

Comparison of “Van Herick’s” method versus “Borrone’s” method for estimating narrow angles

Abstract

Background: Strategies for indirectly assessing the iridocorneal angle aim to be reproducible, reliable, and comparable to gonioscopy for screening in cases of narrow angles and their clinical spectrum.

Objectives: The objective of this study is to determine which of the indirect estimation methods of the iridocorneal angle, either the “Van Herick” method or the “Borrone” method, exhibits a higher correlation with gonioscopy in detecting narrow iridocorneal angles in patients at the Ophthalmology outpatient clinic of the Hospital San Borja Arriarán.

Materials and methods: A cross-sectional study was conducted with a sample of 32 patients (64 eyes) who met the inclusion and exclusion criteria. Results were obtained through gonioscopy, identifying narrow angles in 16 eyes and open angles in 48 eyes. Sensitivity and specificity of both methods (Borrone and Van Herick) were calculated in comparison to gonioscopy, using a selected cutoff point.

Results: The Borrone method showed a sensitivity of 96% and a specificity of 91%, with a 95% confidence interval, compared to gonioscopy. In contrast, the Van Herick method demonstrated a sensitivity of 77% and a specificity of 82% in relation to gonioscopy.

Discussion: The high sensitivity and specificity of the “Borrone” method are attributed to its technical details and its dichotomous nature, making it easier for the operator to determine and interpret. This reduces variability and provides a high correlation with gonioscopy.

Conclusions: In this study, the “Borrone” method was found to have a more significant correlation with gonioscopy compared to the “Van Herick” method. Therefore, the “Borrone” method is considered more reliable and reproducible for detecting possible narrow iridocorneal angles, especially in high patient volume settings, such as ophthalmology outpatient clinics.

Keywords: gonioscopy, iridocorneal angle, glaucoma

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Introduction

Glaucoma stands as the leading cause of irreversible blindness worldwide, distinguished by a progressive optic neuropathy. It can be categorized into two major groups for classification: primary open-angle glaucoma (POAG) or narrow-angle glaucoma (NAG).^{1,2}

Focusing on the narrow-angle spectrum, it subdivides into three categories: (1) Primary Angle Closure Suspect (PACS), (2) Primary Angle Closure (PAC), (3) Primary Angle-Closure Glaucoma (PACG), forming a continuum among these entities.¹

Gonioscopy is considered the “gold standard” clinical method for assessing the characteristics of the iridocorneal angle (ICA).³ However, its execution is not always feasible in a high-volume patient care setting. Therefore, the indirect assessment of the ICA has been employed as a non-invasive alternative to gonioscopy, particularly in the context of screening.

Up to this point, the clinical method for estimating the ICA utilized is the “Van Herick” method and its modification by Foster.^{4,5} Nevertheless, data regarding its sensitivity and specificity have not been satisfactory.

Hence, a new method for indirect estimation of the ICA, the peripheral anterior chamber cut (PACC) defined as the “Borrone” method, as described in its original work, demonstrates a sensitivity of 99% and specificity of 95.7% for detecting narrow angles.⁶ This indicates that its discriminatory ability surpasses that reported

by various authors using the “Van Herick” method. Therefore, the consideration of incorporating this new method in general ophthalmologic clinical evaluation is proposed, particularly for narrow-angle screening, aiming to enhance sensitivity in its detection.

Materials and methods

Objective: To determine which method of indirect iridocorneal angle estimation, comparing that described by “Van Herick” with that described by “Borrone”, has a better correlation with gonioscopy to detect narrow angles.

Study type and design: Cross-sectional study conducted between September and October 2022, within the ophthalmology department of San Borja Arriarán Clinical Hospital, Chile.

A double-blind approach between evaluators is employed in the measurement, where data from the indirect methods are assessed by two first-year resident trainees. To standardize both measurements, the methodology for the Borrone method was followed, utilizing the slit lamp’s illumination arm at a 30-degree angle, a magnification of 1.6X, and employing an anitra light filter available in the slit lamp. The vertical light slit was set to a length of 4 mm and a minimal width allowing for a visible peripheral anterior chamber cut coinciding with the temporal corneal periphery.⁶ For the Van Herick method, the lighting system was positioned 60 degrees from the observation system, projecting the light beam vertically with minimal amplitude towards the most peripheral point of the anterior chamber, as close as

possible to the temporal limbus. This was performed while the patient maintained a primary gaze position, with moderate magnification (10X), similar to conducting an optical section⁴.

Accordingly, the data obtained from the measurements using the “Sussman” 4-mirror gonioscope in gonioscopy are tabulated separately and independently. These measurements are conducted by a single expert operator, an ophthalmologist specializing in glaucoma.

Study population: Patients attending the general ophthalmology outpatient clinic at San Borja Arriarán Clinical Hospital who meet the inclusion criteria.

Sample Size: 32 patients (64 eyes).

Inclusion criteria: Patients over 18 years old without ocular pathology, except for refractive errors.

Exclusion criteria: Patients with a history of refractive, phacorefractive eye surgery, ocular trauma, previously diagnosed narrow-angle spectrum, iridotomy, or corneal opacities that impede evaluation.

Measurement:

For the “Van Herick” method, in the context of our study, it is defined as a dichotomous variable; narrow angles (grades: 0-1-2) and open angles are considered (grades 3-4) (Table 1). Meanwhile, the “Borrone” method, based on the Peripheral Anterior Chamber Depth (PACD) (Table 2), is presented as dichotomous variables in the assessment.

Table 1 “Van Herick” method, grades

Grade 4: Corneal thickness
Grade 3: 1/4 to 1/2 of Corneal thickness
Grade 2: 1/4 Corneal thickness
Grade 1: < 1/4 Corneal thickness
Closed: Absence of anterior chamber periphery

Table 2 “Borrone” method classification

- a) PCAP ≤ 50% of ECA, narrow angle
- b) PCAP > 50% of ECA, open angle

PCAP, Peripheral anterior chamber depth; ECA, Adjacent corneal thickness

Gonioscopy, classified by the Shaffer system, is dichotomized into grades 0 to 2 as narrow angles and grades 3 to 4 as open angles.

Statistical analysis:

Sensitivity, specificity, positive-negative predictive value, positive-negative likelihood ratio, “Receiver Operating Characteristic” (ROC) curve, and “Area Under the Curve” (AUC) were calculated, comparing the results obtained from the “Borrone and Van Herick” methods with those from gonioscopy considered as the “gold standard.”

The data were analyzed using statistical packages: Medcalc 11.2, winepi.net, on Microsoft and Mac platforms.

Ethical procedures:

Information was recorded during clinical measurements, with prior registration in the electronic medical record platform “Florence,” ensuring the confidentiality of personal data and authorization from the institution’s ethics committee.

Results

Out of the 32 patients (64 eyes evaluated), 18 were women (56.25%), and 14 were men (43.75%). Narrow angles were identified in 16 eyes through gonioscopy, while 48 evaluated eyes had open angles.

The sensitivity (S) and specificity (E) of the “Borrone” method compared to gonioscopy with the selected cutoff point were 96% and 91% with a 95% confidence interval (CI), respectively (Table 3). The sensitivity and specificity of the Van Herick method compared to gonioscopy were 77% and 82% with a 95% confidence interval (CI), respectively (Table 3).

Table 3 Statistical comparison of “Van Herick” vs “Borrone” methods for narrow angle

	Van Herick	Borrone
Sensitivity	0.77	0.96
Specificity	0.82	0.91
PPV (VPP)	0.7	0.9
NPV (VPN)	0.84	0.93
LR (+)	3.35	7.01
LR (-)	0.12	0.04

VPP, positive predictive value; VPN (-), negative predictive value; LR (+), positive likelihood ratio; LR (-), negative likelihood ratio

The Receiver Operating Characteristic (ROC) curve and the Area Under the Curve (AUC) were calculated to determine the discriminatory capacity between closed and open angles. The AUC for the “Borrone” method was 0.858 (95% CI, with p < 0.01) (Figure 1).

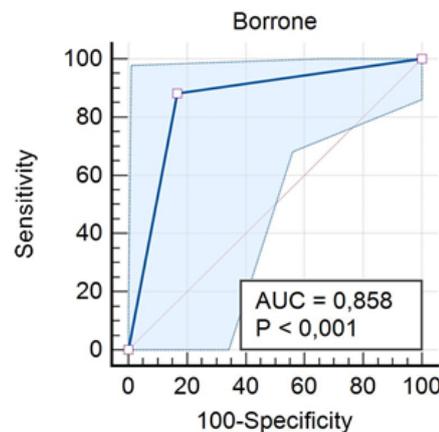


Figure 1 Area Under the Curve (AUC) and Receiver Operating Characteristic (ROC) curve.

The correlation between the “Borrone” method and gonioscopy, assessed by the degree of agreement, was determined to be “excellent” with a Kappa value of 0.89 (Table 4).

Table 4 Agreement between methods - kappa coefficient

	Coefficient Kappa
Kappa Coefficient	0.89
Confidence Interval (0)	(0.59, 1.099)
Confidence Interval (1)	(0.68, 0.997)

Finally, the “Borrone” method correctly estimated narrow angles in 16 out of 16 cases and overestimated 4 cases within the sample measured through gonioscopy.

Discussion

Measurements were conducted with a double-blind approach between operators for indirect methods of dichotomous estimation of the iridocorneal angle and their correlation with gonioscopy. The method defined by “Borrone,” which utilizes erythritol-based green light at lower intensity, allows for pupil constriction, thus not influencing the measurement of the anterior chamber depth. This is due to the iris acting like a sponge, changing its volume significantly during miosis induced by light or mydriasis in darkness. The latter contributes as an appositional mechanism to the trabecular meshwork and narrowing of the iridocorneal angle.⁷

While both methods have a relatively rapid learning curve, the perceived variability between operators is higher with the “Van Herick” method. This observation aligns with the high variability in sensitivity reported in other series as described in the literature.

When comparing both indirect methods in terms of statistical values, there were no significant differences in terms of sensitivity or specificity. However, the raw results favor the “Borrone” method, showing a high correlation with gonioscopy considered as the “gold standard” for this evaluation.

The technical details regarding the measurement of this newer method, as described by “Borrone,” extrapolate to excellent sensitivity, specificity, reliability, and reproducibility in the screening of narrow angles.

For our study, it’s important to consider that the indirect measurements of the iridocorneal angle were performed by two first-year resident trainees, resulting in low variability between them but potentially higher compared to an experienced ophthalmologist. This point could be a limitation due to measurement bias. However, the aim is to determine which of the methods is more intuitive when evaluating patients and thus obtain a safe, reproducible, and consistent result with gonioscopy, especially among physicians in training.

To our consideration, the major weakness of this study is the low sample size in each study group. This is due to the fact that the Borrone method is a newly proposed methodology. Therefore, we decided to conduct an assessment of its performance (as mentioned, using first-year resident trainees) and subsequently carry out a study with a larger sample size (around 154 patients per group according to sample size calculation) to have a more robust experience with greater statistical significance.

Conclusion

It is essential to have an indirect method for evaluating the iridocorneal angle to streamline assessment processes in high-volume outpatient clinics with the least possible margin of error. Based on current evidence, the “Borrone” method should be considered for screening narrow angles. However, a larger sample size is needed to determine with greater statistical power the validation of this method; our work serves as a starting point for future studies.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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