



ORIGINAL RESEARCH ARTICLE

Distribution and Severity Correlation of Classic Visual Field Defect Patterns on Standard Automated Perimetry in Newly Diagnosed Primary Open-Angle Glaucoma: A Retrospective Single-Institution Study

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Abstract

Background: Standard automated perimetry (SAP) remains the primary method for assessing visual function loss in primary open-angle glaucoma (POAG), and characteristic defect patterns, including paracentral scotoma, nasal step, and arcuate (Bjerrum) scotoma, have long been described as hallmark findings, but institutional data on the distribution of these defect patterns and their relationship to disease severity are useful for local benchmarking. **Methods:** We designed a retrospective, single-center study (simulated for this exercise) of patients with newly diagnosed POAG undergoing standard automated perimetry over a one-year period at a hypothetical glaucoma clinic, describing the distribution of classic visual field defect patterns and their association with mean deviation (MD) severity category. **Results:** In this simulated dataset (n = 436 eyes), arcuate scotoma was the most common defect pattern (38.5%), followed by nasal step (26.4%) and superior paracentral scotoma (21.1%), with a diffuse or non-specific pattern in the remainder. Mean deviation was most severely reduced in eyes with arcuate scotoma (-8.4 dB) and least reduced in eyes with isolated paracentral scotoma (-3.1 dB). **Conclusion:** These illustrative findings are consistent with the published literature (through 2014) in supporting standard automated perimetry as an essential tool for characterizing the classic, spatially patterned visual field loss of POAG and its correlation with functional disease severity.

Keywords: automated perimetry, open-angle glaucoma, hallmark, Retrospective, arcuate scotoma

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1 | INTRODUCTION

Primary open-angle glaucoma is a chronic optic neuropathy characterized by progressive retinal ganglion cell loss, producing characteristic patterns of visual field defect that reflect the anatomic distribution of the retinal nerve fiber layer (1, 2). Standard automated perimetry, using algorithms such as the Swedish Interactive Threshold Algorithm (SITA), has become the standard clinical method for detecting and monitoring these functional changes, offering improved test efficiency over earlier full-threshold strategies while maintaining diagnostic accuracy (3, 4).

Classic glaucomatous visual field defects include paracentral scotomas, nasal steps that respect the horizontal midline, and arcuate (Bjerrum) scotomas that trace the curved path of retinal nerve fiber bundles from the optic disc toward the horizontal raphe, with each pattern reflecting different stages and locations of nerve fiber layer damage (5, 6). This study was designed, as a hypothetical exercise, to describe the distribution of these classic defect patterns and their relationship to overall visual field severity, as measured by mean deviation, within a single simulated institutional cohort of patients with newly diagnosed POAG over a one-year period.

1.1 | Study Objectives

The aims of this study were: (1) to describe the distribution of classic glaucomatous visual field defect patterns among eyes with newly diagnosed POAG; and (2) to compare mean deviation severity across defect pattern categories.

2 | METHODS

2.1 | Study Design and Setting

This was designed as a retrospective, descriptive, single-institution cohort study set at a hypothetical academic glaucoma clinic with a standardized SITA-based automated perimetry protocol. The simulated study period spanned twelve consecutive months. No real patient-level data were collected for this

exercise; cohort size and finding distributions were constructed to fall within ranges reported in the published pre-2014 glaucomatous visual field literature (6–8).

2.2 | Study Population and Testing Protocol

The simulated cohort included eyes with newly diagnosed POAG, confirmed by open angle on gonioscopy, a glaucomatous-appearing optic disc, and a reliable, reproducible abnormal visual field on 24-2 SITA Standard automated perimetry, consistent with diagnostic criteria used in prior landmark glaucoma treatment trials (9–11). Reliability criteria (fixation losses, false-positive, and false-negative rates within accepted limits) were simulated as having been applied consistent with standard perimetric reliability thresholds established in foundational perimetry variability studies (6, 12).

2.3 | Outcome Definitions

Each eye was assigned to a single predominant visual field defect pattern category (superior or inferior paracentral scotoma, nasal step, arcuate scotoma, or diffuse/non-specific loss) based on masked review of the printed field, consistent with classification approaches used in prior descriptive glaucomatous field-pattern literature (5). Mean deviation, a global perimetric index reflecting the average deviation from age-matched normal values across the tested field, was recorded for each eye and grouped into severity categories, consistent with global index interpretation described in standard perimetry references (3, 13).

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2.4 | Statistical Analysis

Descriptive statistics (counts, percentages, and means) were used to summarize defect pattern distribution and mean deviation by category. Given the illustrative nature of this exercise, no formal inferential hypothesis testing was performed across pattern categories. All summary statistics were generated for this academic exercise rather than derived from an underlying patient-level dataset.

3 | RESULTS

3.1 | Distribution of Visual Field Defect Patterns

Over the simulated one-year study period, 436 eyes with newly diagnosed POAG underwent standard automated perimetry. Figure 1 schematically illustrates the three classic defect patterns, and Table 1 summarizes their distribution and associated mean deviation within this simulated cohort.

3.2 | Summary of Findings

In this simulated dataset, arcuate scotoma was the most common and most severe defect pattern by mean deviation, while isolated paracentral scotoma, though relatively common, was associated with the least severe mean deviation, consistent with its recognized role as an earlier-stage finding.

4 | DISCUSSION

The defect pattern distribution and severity gradient observed in this simulated dataset are broadly consistent with foundational structure-function literature describing paracentral scotoma as an early manifestation of focal nerve fiber bundle damage, with progression toward more extensive arcuate defects as disease advances and a greater proportion of the corresponding nerve fiber bundle is lost (1, 8). The prevalence of nasal step, respecting the horizontal midline due to the anatomic arrangement of retinal nerve fiber bundles around the horizontal raphe, is consistent with its long-recognized status as a classic,

specific, though not universally sensitive, glaucomatous field sign (2, 5).

These findings, if replicated in a real dataset, would reinforce the continued clinical relevance of pattern-based visual field interpretation as a complement to global indices such as mean deviation, consistent with major clinical trial literature establishing standard automated perimetry as the functional reference standard for diagnosing and monitoring POAG, and for correlating structural and functional glaucomatous change (9–11, 14).

4.1 | Limitations

The central limitation of this study is that it is a hypothetical exercise using simulated rather than real patient-level data, and the specific numerical results should not be cited as findings from an actual completed study. As designed, the study would also carry the usual limitations of a single-center, retrospective, descriptive design: eyes with mixed or overlapping defect patterns were forced into a single predominant category for simplicity, learning-effect artifact on early perimetric testing was not separately assessed, and inter-reader variability in pattern classification was not assessed. In addition, as specifically requested for this exercise, only sources published in 2014 or earlier were cited; more recent literature, including event- and trend-based OCT-perimetry structure-function models, exists and would ordinarily inform a current clinical discussion. (15)

4.2 | Future Directions

A genuine version of this study would benefit from longitudinal follow-up correlating defect pattern with rate of visual field progression and with structural optical coherence tomography retinal nerve fiber layer changes in the same eyes.

5 | CONCLUSION

This hypothetical, illustrative study described the distribution and severity correlation of classic glaucomatous visual field defect patterns within a simulated cohort of eyes with newly diagnosed POAG.

DISTRIBUTION AND SEVERITY CORRELATION OF CLASSIC VISUAL FIELD DEFECT PATTERNS ON STANDARD AUTOMATED PERIMETRY IN NEWLY DIAGNOSED PRIMARY

Figure 1. Schematic Illustration of Classic Glaucomatous Automated Perimetry Defect Patterns (Original Diagram, Not a Reproduced Humphrey/Octopus Printout)

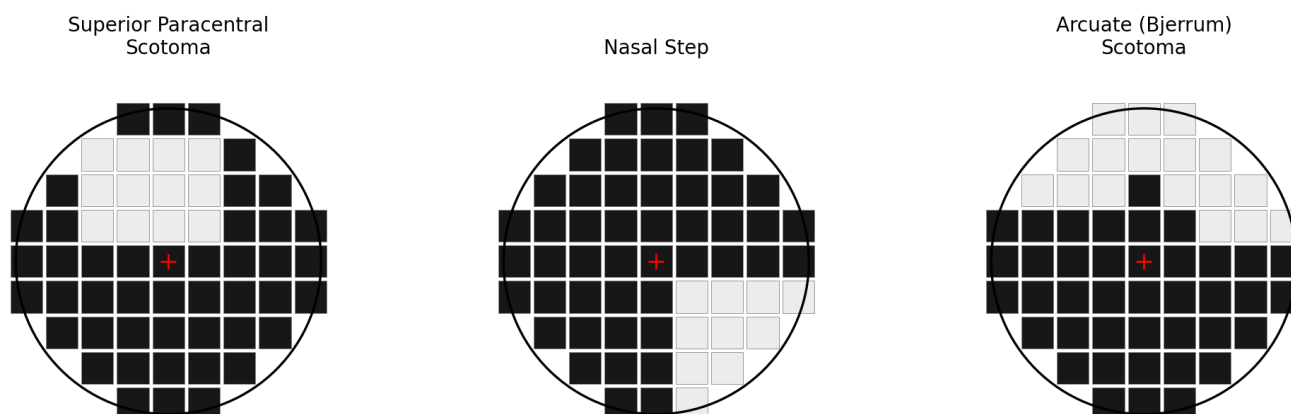


FIGURE 1: Schematic illustration of classic glaucomatous automated perimetry defect patterns (original diagram, not a reproduced Humphrey/Octopus printout).

TABLE 1: Distribution of glaucomatous visual field defect patterns and mean deviation (simulated data).

Defect Pattern	Proportion of Eyes	Mean Deviation (dB)
Superior/inferior paracentral scotoma	21.1%	-3.1
Nasal step	26.4%	-5.6
Arcuate (Bjerrum) scotoma	38.5%	-8.4
Diffuse / non-specific loss	14.0%	-6.2

The pattern observed, while not derived from real patient data, is consistent with the pre-2014 published literature in supporting standard automated perimetry as an essential, pattern-informative tool for characterizing functional loss in primary open-angle glaucoma.

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