Original Article

Comparison of Visual Field Measurements in Glaucomatous Eyes using Oculus and Metrovision Perimeters

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Abstract

Purpose: To investigate the agreement between the Oculus and Metrovision perimeters in the visual field evaluation of glaucoma patients.

Methods: In this cross-sectional study, 41 consecutive glaucoma patients were enrolled. After detailed clinical examinations, visual field testing was performed for all patients using the Oculus and Metrovision perimeters. The interval time between the two visual field examinations was 30 min.

Results: A total of 22 participants were male (53.7%) and the mean ± standard deviation (SD) age was 58.6 ± 9.1 years. The absolute average of the mean deviation (MD) in the oculus perimeter (8.24 ± 4.92 dB) was higher compared to the Metrovision perimeter (4.02 ± 4.62; $P < 0.001$). This difference was also evident in the Bland–Altman graph. The loss variance (pattern SD) values of Oculus perimeter (28.58 ± 16.40) and Metrovision perimeter (28.10 ± 28.45) were not significantly different; although based on the Bland–Altman plots in the lower MDs, the agreement is better and the data dispersion is lower, and in the higher MDs, the agreement is lower. The parameters of four visual field quadrants were also compared and showed poor correlations ($P < 0.001$).

Conclusion: The Oculus and Metrovision perimeter devices have good agreement in lower MDs; however, they cannot be used interchangeably.

Keywords: Glaucoma, Metrovision perimeter, Oculus perimeter, Perimetry, Visual field test

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Introduction

Glaucoma is a common cause of irreversible blindness in the world.[1] It is also one of the leading causes of visual field defects.[2,3] The prevalence of open-angle glaucoma in the elderly population in various studies has been reported between 1.1% and 3%.[4-8] There are multiple ways to evaluate and diagnose this condition. Visual field testing is an essential and valuable clinical tool for evaluating and diagnosing retinal diseases, optic nerve disorders, glaucoma, etc.[9,10]

Various automated instruments are available in the clinical setting for perimetric evaluation, including Humphrey, Octopus, Oculus, and several other machines. Visual field measurement provides functional data and is one of the most valuable clinical tools for glaucoma evaluation, while other tests mainly focus on structural changes.[11,12]

Metrovision automated perimeter is a new device with various strategies to assess and monitor the visual field. A variety of two-dimensional and three-dimensional analysis methods in Metrovision make it capable to indicate visual field defects accurately. Furthermore, this perimeter has higher test point density in sensitive zones, which has made it more efficient for the early detection of clinically important visual field defects.

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There are limited publications on the agreement of Metrovision perimeter with other devices. The present study aimed to compare the visual field results of the Metrovision and the Oculus automated perimeters and to evaluate the agreement or any systematic biases between these two devices.

Methods

This was a cross-sectional study conducted on eligible glaucoma patients at Mashhad University of Medical Sciences (MUMS) and was supported by the Refractive Errors Research Center of MUMS and the Deputy of Research of MUMS, Iran. The study protocol was approved by the Research Ethics Committee of MUMS (ID: IR.MUMS.REC.1397.191). Written informed consent was obtained from all participants.

All patients who enrolled in the present study had a confirmed glaucoma diagnosis based on the clinical evaluation by a glaucoma-fellowship-trained ophthalmologist and glaucoma severity classification of patients was based on patient records and previous Humphrey visual field test data.

The best-corrected visual acuity of 20/60 or better was considered an inclusion criterion. Participants with a history of other ocular or systemic diseases that potentially affect the visual field and nonglaucomatous visual fields with artifacts were excluded from the study.

The visual field of all participants was evaluated by both the Oculus Twinfield (Oculus Inc., Wetzlar, Germany) and Metrovision automated perimeters (MonCv3, Metrovision, France). All participants were corrected with an appropriate near vision correction (CR39 rimless spectacle lenses), considering the age and working distance factors, during the visual field examination. Both procedures were performed by the same examiner after complete explanation of the test nature to each patient. All the study participants passed the test at least once before the real assessment to get familiar with the test. Fixation losses, false negatives, or false positives >20% were considered unacceptable, and in this situation, the participant was excluded from the study population. A 30-min break was considered between the two perimetric experiments to prevent the fatigue effect. The order of testing on the devices was random.

Visual field was assessed using the 30-2 fast strategy in both devices with the same stimulus (a Size III white stimulus) and background luminance (31.8 asb). However, the maximum luminance of the stimulus was different in Oculus and Metrovision (318 cd/m^2 vs. 600 cd/m^2, respectively).

Global indicators of the visual field defect including mean deviation in Oculus and mean deficit in Metrovision (MD), pattern standard deviation in Oculus and pattern standard deficit in Metrovision (PSD), along with false positive, false negative, and duration were assessed in both Oculus and Metrovision perimeters. Furthermore, the average threshold of sensitivity in four quadrants (supra nasal, infer nasal, infratemporal, and supratemporal) and the number of points with $P < 0.5$ in pattern deviation were compared between the two perimeters.

All statistical analyses were performed using SPSS software version 11.5 (SPSS Inc., Chicago, Illinois, USA). The normality of the data was assessed by Shapiro–Wilk test. Data were nonnormally distributed; therefore, appropriate nonparametric analysis tests were used for the analysis of the data. Bland–Altman and the intraclass correlation tests were used to assess the agreement between two perimeters. The level of significance was set at 0.05.

Results

Eighty eyes of 41 patients with glaucoma (22 males [53.6%]) were examined. The mean age of patients was 58.6 ± 9.1 years (range, 36–77 years). Glaucoma was bilateral in 39 patients and unilateral in 2 patients. Average fixation loss values in the Oculus and Metrovision perimeters were 0.83 ± 0.11 vs. 0.94 ± 0.09 ($P < 0.001$) and the false positive value was equal in the two devices (0.95 ± 0.08 vs. 0.96 ± 0.08, $P = 0.664$).

Table 1 compares the visual field measurements between the two devices. The results showed no significant difference for PSD value between the two instruments. However, the absolute value of MD was significantly greater in the Oculus perimeter than Metrovision (8.24 ± 4.92 vs. 4.02 ± 4.62, $P < 0.001$) and the fovea threshold sensitivity was less in the Oculus compared to the Metrovision perimeter. The test duration was also longer in the Oculus than in the Metrovision perimeter [Table 1].

The comparison of antilogarithm means thresholds in four quadrants between the two devices is summarized in Table 2. Due to the difference in the maximum stimulus luminance between the two devices, the antilogarithm means thresholds of four quadrants were used for comparison. According to our findings, the antilogarithm means threshold sensitivity in the Metrovision perimeter was significantly larger than the Oculus perimeter in all four quadrants [Table 2].

The results of the paired comparison between Oculus and Metrovision perimeters are presented in Table 3.

The results of the paired comparison between fovea threshold sensitivity with different visual acuity measurements by the Oculus and Metrovision perimeters are presented in Table 4. Figure 1 shows the Bland–Altman plots of MD, loss variance (LV, PSD), fovea threshold, and antilog fovea threshold [Figure 1]. Figure 2 shows the antilog average threshold of four quadrants between the two devices. The Bland–Altman plots show differences in the average measurement of the two devices. The bold horizontal line demonstrates the mean difference between the devices. The lines above and below represent the 95% limits of the agreement interval [Figure 2]. In the superonasal and inferonasal quadrants, which are more important in glaucoma, according to the Bland–Altman plots, in the lower MDs, the agreement is better and the data dispersion is lower, and to the right side of the diagram and the higher MDs, the agreement is lower and the data dispersion is higher.

Table 1: Comparison of the visual field measurements between Oculus and Metrovision perimeters

Parameter	Oculus perimeter	Median	IQR	Metrovision perimeter	Median	IQR	*P*
MD (db)	8.24±4.92 (0.93–21.17)	8.01	7.61	4.02±4.62 (0.1–21.30)	1.95	5.90	<0.001
PSD	28.53±16.40 (5.60–85.61)	25.58	22.23	28.10±28.45 (0–103)	17.00	38.50	0.427
Fovea (db)	21.12±5.48 (0–30)	22.00	4.00	24.72±4.58 (4–27)	27.00	2.00	<0.001
Fovea (antilogarithm)	202.12±175.95 (1–1000)	158.49	151.19	386.47±163.99 (2.5–501.19)	501.19	184.96	<0.001
Points with *P*<0.50%	8.94±9.8 (0–45)	5.00	13.00	10.77±12.21 (0–55)	5.45	3.37	0.555
Duration (min)	8.74±1.36 (5.19–12.16)	8.43	1.44	6.07±2.61 (2.51–14.29)	5.00	16.50	<0.001

P: Two-related tests (Wilcoxon test). MD: Mean deviation / deficit, PSD: Pattern standard deviation / deficit, IQR: Interquartile range

Table 2: Comparison of the antilogarithm mean threshold of four quadrants between the Oculus and Metrovision perimeters

Parameter (db)	Oculus perimeter	Median	IQR	Metrovision perimeter	Median	IQR	*P*
Supranasal	24.60±27.02 (1–97.61)	15.85	28.65	143.69±93.24 (1.24–260.49)	157.53	191.18	<0.001
Infranasal	32.95±31.57 (1–125.89)	21.50	47.1	156.01±90.63 (1.12–248.16)	206.91	174.38	<0.001
Infratemporal	29.94±28.47 (1–128.98)	19.63	33.60	88.14±45.07 (1.95–187.8)	95.85	63.88	<0.001
Supratemporal	22.74±23.49 (1–88.59)	11.85	30.92	133.02±86.47 (1.97–245.17)	138.71	178.18	<0.001

P: Two-related tests (Wilcoxon test). IQR: Interquartile range

Table 3: Comparison of visual field measurements made by Oculus perimeter and Metrovision

Parameter	Oculus	Metrovision	95% CI	*P*	95% LoA	ICC
MD (db)	8.24	4.02	0.639 to 0.832	<0.001	−2.41 to 10.84	0.750
PSD	28.53	28.10	0.235 to 0.594	0.530	−48.09 to 48.97	0.432
Fovea threshold (db)	21.12	24.72	0.469 to 0.741	<0.001	−12.19 to 4.99	0.624
Antilog fovea	202.12	386.47	0.161 to 0.542	<0.001	−559.45 to 196.7	0.367
Antilog supranasal	24.6	143.69	0.131 to 0.520	<0.001	−273.69 to 35.5	0.340
Antilog inferanasal	32.95	156.01	0.181 to 0.556	<0.001	−270.7 to 24.57	0.384
Antilog inferatemporal	29.94	88.14	0.306 to 0.641	<0.001	−132.72 to 16.32	0.491
Antilog supratemporal	22.74	133.02	0.071 to 0.474	<0.001	−258.83 to 38.25	0.285

P: Paired t-test. MD: Mean deviation / deficit, PSD: Pattern standard deviation / deficit, CI: Confidence interval of correlation coefficient, LoA: Limits of agreement, ICC: Interclass correlation coefficient

Table 4: Comparison of fovea threshold sensitivity with different visual acuity measurements made by Oculus perimeter and Metrovision perimeter

Parameter (db)	Oculus perimeter	Median	IQR	Metrovision perimeter	Median	IQR	*P*
Fovea threshold (VA≥0.7)	22.36±3.15 (14–30)	24.00	5.00	25.41±3.63 (4–27)	27.00	1.00	<0.001
Fovea threshold (VA≤0.6)	13.36±9.65 (0–23)	18.00	21.0	20.45±7.36 (5–27)	24.00	11.00	0.003

VA: Visual acuity, IQR: Interquartile range

Discussion

Visual field measurement is one of the crucial factors in monitoring glaucoma patients. In addition to glaucoma detection, it helps to select the most appropriate treatment and to determine the treatment's response.[13] The prevalence of glaucoma increases with age, therefore, early diagnosis of glaucoma is crucial.[14,15] Currently, different types of perimeters are available to measure the visual field. Humphrey perimeter is the most common and also the gold-standard test for visual field measurement. However, it may not always be available in clinics, and similar tools such as Oculus and Octopus can be used interchangeably.[16,17] Many comparative studies have been performed and they are all in agreement that all devices can detect visual field defects. They may just be less (or even more) sensitive than Humphrey perimeter.[18,19]

Oculus perimeter is one of the perimeter devices often available in clinics and hospitals and is frequently used to measure the visual field.[17] Metrovision (MonCv3) is a new device for measuring the visual field which includes various tests and analyses that can provide different results for examiners. Therefore, it is important to study the agreement of this device with other perimeters, including the Oculus perimeter.

To the best of our knowledge, there was no study comparing Metrovision perimeters with other perimeters; therefore, the present study could be a basis for future comprehensive studies.

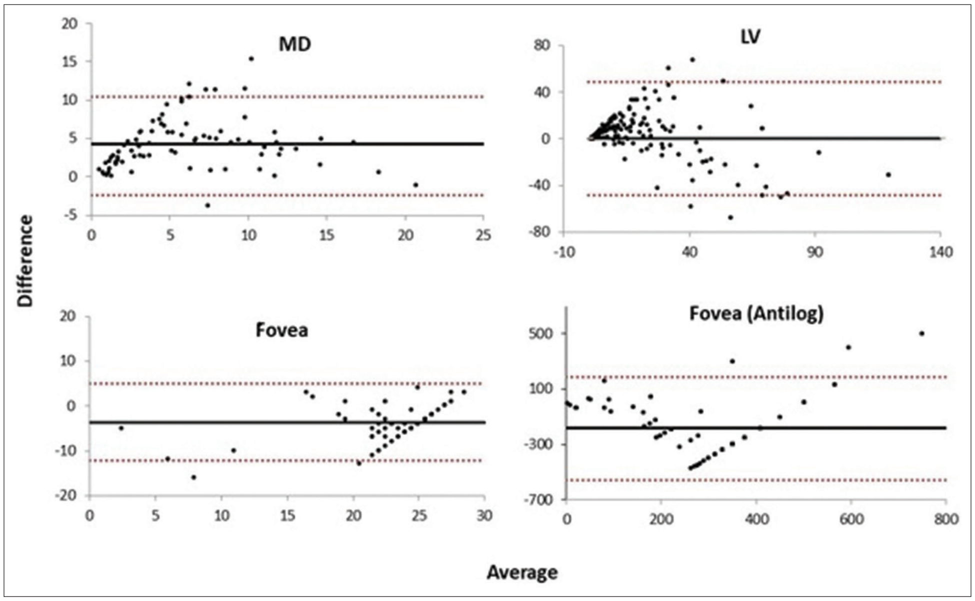

Figure 1: Bland–Altman plots of mean deviation (MD), loss variance (LV), fovea threshold, and antilog fovea threshold. According to the Bland–Altman plots of MD and LV, in the lower MDs, the correlation is better and the data dispersion is lower, and to the right side of the diagram and the higher MDs, the correlation is lower and the data dispersion is more and in the fovea threshold plot, with decrease the patient's foveal threshold, increase the difference between the two devices.

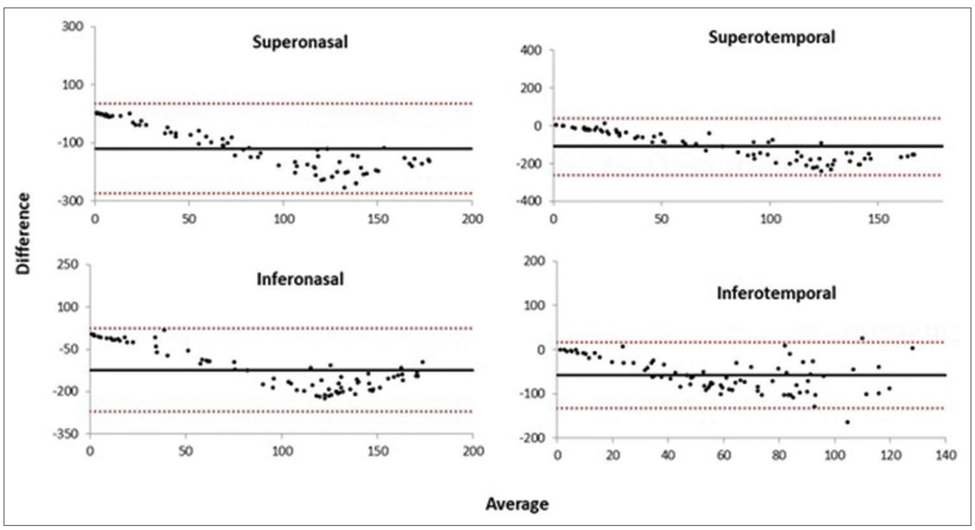

Figure 2: The Bland–Altman plots of antilog average threshold of four quadrants. According to the Bland–Altman plots, in the lower mean deviations / mean deficits (MDs), the correlation is better and the data dispersion is lower, and to the right side of the diagram and the higher MDs, the correlation is lower and the data dispersion is more

Our findings suggest a relatively good correlation between MD of Oculus and Metrovision MDs; however, the absolute MD in Oculus was significantly larger than Metrovision.

There is a slight difference in MD in the lower MDs, but the difference is increasing in the higher MDs. Since the MD value is measured according to the device's normal database, this difference may be explained by the difference between the normal database and the maximum stimulus light of the two devices, also, this may be due to the different dynamic range of these tests.

The Bland–Altman plots show that toward lower MDs, they have better agreement and are less different, but toward higher MDs, they have less agreement [Figure 1].

Furthermore, the difference of threshold averages of the four visual field quadrants (superonasal, inferonasal, inferotemporal, and superotemporal) between the two perimeters may be due to different maximum stimulus illumination of the two devices that results in visual point threshold variation. To eliminate this factor, the data were converted to antilogarithms [Table 1].

The inferonasal region of the two devices, which is also important in glaucoma, is the region where the defects are also poorly correlated and the mean average threshold in Metrovision perimeter was larger than Oculus perimeter and had a significant difference. This weak agreement is also evident in the Bland–Altman plot in the superonasal and inferonasal quadrants, which are more important in glaucoma. There is a good agreement in lower MDs, but the agreement decreases in higher MDs [Figure 2].

Inferotemporal and supratemporal quadrants, which are less damaged in glaucoma, also show the same limited agreements.

The poor agreement and significant discrepancy between the mean deviation/ deficit of the two devices could be due to the different optical and physical characteristics of the two devices. The Metrovision determines the patients near correction based on the refractive error and distance from the device resulting in a better response. This may be the cause for the difference in the amount of the average threshold between the two devices.

LV (PSD) evaluation by the Bland–Altman plot also shows a weak agreement in higher LVs which denotes a similar finding. This discrepancy between the LV (PSD) variable of the Oculus perimeter and the Metrovision perimeter, like MD, may be due to the difference between the normal database and the optical characteristics of the two devices [Figure 1].

Comparison of the mean foveal threshold between the Oculus perimeter and Metrovision showed a significantly larger threshold in the latter device.

In the Bland–Altman plot, with decreasing patient's foveal threshold the difference between the two devices in this parameter was increased. However, there is a difference in the range of normal vision (Fovea threshold: 25–30). According to the results, fovea threshold sensitivity in patients with a better visual acuity (20/20 and 20/25) was better in Metrovision than Oculus. This can be explained by a sharper background in the Metrovision perimeters that results in better visibility of the details. Indeed, greater background contrast in the Metrovision perimeter leads to a better response of Metrovision than Oculus in more flawed vision [Figure 1].

Points with a probability of $P < 0.5$ were slightly more frequent in the Metrovision than the Oculus perimeter; however, it failed to reach the statistical significance level. It can be explained by the difference between the normal databases of Metrovision compared to the normal Iranian population. In a study, Chauhan *et al*. compared two conventional perimetry and high-pass resolution perimetry in 113 patients with open-angle glaucoma and 119 healthy participants and found that due to the difference in the normal database of the two devices, high-pass resolution perimetry detects glaucomatous visual field progression earlier than conventional perimetry and these devices cannot be used interchangeably.[20]

Metrovision test duration was less than that for the Oculus, and the shorter test duration in the Metrovision device can potentially result in more patients' comfort and satisfaction; however, this could be a topic for future studies.

There are several possible limitations in this study including small sample size, lack of demographic data such as refractive error, axial length, limited range of disease severity, and cross-sectional design of the study. The last item is especially important. For a glaucoma diagnostic tool, longitudinal data over time is highly important and clinicians want to know the rate of change over time and its final floor effect. Hence, the dynamic range of tests is of utmost importance. To have this and to compare different tests, longitudinal, prospective studies are much more helpful.

In conclusion, the Oculus and Metrovision perimeter devices are in good agreement with lower MDs; however, they cannot be used interchangeably.

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Conflicts of interest

There are no conflicts of interest.

References

1. Quigley HA. Number of people with glaucoma worldwide. Br J Ophthalmol 1996;80:389-93.
2. Ramrattan RS, Wolfs RC, Panda-Jonas S, Jonas JB, Bakker D, Pols HA, *et al*. Prevalence and causes of visual field loss in the elderly and associations with impairment in daily functioning: The Rotterdam study. Arch Ophthalmol 2001;119:1788-94.
3. Johnson CA, Keltner JL. Incidence of visual field loss in 20,000 eyes and its relationship to driving performance. Arch Ophthalmol 1983;101:371-5.
4. Tielsch JM. The epidemiology and control of open angle glaucoma: A population-based perspective. Annu Rev Public Health 1996;17:121-36.
5. Klein BE, Klein R, Sponsel WE, Franke T, Cantor LB, Martone J, *et al.* Prevalence of glaucoma. The beaver dam eye study. Ophthalmology 1992;99:1499-504.
6. Coffey M, Reidy A, Wormald R, Xian WX, Wright L, Courtney P. Prevalence of glaucoma in the West of Ireland. Br J Ophthalmol 1993;77:17-21.
7. Pakravan M, Yazdani S, Javadi MA, Amini H, Behroozi Z, Ziaei H, *et al*. A population-based survey of the prevalence and types of glaucoma in central Iran: The Yazd eye study. Ophthalmology 2013;120:1977-84.
8. Cho HK, Kee C. Population-based glaucoma prevalence studies in Asians. Surv Ophthalmol 2014;59:434-47.
9. Johnson CA, Samuels SJ. Screening for glaucomatous visual field loss with frequency-doubling perimetry. Invest Ophthalmol Vis Sci 1997;38:413-25.
10. Hart WM Jr., Becker B. The onset and evolution of glaucomatous visual field defects. Ophthalmology 1982;89:268-79.
11. Trope GE, Britton R. A comparison of goldmann and Humphrey automated perimetry in patients with glaucoma. Br J Ophthalmol 1987;71:489-93.
12. Vesti E, Johnson CA, Chauhan BC. Comparison of different methods for detecting glaucomatous visual field progression. Invest Ophthalmol Vis

Sci 2003;44:3873-9.
13. Tielsch JM, Sommer A, Katz J, Royall RM, Quigley HA, Javitt J. Racial variations in the prevalence of primary open-angle glaucoma. The Baltimore eye survey. JAMA 1991;266:369-74.
14. Friedman DS, Wolfs RC, O'Colmain BJ, Klein BE, Taylor HR, West S, *et al*. Prevalence of open-angle glaucoma among adults in the United States. Arch Ophthalmol 2004;122:532-8.
15. Burnstein Y, Ellish NJ, Magbalon M, Higginbotham EJ. Comparison of frequency doubling perimetry with humphrey visual field analysis in a glaucoma practice. Am J Ophthalmol 2000;129:328-33.
16. Casson R, James B, Rubinstein A, Ali H. Clinical comparison of frequency doubling technology perimetry and Humphrey perimetry. Br J Ophthalmol 2001;85:360-2.
17. Capris P, Autuori S, Capris E, Papadia M. Evaluation of threshold estimation and learning effect of two perimetric strategies, SITA Fast and CLIP, in damaged visual fields. Eur J Ophthalmol 2008;18:182-90.
18. Alvarez E, Damato BE, Jay JL, McClure E. Comparative evaluation of oculokinetic perimetry and conventional perimetry in glaucoma. Br J Ophthalmol 1988;72:258-62.
19. Lorch L, Dietrich TJ, Schwabe R, Schiefer U. Comparison of local differential luminance sensitivity (dls) between oculus twinfield perimeter and Humphrey field analyzer 630 (HFA I) in normal volunteers of varying ages. Klin Monbl Augenheilkd 2001;218:782-94.
20. Chauhan BC, House PH, McCormick TA, LeBlanc RP. Comparison of conventional and high-pass resolution perimetry in a prospective study of patients with glaucoma and healthy controls. Arch Ophthalmol 1999;117:24-33.