limitations include the single-center design and lack of comparison with other non-invasive techniques. Future studies should include multi-center trials, larger, more diverse populations, and evaluation of Borrone's method alongside emerging imaging modalities to further validate its diagnostic accuracy.

Conflict of Interest: None
Source of Funding: None

Authors Contribution

Author 1

Substantial contributions to study design, acquisition of data
Analysis & Interpretation of Data, Manuscript writing
Has given final approval of the version to be published
Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Author 2,3

Substantial contributions to concept, study design
Data Analysis, Manuscript writing, Critical Review
Has given final approval of the version to be published
Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

REFERENCES

Jain N, Zia R. The prevalence and break down of narrow anterior chamber angle pathology presenting to a general ophthalmology clinic. Medicine. 2021; 100(24):e26195.

Sun Y, Chen A, Zou M, Zhang Y, Jin L, Li Y, et al. Time trends, associations and prevalence of blindness and vision loss due to glaucoma: an analysis of observational data from the global burden of disease study 2017. BMJ Open. 2022;12(1):e053805.

Lee CS, Lee ML, Yanagihara RT, Lee AY. Predictors of narrow angle detection rate-a longitudinal study of Massachusetts residents over 1.7 million person years. Eye. 2021; 35(3):952-8.

Jindal A, Ctori I, Virgili G, Lucenteforte E, Lawrenson JG. Non-contact methods for the detection of people at risk of primary angle

closure glaucoma. Cochrane Database Syst Rev. 2018; 2018(2):CD012947.

Shalaby WS, Reddy R, Razeghinejad R, Katz LJ. Contemporary approach to narrow angles. J Ophthalmic Vis Res. 2024; 19(1):88-108.

Soh ZD, Jiang Y, Ganesan SS, Zhou M, Nongi M, Majithia S, et al. From 2 dimensions to 3rd dimension: quantitative prediction of anterior chamber depth from anterior segment photographs via deep-learning. PLOS Digit Health. 2023; 2(2):e0000193.

Nwazulu BH, Kizor-Akaraiwe NN, Okeke S, Oko C, Udeh SC, Obi DC. Determinants of blindness from glaucoma among patients receiving treatment: a retrospective cohort study in Enugu, Nigeria. BMC Ophthalmol. 2025;25(1):1-1.

Craven ER, Chopra V, Goldberg JL, Marion KM, Chen X, Chang CT et al. Comparison of iridocorneal angle assessments in open-angle glaucoma and ocular hypertension patients: anterior segment optical coherence tomography and gonioscopy. Clin Ophthalmol. 2022; 16:1301-12.

Zhang Y, Dong Z, Zhang Q, Li L, Thomas R, Li SZ et al. Detection of primary angleclosure suspect with different mechanisms of angle closure using multivariate prediction models. Acta Ophthalmol. 2021; 99(4):e576-86.

Imran K, Khan NA, Zaib HM, Nazir F, Khalid A. Comparison of gonioscopy and anterior segment OCT for detecting angle closure in different quadrants of anterior chamber angle in angle closure glaucoma. Pak J Ophthalmol. 2023; 39(2):123-7.

Bessa NM, de Azevedo Souza R, Santhiago MR, Moraes Jr HV, Gomes BF. Dual scheimpflug imaging as a screening method for occludable angles-a comparison with gonioscopy. Int J Ophthalmol. 2019; 12(2):241-5.

Piero B, Gigliola B, Mauricio P. Comparison of "Van Herick's" method versus "Borrone's" method for estimating narrow angles. Adv Ophthalmol Vis Syst. 2024; 14(1):14-6.

Zhou QU, Guo JI, Chen ZH, Chen W, Deng CH, Yu TI, et al. Deep learning-based classification of the anterior chamber angle in glaucoma gonioscopy. Biomed Optics Express. 2022;13(9):4668-83.

Desmond T, Tran V, Maharaj M, Carnt N, White A. Diagnostic accuracy of AS-OCT vs gonioscopy for detecting angle closure: a systematic review and meta-analysis. Graefe's Arch Clin Exp Ophthalmol. 2022;260(1):1-23.

Bilalov EN, Narziqulova QI, Zakirkhojayev RA, Oralov BA. Optimization of anterior chamber angle imaging approach using anterior optical coherence tomography in glaucoma. West Eur J Med Med Sci. 2024;2(4):14-20.

Camacho CD, Camacho SA, Ohana C, Almeida S, Miguel BM. Glaucoma Agudo: abordagem inicial do clínico generalista, o que todo médico necessita saber. Braz J Health Rev. 2024;7(5):e73623.

Nolan W, Onakoya A. Gonioscopy skills and techniques. Community Eye Health. 2022;34(112):40-42