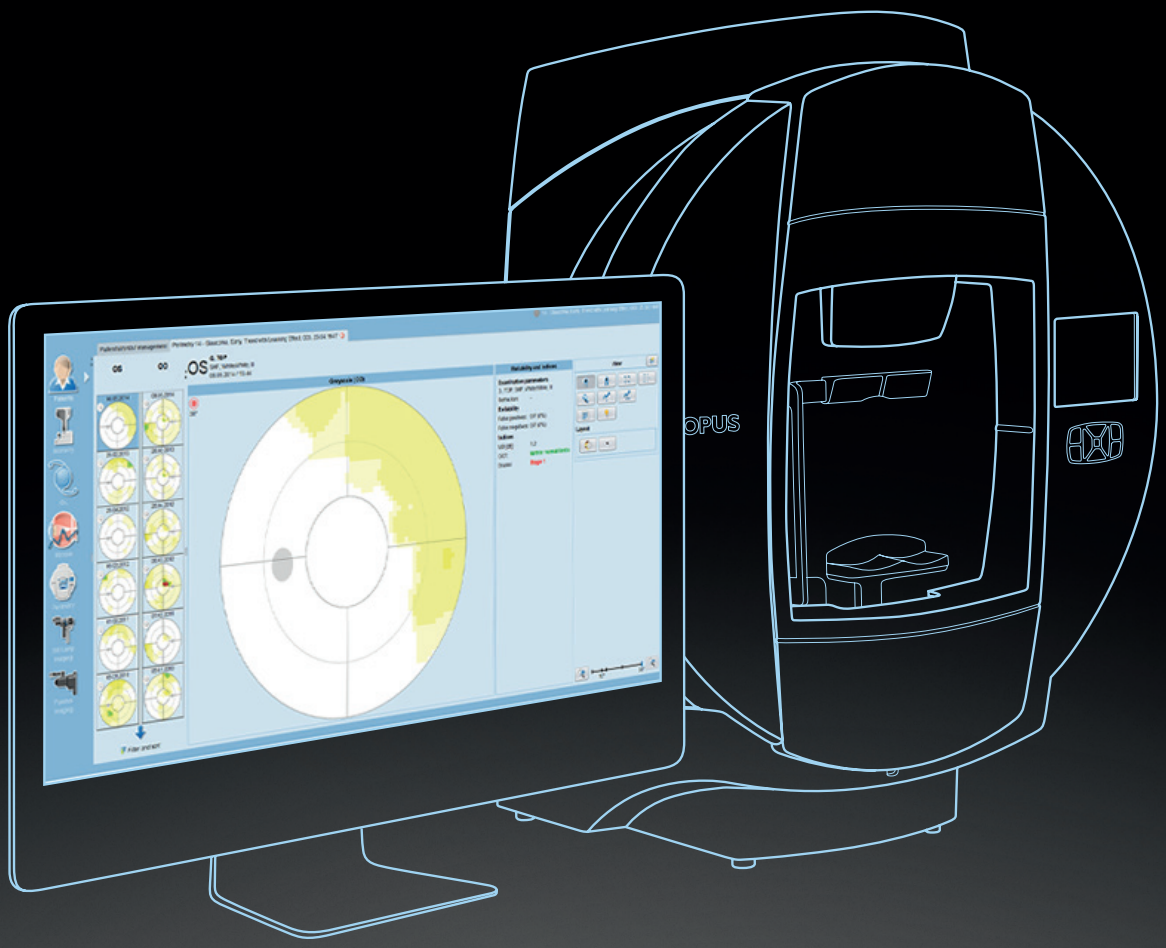

OCTOPUS CLINICAL COMPENDIUM

A collection of published peer-reviewed articles

EDITOR: GÁBOR HOLLÓ

HAAG-STREIT DIAGNOSTICS

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OCTOPUS CLINICAL COMPENDIUM

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Preface

In 2025, Haag-Streit proudly marks 80 years since the introduction of its first perimeter, a milestone that reflects not only the evolution of visual field testing but also eight decades of continuous contribution to ophthalmic science and clinical practice.

From the early mechanical instruments of the 1940s to the highly advanced diagnostic platforms represented today by the Octopus, the history of Haag-Streit perimetry is closely intertwined with the progress of visual field assessment, glaucoma management, and neuro-ophthalmology. This legacy has been shaped through collaboration with clinicians, researchers, and educators worldwide, whose expertise and commitment to evidence-based care have guided innovation and established perimetry as an indispensable tool in ophthalmology.

This volume compiles a curated collection of scientific studies that demonstrate the clinical utility and methodological evolution of the Octopus perimeter. It is intended as a reference for eye care professionals and researchers, providing evidence-based insights into the principles of visual field testing, its role in disease detection and monitoring, and its integration into contemporary ophthalmic practice.

By consolidating this body of work, the Octopus Clinical Compendium aims to support continued research, standardization of testing protocols, and the dissemination of best practices in perimetry, thereby contributing to the advancement of visual field assessment as an essential component of clinical and scientific ophthalmology.

September 2025

Haag-Streit AG

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I.

Introduction

Perimetry remains an essential diagnostic examination method in ophthalmology, neuro-ophthalmology, neurology, neurosurgery and even endocrinology. It is a rapidly developing clinical and research technology, with some mathematics and physics. Modern perimetry offers new information on glaucoma, glaucoma progression, pediatric ophthalmologic and neuro-ophthalmological diseases, and essential in psychophysiology research. Eye specialists need to be familiar with the perimetric systems employed in their office, and non-ophthalmologist specialists with that used by the consulting eye specialist. Ophthalmologists and optometrists need to be able to apply the new perimetry developments and innovations in their practice.

In order to support clinicians' orientation on the perimetric novelties in this compendium we collected abstracts of those peer-reviewed articles that employ Octopus perimetry. The articles included were published in the last three decades. They are grouped (or using "Octopus terminology", clustered) in a practical and clinically useful manner, in chapters. These chapters address the comparison between Octopus and other perimetry systems, the comparison between different Octopus test strategies, early disease detection, progression analysis in glaucoma, conventional structure – function research, optical coherence tomography angiography (OCT angiography) based perfusion – function research, applications in neuro-ophthalmology, new automated and semi-automated kinetic perimetry, and a group of various other application areas. Books are not included since they do not have an abstract. However, we recommend the Reader to visit and download the latest edition of the open access online book Visual Field Digest, which guides the Reader over all theoretical, technical, practical and clinical steps of modern Octopus perimetry, in a comprehensive manner.

The current Compendium is intended to support clinical ophthalmologists in their practice, and PhD students and residents in their education. I am certain that it is a useful support to all clinicians and researchers for the benefit of the patients.

September, 2025

Prof. Gábor Holló, MD, PhD, DSc

II.

Comparative studies with other perimetry systems and between test strategies within the Octopus system

Over the last decades different perimetry systems became introduced for both cross- sectional evaluation of the visual field and longitudinal patient follow-up. Since the different perimetry systems employ different test point patterns, algorithms and hardware characteristics, the clinician users need to be familiar with the system provided options, the between-system technical differences, and the continuous technical and software updates and changes. It is also important to understand that even within one perimetry system there are various programs and test strategies, which all can be used for the same clinical purposes, respectively. For example, in Octopus perimetry Dynamic Strategy and Tendency Oriented Perimetry (TOP) are equally available for testing the 30-degree central visual field for general investigation and glaucoma evaluation. An ophthalmologist has to be able to decide which test and strategy is the best for each individual patient, considering the test duration, the ease of performing the test, and the resulting information pieces. The ophthalmologists also need to know when and how to change the tested area and/or the test strategy during the long-term follow-up, if necessary.

In order to usefully apply the existing options in practice, in this chapter we collected publication abstracts in which Octopus perimetry is compared to other visual field analysing systems, and in which the different test strategies within Octopus perimetry are investigated.

1.
Comparison of structure-function relationship between corresponding retinal nerve fibre layer thickness and Octopus visual field cluster defect values determined by normal and tendency-oriented strategies

(Holló G. British Journal of Ophthalmology 2017 Feb;101(2):150-154.
doi: 10.1136/bjophthalmol-2015-307759. Epub 2016 Apr 22)

2.
Accuracy of kinetic perimetry assessment with the Humphrey 850; an exploratory comparative study

(Fiona J. Rowe, Lauren R. Hepworth, Kerry L. Hanna, Meera Mistry, Carmel P. Noonan. Eye 2019 Dec;33(12):1952-1960. doi: 10.1038/s41433-019-0520-1)

3.
Perimetry comparisons for Octopus G Top and dynamic programmes versus Humphrey 24-2 SITA Fast and SITA standard programmes

(Fiona J. Rowe, Manijeh Wishart, Sarah Spencer. Ophthalmology Research: An International Journal 2(1): 24-42, 2014, Article no. OR.2014.004)

4.
Detection of central visual field defects in early glaucomatous eyes: Comparison of Humphrey and Octopus perimetry

(Gloria Roberti , Gianluca Manni, Ivano Riva, Gabor Holló, Luciano Quaranta, Luca Agnifili, Michele Figus, Sara Giammaria, Davide Rastelli, Francesco Oddone. PLoS ONE 2017 Oct 27;12(10):e0186793. doi: 10.1371/journal.pone.0186793. eCollection 2017)

5.
Comparison of quality and output of different optimal perimetric testing approaches in children with glaucoma

(Dipesh E. Patel, Phillippa M Cumberland, Bronwen C. Walters, Isabelle Russell-Eggitt, John Brookes, Maria Papadopoulos, Peng Tee Khaw, Ananth C. Viswanathan, David Garway-Heath, Mario Cortina-Borja, Jugnoo S. Rahi, OPTIC study group. JAMA Ophthalmology 2018 Feb 1;136(2):155-161. doi: 10.1001/jamaophthalmol.2017.5898)

6.
Comparison of diagnostic ability between a fast strategy, tendency-oriented perimetry, and the standard bracketing strategy

(M Gonzalez-Hernandez , J Morales, A Azuara-Blanco, J Garcia Sanchez, M Gonzalez de la Rosa. Ophthalmologica 2005 Nov-Dec;219(6):373-8. doi: 10.1159/000088381)

7.
Comparative analysis of visual field plotting by Octopus Interzeag 1-2-3, Humphrey Field Analyser II and Frequency Doubling Perimetry in glaucoma patients in south Indian population

(A R Rajalakshmi, Elangovan Suma, D Ranjit Prabhu. Journal of Clinical and Diagnostic Research 2015 Jul;9(7):NC01-3. doi: 10.7860/JCDR/2015/13001.6204. Epub 2015 Jul 1)

8.
Comparison of two fast strategies, SITA Fast and TOP, for the assessment of visual fields in glaucoma patients

(A J W King, A Taguri, A C Wadood, A Azuara-Blanco. Graefe's Archive for Clinical and Experimental Ophthalmology 2002 Jun;240(6):481-7. doi: 10.1007/s00417-002-0482-y. Epub 2002 May 15)

9.
Sensitivity and specificity of frequency-doubling technology, tendency-oriented perimetry, and Humphrey Swedish interactive threshold algorithm-fast perimetry in a glaucoma practice

(Azfar C Wadood, Augusto Azuara-Blanco, Peter Aspinall, Abdel Taguri, Anthony J W King. American Journal of Ophthalmology 2002 Mar;133(3):327-32. doi: 10.1016/s0002-9394(01)01424-6)

1.

Comparison of structure-function relationship between corresponding retinal nerve fibre layer thickness and Octopus visual field cluster defect values determined by normal and tendency-oriented strategies

AUTHORS: Gábor Holló

PUBLICATION: British Journal of Ophthalmology 2017 Feb;101(2):150-154.
doi: 10.1136/bjophthalmol-2015-307759. Epub 2016 Apr 22

Purpose

Previously, we found a strong structure-function relationship between Octopus visual field cluster sensitivity and corresponding sector retinal nerve fibre layer thickness (RNFLT) values, using normal strategy and 16 custom-made cluster-sector pairs. However, Octopus commercially offers 10 clusters, correction for diffuse defect (corrected clusters) and tendency-oriented perimetry (TOP) strategy. In the current investigation, we evaluated structure-function relationship for these conditions, respectively.

Methods

Twenty-four healthy, 45 ocular hypertensive and 63 glaucoma eyes underwent Octopus perimetry (normal and TOP strategies) and RNFLT measurements on the same day. Pearson's correlation between corresponding cluster defect and sector RNFLT values was investigated.

Results

Correlation between the corresponding cluster defect and sector RNFLT values was significant ($p<0.0001$) for all clusters, with both test strategies. The r values ranged from -0.3529 and -0.3877 to -0.5798 and -0.5893, respectively. The highest r values were found for the inferotemporal RNFLT sector superior and superior paracentral cluster pairs with both strategies. No difference in correlation was seen between the strategies ($p\geq0.183$). For corrected clusters, significant correlation ($p<0.01$) was seen only for two inferotemporal and one superotemporal RNFLT sectors, with both strategies (r values: -0.2446, -0.2375; -0.3526, -0.3119; -0.2392, -0.2340, respectively).

Conclusions

Octopus normal and TOP strategies provide similar, moderate-to-strong negative correlation between the corresponding cluster defect and sector RNFLT values for all 10 manufacturer-provided clusters. For corrected clusters the relationship is poor, which suggests that by correcting for diffuse sensitivity loss some local glaucomatous defect is removed. For structure-function based clinical decisions, use of TOP is possible but use of corrected clusters is not recommended.

Overview

Study design
Comparative cross-sectional study

Study device
Octopus

Number of eyes/patients
132 eyes

2.

Accuracy of kinetic perimetry assessment with the Humphrey 850; an exploratory comparative study

AUTHORS: Fiona J. Rowe, Lauren R. Hepworth, Kerry L. Hanna, Meera Mistry, Carmel P. Noonan

PUBLICATION: Eye 2019 Dec;33(12):1952-1960. doi: 10.1038/s41433-019-0520-1

Purpose

To compare kinetic perimetry on the Humphrey 850 and Octopus 900 perimeters for assessment of visual fields, uniocular rotations and fields of binocular single vision.

Methods

Prospective cross section study comparing Humphrey 850 kinetic perimetry to kinetic perimetry using the Octopus 900. Results were compared for both perimeters for the measurement of visual field boundaries, uniocular rotations and fields of binocular single vision in subjects with normal visual function, with comparisons of mean vector extremity values and duration of testing. A visual field boundary overlay was used to assess detection potential of Humphrey 850 kinetic perimetry using I4e and I2e targets in results of known abnormal visual fields.

Results

Fifteen subjects (30 eyes) with normal parameters of visual function underwent dual perimetry assessment. Mean visual field boundaries and ocular rotation extremity values were similar for Humphrey and Octopus kinetic perimetry along horizontal meridians. Measurements for Humphrey perimetry were significantly smaller for superior and inferior visual field and rotations with ceiling effects at approximately 40 and 50 degrees, respectively. Use of visual field boundary overlays for 140 patient results showed high detection of the known abnormal visual field results by the Humphrey 850 perimeter (91.4% with I4e target; 95% with I2e target) but with notable exceptions for peripheral superior visual field defects.

Conclusions

The Humphrey perimeter's aspheric bowl introduces a ceiling effect for measurements in the superior and inferior visual field at approximately 40 and 50 degrees respectively. This results in potential diagnostic accuracy issues when measuring uniocular rotations, fields of binocular single and visual field boundaries in conditions that specifically impair superior and/or inferior ocular motility (e.g., thyroid eye disease) or visual fields (e.g., chiasmal compression).

Overview

Study design

Observational prospective cross-sectional comparative study

Study device

Octopus and Humphrey

Number of eyes/patients

30 eyes / 15 patients

3.

Perimetry comparisons for Octopus G TOP and Dynamic programmes versus Humphrey 24-2 SITA Fast and SITA standard programmes

AUTHORS: Fiona J. Rowe, Manijeh Wishart, Sarah Spencer

PUBLICATION: Ophthalmology Research: An International Journal 2(1): 24-42, 2014, Article no. OR.2014.004

Purpose

Previous comparisons of Octopus and Humphrey threshold programmes have shown differences, particularly for depth of defects. Recent developments have altered the Octopus background illumination. Thus, we sought to determine the subsequent extent of differences in results from commonly used central static programmes using Octopus and Humphrey perimeters.

Methods

We utilised Octopus G-TOP or G-dynamic programmes and Humphrey 24-2 SITA fast or standard programmes. Poor reliability was taken as errors >25%. Comparison was made for global indices (mean sensitivity, mean deviation, pattern standard deviation/loss variance), test duration from each perimeter using unpaired tests, and Bland Altman plots for correlation of individual differences between perimeters. Clinical agreement for presence/absence of visual field loss was determined by independent assessment of results by two authors (kappa test).

Results

Eighty patients (159 eyes) were recruited. 38 eyes were excluded due to poor reliability. 34 patients (55 eyes) underwent fast static visual field assessment: 17 males and 17 females with a mean age of 63 years (SD 14). 38 patients (64 eyes) underwent standard static visual field assessment: 18 males and 20 females with a mean age of 65 years (SD 13). For both full and fast perimetry, both perimeters showed good agreement for inter observer comparison (K=0.5-0.6). SITA standard perimetry showed a higher mean sensitivity value (+2.5dB±1.0) and SITA fast perimetry showed a higher mean sensitivity value (+3.4dB±1.1) than Octopus values. Bland-Altman analysis showed increasing variability with increasing severity of defect indicating a lack of correlation for moderate to severe visual field results.

Conclusions

Visual field results were comparable for mild defects. Octopus perimetry continues to show greater defect size where there is more extensive visual field loss relating to the different strategies used by both perimeters.

Overview

Study design

Observational prospective cross-sectional comparative study

Study device

Octopus and Humphrey

Number of eyes/patients

159 eyes

4.

Detection of central visual field defects in early glaucomatous eyes: Comparison of Humphrey and Octopus perimetry

AUTHORS: Gloria Roberti, Gianluca Manni, Ivano Riva, Gabor Holló, Luciano Quaranta, Luca Agnifili, Michele Figus, Sara Giammaria, Davide Rastelli, Francesco Oddone

PUBLICATION: PLoS ONE 2017 Oct 27;12(10):e0186793. doi: 10.1371/journal.pone.0186793. eCollection 2017

Purpose

To compare the detection rate of central visual field defect (CVFD) between the 30-degree Octopus G1 program (Dynamic strategy) and the HFA 10–2 SITA-Standard test in early glaucoma eyes not showing any CVFD on the HFA 24–2 SITA-Standard test.

Methods

One eye of 41 early glaucoma patients without CVFD in the central 10° on HFA 24–2 test was tested with both the HFA 10–2 test and the Octopus G1 program 15 minutes apart, in random order. The primary outcome measure was the comparison of CVFD detection rates. Secondary outcome measures comprised the agreement in detecting CVFD, and the comparison of test durations and the numbers of depressed test points outside the central 10-degree area between the HFA 24–2 test and the Octopus G1 program.

Results

The mean age of the population was 65.2±10.1 years, and the mean deviation with HFA 24–2 was -3.26±2.6 dB. The mean test duration was not significantly different between the tests (p = 0.13). A CVFD was present in 33 (80.4%) HFA 10–2 test and in 23 (56.0%) Octopus G1 tests (p = 0.002). The overall agreement between the HFA 10–2 and Octopus G1 examinations in classifying eyes as having or not having CVFD was moderate (Cohen's kappa 0.47). The Octopus G1 program showed 69.6% sensitivity and 100% specificity to detect CVFD in eyes where the HFA 10–2 test revealed a CVFD. The number of depressed test points (p<5%) outside the central 10° area detected with the Octopus G1 program (19.68±10.6) was significantly higher than that detected with the HFA 24–2 program (11.95±5.5, p<0.001).

Conclusions

Both HFA 10–2 and Octopus G1programs showed CVFD not present at HFA 24–2 test although the agreement was moderate. The use of a single Octopus G1 examination may represent a practical compromise for the assessment of both central and peripheral visual field up to 30° eccentricity without any additional testing and increasing the total investigation time.

Overview

Study design
Observational prospective cross-sectional comparative study

Study device
Octopus and Humphrey

Number of eyes/patients
41 eyes

5.

Comparison of quality and output of different optimal perimetric testing approaches in children with glaucoma

AUTHORS: Dipesh E. Patel, Phillippa M Cumberland, Bronwen C. Walters, Isabelle Russell-Eggitt, John Brookes, Maria Papadopoulos, Peng Tee Khaw, Ananth C. Viswanathan, David Garway-Heath, Mario Cortina-Borja, Jugnoo S. Rahi, OPTIC study group

PUBLICATION: JAMA Ophthalmology 2018 Feb 1;136(2):155-161. doi: 10.1001/jamaophthalmol.2017.5898

Purpose

To compare different static and combined static/kinetic perimetry approaches in children with glaucoma.

Methods

Cross-sectional, observational study recruiting children prospectively between May 2013 and June 2015 at 2 tertiary specialist pediatric ophthalmology centers in London, England (Moorfields Eye Hospital and Great Ormond Street Hospital). The study included 65 children aged 5 to 15 years with glaucoma (108 affected eyes).

A comparison of test quality and outcomes for static and combined static/kinetic techniques, with respect to ability to quantify glaucomatous loss. Children performed perimetric assessments using Humphrey static (Swedish Interactive Thresholding Algorithm 24-2 FAST) and Octopus combined static tendency-oriented perimetry/kinetic perimetry (isopter V4e, III4e, or I4e) in a single sitting, using standardized clinical protocols, administered by a single examiner. Information was collected about test duration, completion, and quality (using automated reliability indices and our qualitative Examiner-Based Assessment of Reliability score). Perimetry outputs were scored using the Aulhorn and Karmeyer classification. One affected eye in 19 participants was retested with Swedish Interactive Thresholding Algorithm 24-2 FAST and 24-2 standard algorithms.

Results

Sixty-five children (33 girls [50.8%]), with a median age of 12 years (interquartile range, 9-14 years), were tested. Test quality (Examiner-Based Assessment of Reliability score) improved with increasing age for both Humphrey and Octopus strategies and were equivalent in children older than 10 years (McNemar test, $\chi 2 = 0.33$; $P = .56$), but better-quality tests with Humphrey perimetry were achieved in younger children (McNemar test, $\chi 2 = 4.0$; $P = .05$). Octopus and Humphrey static MD values worse than or equal to -6 dB showed disagreement (Bland-Altman, mean difference, -0.70; limit of agreement, -7.74 to 6.35) but were comparable when greater than this threshold (mean difference, -0.03; limit of agreement, -2.33 to 2.27). Visual field classification scores for static perimetry tests showed substantial agreement (linearly weighted κ, 0.79; 95% CI, 0.65-0.93), although 25 of 80 (31%) were graded with a more severe defect for Octopus static perimetry. Of the 7 severe cases of visual field loss (grade 5), 5 had lower kinetic than static classification scores.

Conclusions

A simple static perimetry approach potentially yields high-quality results in children younger than 10 years. For children older than 10 years, without penalizing quality, the addition of kinetic perimetry enabled measurement of far-peripheral sensitivity, which is particularly useful in children with severe visual field restriction.

Overview

Study design
Cross-sectional observational study

Study device
Octopus and Humphrey

Number of eyes/patients
108 eyes / 65 patients

6.

Comparison of diagnostic ability between a fast strategy, tendency-oriented perimetry, and the standard bracketing strategy

AUTHORS: M Gonzalez-Hernandez , J Morales, A Azuara-Blanco, J Garcia Sanchez, M Gonzalez de la Rosa

PUBLICATION: Ophthalmologica 2005 Nov-Dec;219(6):373-8. doi: 10.1159/000088381

Purpose

To compare the diagnostic abilities of the standard bracketing strategy (BR) and a fast strategy, the tendency-oriented perimetry (TOP).

Methods

Seventy-seven controls and 91 eyes from patients with glaucoma were analyzed with the strategies TOP and BR. Sensitivity (Se), specificity (Sp), the area under the receiver operating characteristic (ROC) curve (AC) and the optimum cutoff value (CO) were calculated for the visual field indices mean defect (MD), the square root of the loss variance (sLV) and the number of pathological points (NPP).

Results

In the glaucoma group, the mean MD value using TOP and BR was 7.5 and 8.3 dB, respectively. The mean sLV value using TOP and BR was 5.0 and 5.3 dB, respectively. Indices provided by TOP had higher ROC values than the ones provided by BR. Using TOP, the index with the best diagnostic ability was sLV (Sp = 94.8, Se = 90.1, AC = 0.966, CO = 2.5 dB), followed by NPP and MD. Using BR, the best results were obtained for MD (Sp = 92.2, Se = 81.3, AC = 0.900, CO = 2.5 dB) followed by sLV and NPP.

Conclusions

A fast strategy, TOP, had superior diagnostic ability than the standard BR. Although TOP provided lower LV values than BR, the diagnostic ability of this index was higher than that of the conventional strategy.

Overview

Study design
Observational prospective comparative study

Study device
Octopus

Number of eyes/patients
168 eyes

7.

Comparative analysis of visual field plotting by Octopus Interzeag 1-2-3, Humphrey Field Analyser II and Frequency Doubling Perimetry in glaucoma patients in south Indian population

AUTHORS: A R Rajalakshmi, Elangovan Suma, D Ranjit Prabhu

PUBLICATION: Journal of Clinical and Diagnostic Research 2015 Jul;9(7):NC01-3.
doi: 10.7860/JCDR/2015/13001.6204. Epub 2015 Jul 1

Purpose

Standard achromatic perimetry tests the differential light sensitivity whereas the frequency doubling technology tests the contrast sensitivity. The aim of this study was to compare and correlate the visual field indices with three different types of perimeters namely frequency doubling perimetry (FDP), Humphrey field analyser (HFA) and Octopus Interzeag 1-2-3 (OI) for detecting glaucomatous field defects.

Methods

Hundred eyes of 50 glaucoma patients were studied. All the patients underwent visual field examinations by Octopus Interzeag 1-2-3, Humphrey field Analyser II and Frequency Doubling perimetry (FDP). The correlations of the global indices were compared. The time taken to perform the test with the three perimeters was analysed.

Results

The visual field plotting by the perimeters were comparable and significant positive correlation was observed. The time taken to perform visual field test by Octopus Interzeag 1-2-3 was shorter than the other two methods.

Conclusions

The visual field plotting by Octopus Interzeag 1-2-3, Humphrey field analyser and frequency doubling technology perimetry were comparable and Octopus field plotting takes lesser time than the rest two methods.

Overview

Study design
Observational prospective comparative study

Study device
Octopus, Humphrey and FDT

Number of eyes/patients
100 eyes / 50 patients

8.

Comparison of two fast strategies, SITA Fast and TOP, for the assessment of visual fields in glaucoma patients

AUTHORS: A J W King, A Taguri, A C Wadood, A Azuara-Blanco

PUBLICATION: Graefe's Archive for Clinical and Experimental Ophthalmology 2002 Jun;240(6):481-7.
doi: 10.1007/s00417-002-0482-y. Epub 2002 May 15

Purpose

To compare two fast threshold strategies of visual field assessment; SITA Fast (HSF) and Tendency Orientated Perimetry (TOP), in detecting visual field loss in patients with glaucoma.

Methods

Seventy-six glaucoma, ocular hypertensive and normal patients had HSF and TOP performed in random order. Quantitative comparisons for the global visual field indices - mean deviation and defect (MD) for HSF and TOP, and pattern standard deviation (PSD) for HSF and loss variance (LV) for TOP - were made using correlation coefficients. Humphrey global parameters were converted to Octopus equivalents, and method comparison analysis was used to determine agreement between the two strategies. Test duration times were compared using t-test. Sensitivity and specificity for these two algorithms were determined according to predetermined criteria.

Results

High correlation coefficient values were obtained for MD measurements between HSF and TOP (r=-0.89, P<0.0005) and for PSD (HSF) and LV (TOP) (r=0.88, P<0.0005). Following conversion of HSF values to Octopus equivalents the TOP strategy estimated MD to be greater and LV to be less than HSF values, the difference increasing as the magnitude of the defect increased. The mean test duration time was 4.04 (0.87) min for HSF and 2.38 (0.34) min for TOP (P<0.0005). Sensitivity of diagnostic criteria ranged from 86.4% to 89.2% for HSF and from 84.7% to 85.2% for TOP. Specificity ranged from 80.0% to 93.8% for HSF and from 76.5% to 86.7% for TOP.

Conclusions

There was a high correlation between the HSF and TOP strategies for measurements of global indices. However, the TOP strategy tended to underestimate focal visual field loss compared with SITA Fast. The TOP strategy was faster than SITA Fast. The sensitivity and specificity of the two algorithms were similar. This study establishes the ability of these fast strategies to successfully assess visual fields in glaucoma patients with perimetric experience.

Overview

Study design
Observational prospective cross-sectional comparative study

Study device
Octopus and Humphrey

Number of eyes/patients
76 patients

9.

Sensitivity and specificity of frequency-doubling technology, tendency-oriented perimetry, and Humphrey Swedish interactive threshold algorithm-fast perimetry in a glaucoma practice

AUTHORS: Azfar C Wadood, Augusto Azuara-Blanco, Peter Aspinall, Abdel Taguri, Anthony J W King

PUBLICATION: American Journal of Ophthalmology 2002 Mar;133(3):327-32.
doi: 10.1016/s0002-9394(01)01424-6

Purpose

To evaluate the sensitivity and specificity of the screening mode of the Humphrey-Welch Allyn frequency-doubling technology (FDT), Octopus tendency-oriented perimetry (TOP), and the Humphrey Swedish Interactive Threshold Algorithm (SITA)-fast (HSF) in patients with glaucoma.

Design

A comparative consecutive case series.

Methods

This was a prospective study which took place in the glaucoma unit of an academic department of ophthalmology. One eye of 70 consecutive glaucoma patients and 28 age-matched normal subjects was studied. Eyes were examined with the program C-20 of FDT, G1-TOP, and 24-2 HSF in one visit and in random order. The gold standard for glaucoma was presence of a typical glaucomatous optic disk appearance on stereoscopic examination, which was judged by a glaucoma expert. The sensitivity and specificity, positive and negative predictive value, and receiver operating characteristic (ROC) curves of two algorithms for the FDT screening test, two algorithms for TOP, and three algorithms for HSF, as defined before the start of this study, were evaluated. The time required for each test was also analyzed.

Results

Values for area under the ROC curve ranged from 82.5%-93.9%. The largest area (93.9%) under the ROC curve was obtained with the FDT criteria, defining abnormality as presence of at least one abnormal location. Mean test time was 1.08 +/- 0.28 minutes, 2.31 +/- 0.28 minutes, and 4.14 +/- 0.57 minutes for the FDT, TOP, and HSF, respectively. The difference in testing time was statistically significant (P <.0001).

Conclusions

The C-20 FDT, G1-TOP, and 24-2 HSF appear to be useful tools to diagnose glaucoma. The test C-20 FDT and G1-TOP take approximately 1/4 and 1/2 of the time taken by 24 to 2 HSF.

Overview

Study design
Comparative consecutive case series

Study device
Octopus, FDT and Humphrey

Number of eyes/patients
70 eyes / 70 patients

III.

Early detection of a disease

Treatment offers better outcome and less severe decline of vision related quality of life if it is initiated earlier, when the biological damage and the related functional deterioration are mild. It is particularly important when successful long-term management of a slowly developing irreversible disease, like glaucoma is considered. Therefore, early detection of visual field deterioration is of great clinical importance in ophthalmology. At the same time false positive test results need to be avoided, since these may lead to unnecessary treatment initiation. Thus, an early detection of functional deterioration needs to be accurate. Octopus perimetry offers various benefits to detect true deterioration early and accurately. It offers various test areas and strategies, central test point locations, a test point distribution that follows the retinal nerve fiber bundles, a short test time and software provided cluster analyses.

In the current chapter abstracts of articles that address early detection of functional deterioration using Octopus perimetry are collected.

10.
Detection of central visual field defects in early glaucomatous eyes: Comparison of Humphrey and Octopus perimetry

(Gloria Roberti, Gianluca Manni, Ivano Riva, Gabor Holló, Luciano Quaranta, Luca Agnifili, Michele Figus, Sara Giammaria, Davide Rastelli, Francesco Oddone. PLoS One. 2017 Oct 27;12(10):e0186793. doi: 10.1371/journal.pone.0186793. eCollection 2017)

11.
Diagnostic ability of Humphrey perimetry, Octopus perimetry, and optical coherence tomography for glaucomatous optic neuropathy

(B Monsalve, A Ferreras, P Calvo, JA Urcola, M Figus, J Monsalve, P Frezzotti. Eye 2017 Mar;31(3):443-451. doi: 10.1038/eye.2016.251. Epub 2016 Nov 11)

12.
Comparison of frequency doubling and flicker defined form perimetry in early glaucoma

(Folkert K. Horn, Vicki Scharch, Christian Y. Mardin, Robert Lämmer, Jan Kremers. Graefe's Archive for Clinical and Experimental Ophthalmology 2016 May;254(5):937-46. doi: 10.1007/s00417-016-3286-1. Epub 2016 Feb 17)

13.
Detection of early glaucomatous progression with octopus cluster trend analysis

(Farzaneh Naghizadeh, Gábor Holló. Journal of Glaucoma 2014 Jun-Jul;23(5):269-75. doi: 10.1097/IJG.0b013e3182741c69)

10.

Detection of central visual field defects in early glaucomatous eyes: Comparison of Humphrey and Octopus perimetry

AUTHORS: Gloria Roberti, Gianluca Manni, Ivano Riva, Gabor Holló, Luciano Quaranta, Luca Agnifili, Michele Figus, Sara Giammaria, Davide Rastelli, Francesco Oddone

PUBLICATION: PLoS One 2017 Oct 27;12(10):e0186793. doi:10.1371/journal.pone.0186793. eCollection 2017

Purpose

To compare the detection rate of central visual field defect (CVFD) between the 30-degree Octopus G1 program (Dynamic strategy) and the HFA 10-2 SITA-Standard test in early glaucoma eyes not showing any CVFD on the HFA 24-2 SITA-Standard test.

Methods

One eye of 41 early glaucoma patients without CVFD in the central 10° on HFA 24-2 test was tested with both the HFA 10-2 test and the Octopus G1 program 15 minutes apart, in random order. The primary outcome measure was the comparison of CVFD detection rates. Secondary outcome measures comprised the agreement in detecting CVFD, and the comparison of test durations and the numbers of depressed test points outside the central 10-degree area between the HFA 24-2 test and the Octopus G1 program.

Results

The mean age of the population was 65.2±10.1 years, and the mean deviation with HFA 24-2 was -3.26±2.6 dB. The mean test duration was not significantly different between the tests ($p = 0.13$). A CVFD was present in 33 (80.4%) HFA 10-2 test and in 23 (56.0%) Octopus G1 tests ($p = 0.002$). The overall agreement between the HFA 10-2 and Octopus G1 examinations in classifying eyes as having or not having CVFD was moderate (Cohen's kappa 0.47). The Octopus G1 program showed 69.6% sensitivity and 100% specificity to detect CVFD in eyes where the HFA 10-2 test revealed a CVFD. The number of depressed test points ($p<5\%$) outside the central 10° area detected with the Octopus G1 program (19.68±10.6) was significantly higher than that detected with the HFA 24-2 program (11.95±5.5, $p<0.001$).

Conclusions

Both HFA 10-2 and Octopus G1programs showed CVFD not present at HFA 24-2 test although the agreement was moderate. The use of a single Octopus G1 examination may represent a practical compromise for the assessment of both central and peripheral visual field up to 30° eccentricity without any additional testing and increasing the total investigation time.

Overview

Study design
Observational prospective cross sectional comparative study

Study device
Octopus and Humphrey

Number of eyes/patients
41 eyes / 41 patients

11.

Diagnostic ability of Humphrey perimetry, Octopus perimetry, and optical coherence tomography for glaucomatous optic neuropathy

AUTHORS: B Monsalve, A Ferreras, P Calvo, JA Urcola, M Figus, J Monsalve, P Frezzotti

PUBLICATION: Eye 2017 Mar;31(3):443-451. doi: 10.1038/eye.2016.251. Epub 2016 Nov 11

Purpose

To evaluate and compare the diagnostic accuracy of the Humphrey Field Analyzer (HFA), Octopus perimetry, and Cirrus OCT for glaucomatous optic neuropathy.

Methods

Eighty-eight healthy individuals and 150 open-angle glaucoma patients were consecutive and prospectively selected. Eligibility criteria for the glaucoma group were intraocular pressure ≥21 mm Hg and glaucomatous optic nerve head morphology. All subjects underwent a reliable standard automated perimetry with the HFA and Octopus perimeter, and were imaged with the Cirrus OCT. Receiver-operating characteristic (ROC) curves were plotted for the threshold values and main indices of the HFA and Octopus, the peripapillary retinal nerve fiber layer thicknesses, and the optic nerve head parameters. Sensitivities at 85 and 95% fixed-specificities were also calculated. The best areas under the ROC curves (AUCs) were compared using the DeLong method.

Results

In the glaucoma group, mean deviation (MD) was −5.42 ± 4.6 dB for HFA and 3.90 ± 3.6 dB for Octopus. The MD of the HFA (0.966; P<0.001), mean sensitivity of the Octopus (0.941; P<0.001), and average cup-to-disc (C/D) ratio measured by the Cirrus OCT (0.958; P<0.001) had the largest AUCs for each test studied. There were no significant differences among them. Sensitivities at 95% fixed-specificity were 82% for pattern standard deviation of the HFA, 81.3% for average C/D ratio of OCT, and 80% for the MD of the Octopus.

Conclusions

HFA, Octopus, and Cirrus OCT demonstrated similar diagnostic accuracies for glaucomatous optic neuropathy. Visual field and OCT provide supplementary information and thus these tests are not interchangeable.

Overview

Study design
Prospective transversal comparative study

Study device
Octopus, Humphrey and Cirrus

Number of eyes/patients
238 eyes

12.

Comparison of frequency doubling and flicker defined form perimetry in early glaucoma

AUTHORS: Folkert K. Horn, Vicki Scharch, Christian Y. Mardin, Robert Lämmer, Jan Kremers

PUBLICATION: Graefe's Archive for Clinical and Experimental Ophthalmology 2016 May;254(5):937-46. doi: 10.1007/s00417-016-3286-1. Epub 2016 Feb 17

Purpose

To compare perimetric data based on the second-generation frequency doubling technology (FDT) and on flicker defined form (FDF) stimulation in early glaucoma patients.

Methods

Seventy-two experienced glaucoma patients and 50 healthy subjects of the Erlangen Glaucoma Registry participated in the study. The definition of glaucoma was solely based on optic disc appearance. All patients underwent FDF perimetry (HEP), FDT perimetry (Matrix), standard automated perimetry (SAP, Octopus), and peripapillar measurements of the RNFL thickness (Spectralis OCT). Exclusion criteria were: mean defect (MD) in SAP > 6 dB, eye diseases other than glaucoma, or non-reliable FDF or FDT measurements. Statistical analyses included comparison of the standard indices and correlations between methods. Venn-diagrams show the number of patients with abnormal results in HEP, Matrix, SAP, and mean RNFL thickness.

Results

Mean defect data from FDT and FDF perimetry were strongly correlated (R = –0.85, P <0.001). In this cohort of early glaucoma patients, the MD values were 6.1 ± 5.0 dB (FDF) and 4.5 ± 4.1 dB (FDT). Sensitivity in this patient group was 65 % for FDF-MD, 60 % for FDT-MD, and 60 % for RNFL-thickness, all at a specificity of 95 %. The correlation analysis between local RNFL thickness and corresponding visual defects revealed significant Spearman correlation coefficients for the arcuate bundles of the visual field (FDF-inferior: R = –0.65, FDF-superior: R = –0.74, FDT-inferior: R = –0.55, FDT-superior: R =–0.72).

Conclusions

FDF and FDT stimulations can be used to detect patients with early glaucoma. Combined consideration of RNFL thickness and results from one of these perimetric tests can increase the total number of detected patients.

Overview

Study design
Observational cross-sectional comparative study

Study device
Octopus, HEP, FDT and Spectralis

Number of eyes/patients
122 patients

13.

Detection of early glaucomatous progression with octopus cluster trend analysis

AUTHORS: Farzaneh Naghizadeh, Gábor Holló

PUBLICATION: Journal of Glaucoma 2014 Jun-Jul;23(5):269-75. doi: 10.1097/IJG.0b013e3182741c69

Purpose

To compare the ability of Corrected Cluster Trend Analysis (CCTA) and Cluster Trend Analysis (CTA) with event analysis of Octopus visual field series to detect early glaucomatous progression.

Methods

One eye of 15 healthy, 19 ocular hypertensive, 20 preperimetric, and 51 perimetric glaucoma (PG) patients were investigated with Octopus normal G2 test at 6-month intervals for 1.5 to 3 years. Progression was defined with significant worsening in any of the 10 Octopus clusters with CCTA, and event analysis criteria, respectively.

Results

With event analysis, 9 PG eyes showed localized progression and 1 diffuse mean defect (MD) worsening. With CCTA, progression was indicated in 1 normal, 1 ocular hypertensive, and 1 preperimetric glaucoma eyes due to vitreous floaters, and 28 PG eyes including all 9 eyes with localized progression with event analysis. The locations of CCTA progression matched those found with event analysis in all 9 cases. In 17 of the remaining 19 eyes, progressing clusters matched the locations that were suspicious but not definitive for progression with event analysis. In the eye with diffuse MD worsening, CTA found significant progression for 7 clusters. For global MD progression rate, eyes worsened with CCTA only did not differ from the stable eyes but had significantly smaller progression rates than the eyes progressed with event analysis (P=0.0002).

Conclusions

In PG, Octopus CCTA and CTA are clinically useful to identify early progression and areas suspicious for early progression. However, in some eyes with no glaucomatous visual field damage, vitreous floaters may cause progression artifacts.

Overview

Study design
Prospective comparative study

Study device
Octopus

Number of eyes/patients
105 eyes / 105 patients

IV.

Glaucoma progression analysis

Glaucoma is a leading cause of irreversible deterioration of the visual functions and blindness worldwide. This disease (in fact, a group of diseases) is characterized by progressive and irreversible damage of the retinal nerve fibers (the axons of the retinal ganglion cells) in the lamina cribrosa area, which results in a progressive nerve fiber bundle type visual field deterioration (sensitivity reductions and losses, i.e. scotomas). In glaucoma the progressive deterioration typically destroys the peripheral and the extrafoveal central 30-degree visual field over years (usually in 10-15 years) before it the extends to the center of the visual field (the functional representation of the central retina, i.e. the fovea). Only this makes the disease detectable for the patient, who in this disease stage realises a rapid decline of the central visual acuity.

The above process, unfortunately not uncommonly, also occurs when the initiated treatment of glaucoma is not sufficiently strong to stop progression, or when the patients' adherence is insufficient. In other words, a clinically significant worsening of a chronic disease like glaucoma is common under treatment. This is why a careful, high quality visual function analysis (visual field progression analysis) is essential for successful long-term glaucoma management. Octopus visual field progression analysis (in clinical practice in combination with structural progression analyses) detects early and measures quantitatively the progression for both the global tested visual field (mean defect, local defect and diffuse defect) and each of the ten visual field clusters, respectively. A cluster comprises those test point locations that belong to the same retinal nerve fiber bundle, and therefore change together in nerve fibre bundle type diseases, like glaucoma. Clustering the test point locations which change together improves the specificity of detecting a change that is caused by glaucoma, since changes due to other reasons (e.g. development of vitreous floaters) do not follow the cluster pattern. Thus, the specificity of the detection and quantification of glaucomatous progression is improved with clustering. Early and specific detection of progression (much before the patient is able to realize the functional worsening) makes early treatment intensification possible, and by this strongly supports the preservation of the visual field.

Since glaucoma is a very common disease which requires management over decades, progression analysis is a particularly important function in Octopus perimetry. Therefore, it is not unexpected that several studies addressed this point in the last decades. The abstracts of these articles are collected in this chapter.

14.
Effects of glaucoma surgery on visual field progression in open-angle glaucoma considering the floor effect

(Andreas Schlatter, Teresa Rauchegger, Eduard Schmid, Barbara Teuchner. Acta Ophthalmologica 2022 Aug;100(5):e1127-e1134. doi: 10.1111/aos.15048. Epub 2021 Oct 27)

15.
Evaluation of the progression of visual field damage in patients suffering from early manifest glaucoma

(Andrea Perdicchi, Solmaz Abdolrahimzadeh, Alessandro Cutini, Angela Ciarnella, Gian Luca Scuderi. Clinical Ophthalmology 2016 Aug 25:10:1647-51. doi: 10.2147/OPTH.S113995. eCollection 2016)

16.
Evaluation of Octopus Polar Trend Analysis for Detection of Glaucomatous Progression

(Gábor Holló, Farzaneh Naghizadeh. European Journal of Ophthalmology 2014 Nov-Dec;24(6):862-8. doi: 10.5301/ejo.5000504. Epub 2014 Jun 28)

17.
Visual field progression in glaucoma: cluster analysis

(H Bresson-Dumont , J Hatton, J Foucher, M Fonteneau. Journal Français d'Ophtalmologie 2012 Nov;35(9):735-41. doi: 10.1016/j.jfo.2011.10.011. Epub 2012 Jul 6)

14.

Effects of glaucoma surgery on visual field progression in open-angle glaucoma considering the floor effect

AUTHORS: Andreas Schlatter, Teresa Rauchegger, Eduard Schmid, Barbara Teuchner

PUBLICATION: Acta Ophthalmologica 2022 Aug;100(5):e1127-e1134. doi: 10.1111/aos.15048. Epub 2021 Oct 27

Purpose

The aim of this retrospective analysis was to investigate whether trabeculectomy (TRAB) and XEN® Gel Stent implantation (XEN) – both filtrating surgery techniques – can slow down the deterioration of visual field (VF) parameters considering the floor effect, which could lead to a misestimation of pre- and postoperative VF rate of progression (ROP).

Methods

Included in this study were patients with open-angle glaucoma, who underwent either TRAB or XEN® gel stent implantation and who had at least three VF tests before and after surgery, over an observation period of 13 years. The annual ROP of the mean defect (MD) and the square root of loss variance (sLV) were calculated with two different censoring thresholds: by censored regression and by ordinary least squares regression (OLSR). In addition, the diagnostic range of sLV was calculated.

Results

48 eyes of 39 glaucoma patients were included in the study. The annual rate of MD progression was significantly reduced by filtering surgery when calculating the yearly ROP using OLSR ($p = 0.006$) and by censoring values exceeding a precalculated cut-off of 14.20 dB ($p = 0.041$) and a cut-off from the literature of 15.00 dB ($p = 0.028$). On average, the MD was impacted by a significant floor effect of 14.20 dB (95% CI: 12.83-15.56), corresponding to 17.7/59 absolute defects or 29.9% of the whole VF. When applying both OLSR and censored regression, the annual rate of sLV progression did not show a significant difference. The sLV showed a diagnostic boundary at a MD of 15.78 dB.

Conclusions

This study shows that filtering surgery can reduce the progression of VF in patients with open-angle glaucoma, especially those whose disease develops aggressively. This is valid even if the floor effect in advanced cases is compensated by censored regression. On average, the ROP of MD is affected by a significant floor effect at about 29.9% absolute loss of the whole VF.

Overview

Study design
Retrospective analysis study

Study device
Octopus

Number of eyes/patients
48 eyes / 39 patients

15.

Evaluation of the progression of visual field damage in patients suffering from early manifest glaucoma

AUTHORS: Andrea Perdicchi, Solmaz Abdolrahimzadeh, Alessandro Cutini, Angela Ciarnella, Gian Luca Scuderi

PUBLICATION: Clinical Ophthalmology 2016 Aug 25:10:1647-51. doi: 10.2147/OPTH.S113995. eCollection 2016

Purpose

This retrospective study aimed to determine how often a perimetric examination should be carried out in order to identify visual field (VF) changes in patients with relatively early manifestation glaucoma.

Methods

Patients included had a relatively recent manifestation of primary open-angle glaucoma. Patients with a minimum follow-up of 5 years and a minimum of seven VF tests were included. Statistical analysis was performed to verify the trend of variations in mean defect (MD) over time (PeriData). The results were subjected to a t-test for a comparative analysis of progression of VF changes over time. The annual rate of progression provided by PeriData considering all the VFs analyzed was compared with that obtained on half of the VF examinations during the same follow-up period. An analysis of the MD trend over time was also carried out in relationship to the number of VF tests done and by dividing the sample into a high-frequency group (more than eight VFs) and a low-frequency group (fewer than eight VFs) in the follow-up period.

Results

A total of 96 eyes of 96 patients were included, and overall 846 VFs were examined. The paired t-test performed comparing the MD index of all the VFs against half of them did not show statistical significance (P=0.537). The high-frequency group comprised 39 eyes (average VF 11.05±1.91, average time interval 0.76 years) while the low-frequency group comprised 57 eyes (average VF 6.95±0.6, average time interval 1.21 years). The analysis of the MD trend in the high-frequency patients showed significance (P=0.017); the low-frequency group did not show statistical significance (P=0.08).

Conclusions

The number of VFs in a determined time interval was not significant. However, a greater frequency of tests provides a predictive evaluation of the rate of progression of early manifestation open-angle glaucoma.

Overview

Study design
Retrospective observational cohort study

Study device
Octopus

Number of eyes/patients
96 eyes / 96 patients

16.

Evaluation of Octopus Polar Trend Analysis for detection of glaucomatous progression

AUTHORS: Gábor Holló, Farzaneh Naghizadeh

PUBLICATION: European Journal of Ophthalmology 2014 Nov-Dec;24(6):862-8.
doi: 10.5301/ejo.5000504. Epub 2014 Jun 28.

Purpose

To investigate the clinical usefulness of Polar Trend Analysis (PTA) of the Octopus Field Analysis software for detection of glaucoma progression in medically treated glaucoma.

Methods

One eye each of 52 participants underwent Octopus Normal G2 perimetry and imaging with the RTVue-100 optical coherence tomograph at 6-month intervals (median follow-up 5 years). The eyes were classified as progressors or nonprogressors with PTA, which graphically presents pointwise linear regression analysis of focal defect at the corresponding nerve fiber angle at the disc margin. Polar Trend Analysis progression was defined as more than 1 significantly progressing test point location per sector. Progression of the retinal nerve fiber layer thickness (RNFLT) and ganglion cell complex (GCC) thickness parameters were evaluated with linear regression analysis.

Results

Seventeen eyes were classified as PTA progressors (all in the inferotemporal or superotemporal areas or in both), and 35 eyes as nonprogressors. Frequencies of statistically significant RNFLT and GCC progressions did not differ significantly between the groups for any peripapillary area ($p>0.05$ for all comparisons). Significant inferior average RNFLT progression occurred in 50% of the PTA progressor eyes. Long-term measurement variability during the follow-up period was significantly higher in the PTA progressor group for inferior and superior GCC thickness and inferior average RNFLT ($p<0.001$ for all comparisons).

Conclusions

In glaucoma, PTA may indicate glaucomatous progression earlier than linear regression analysis of the RNFLT and GCC parameters. It may already draw attention to glaucomatous progression when the alteration of the corresponding structural parameters is represented only by increased long-term variability.

Overview

Study design
Prospective comparative study

Study device
Octopus and RTVue OCT

Number of eyes/patients
52 eyes / 52 participants

17.

Visual field progression in glaucoma: cluster analysis

AUTHORS: H Bresson-Dumont , J Hatton, J Foucher, M Fonteneau

PUBLICATION: Journal Français d'Ophtalmologie 2012 Nov;35(9):735-41. doi: 10.1016/j.jfo.2011.10.011. Epub 2012 Jul 6

Purpose

Visual field progression analysis is one of the key points in glaucoma monitoring, but distinction between true progression and random fluctuation is sometimes difficult. There are several different algorithms but no real consensus for detecting visual field progression. The trend analysis of global indices (MD, sLV) may miss localized deficits or be affected by media opacities. Conversely, point-by-point analysis makes progression difficult to differentiate from physiological variability, particularly when the sensitivity of a point is already low. The goal of our study was to analyse visual field progression with the EyeSuite™ Octopus Perimetry Clusters algorithm in patients with no significant changes in global indices or worsening of the analysis of pointwise linear regression.

Methods

We analyzed the visual fields of 162 eyes (100 patients - 58 women, 42 men, average age 66.8 ± 10.91) with ocular hypertension or glaucoma. For inclusion, at least six reliable visual fields per eye were required, and the trend analysis (EyeSuite™ Perimetry) of visual field global indices (MD and SLV), could show no significant progression. The analysis of changes in cluster mode was then performed. In a second step, eyes with statistically significant worsening of at least one of their clusters were analyzed point-by-point with the Octopus Field Analysis (OFA).

Results

Fifty four eyes (33.33%) had a significant worsening in some clusters, while their global indices remained stable over time. In this group of patients, more advanced glaucoma was present than in stable group (MD 6.41 dB vs. 2.87); 64.82% (35/54) of those eyes in which the clusters progressed, however, had no statistically significant change in the trend analysis by pointwise linear regression.

Conclusions

Most software algorithms for analyzing visual field progression are essentially trend analyses of global indices, or point-by-point linear regression. This study shows the potential role of analysis by clusters trend. However, for best results, it is preferable to compare the analyses of several tests in combination with morphologic exam.

Overview

Study design
Retrospective analysis study

Study device
Octopus

Number of eyes/patients
162 eyes

V.

Kinetic perimetry

Despite static threshold perimetry became the most commonly used visual field test approach kinetic perimetry remains a highly accurate visual field investigation method, particularly for outside the central 30-degree area. In clinical practice it is mainly used for neuro-ophthalmology cases. The original manual Goldmann perimetry, for which the currently used static and kinetic perimetry parameters were developed, is seldom applied in the 21st century. But kinetic perimetry offered by the Octopus perimeter family has reopened the field for standardized application of this examination type. Octopus kinetic perimetry comprises automated and semi-automated functions, in which the classic stimulus parameters and vector directions are all offered. The interest in clinical use of Octopus kinetic perimetry remains high, this is why several investigations evaluated its clinical value, as shown by the abstracts collected in this chapter.

18.
Periphery kinetic perimetry: clinically feasible to complement central static perimetry

(Xiaoxiao Ma, Li Tang, Xiaoming Chen, Liuzhi Zeng. BMC Ophthalmology 2021 Sep 23;21(1):343. doi: 10.1186/s12886-021-02056-5)

19.
Octopus 900 automated kinetic perimetry versus standard automated static perimetry in glaucoma practice

(Fiona J Rowe , Gabriela Czanner , Tobi Somerville , Ishaana Sood , Devindra Sood. Current Eye Research 2021 Jan;46(1):83-95. doi: 10.1080/02713683.2020.1786133. Epub 2020 Jul 15)

20.
Evaluation of kinetic programs in various automated perimeters

(Shigeki Hashimoto, Chota Matsumoto, Mariko Eura, Sachiko Okuyama, Yoshikazu Shimomura. Japanese Journal of Ophthalmology 2017 Jul;61(4):299-306. doi: 10.1007/s10384-017-0516-y. Epub 2017 Apr 25)

21.
Semi-automated kinetic perimetry: Comparison of the Octopus 900 and Humphrey visual field analyzer 3 versus Goldmann perimetry

(Claudia Bevers, Gauthier Blanckaert, Karel Van Keer, Jean-François Fils, Evelien Vandewalle, Ingeborg Stalmans. Acta Ophthalmologica 2019 Jun;97(4):e499-e505. doi: 10.1111/aos.13940. Epub 2018 Oct 21)

22.
Reclaiming the periphery: automated kinetic perimetry for measuring peripheral visual fields in patients with glaucoma

(Vera M. Mönter, David P. Crabb, Paul H. Artes. IOVS (Investigative Ophthalmology & Visual Science) 2017 Feb 1;58(2):868-875. doi: 10.1167/iovs.16-19868)

23.
Learning effect and repeatability of automated kinetic perimetry in healthy participants

(Kazunori Hirasawa, Nobuyuki Shoji. Current Eye Research 2014 Sep;39(9):928-37. doi: 10.3109/02713683.2014.888450. Epub 2014 Mar 3)

24.
Uniocular and binocular fields of rotation measures: Octopus versus Goldmann

(Fiona J Rowe , Sahira Hanif. Graefe's Archive for Clinical and Experimental Ophthalmology 2011 Jun;249(6):909-19. doi: 10.1007/s00417-010-1596-2. Epub 2011 Jan 18)

25.
Semi-automated kinetic perimetry provides additional information to static automated perimetry in the assessment of the remaining visual field in end-stage Glaucoma

(Katarzyna Nowomiejska, Dominika Wrobel-Dudzinska, Katarzyna Ksiazek, Piotr Ksiazek, Konrad Rejdak, Ryszard Maciejewski, Anselm G Juenemann, Robert Rejdak. OPO (Ophthalmic & Physiological Optics: The Journal of the College of Optometrists) 2015 Mar;35(2):147-54. doi: 10.1111/opo.12183. Epub 2014 Nov 28)

26.
Normal values for the full visual field, corrected for age- and reaction time, using semiautomated kinetic testing on the Octopus 900 Perimeter

(Julia Grobbel, Janko Dietzsch, Chris A Johnson, Reinhard Vonthein, Katarina Stingl, Richard G Weleber, Ulrich Schiefer. TVST (Translational Vision Science & Technology) 2016 Mar 4;5(2):5. doi: 10.1167/tvst.5.2.5. eCollection 2016 Mar)

18.

Periphery kinetic perimetry: clinically feasible to complement central static perimetry

AUTHORS: Xiaoxiao Ma, Li Tang, Xiaoming Chen, Liuzhi Zeng

PUBLICATION: BMC Ophthalmology 2021 Sep 23;21(1):343. doi: 10.1186/s12886-021-02056-5

Purpose

Existing evidence suggests that visual field defect in eyes with glaucoma significantly varies between individuals. The following study compared the central visual field defects with the peripheral visual field defects in patients with suspect glaucoma and primary open-angle glaucoma (POAG) and investigated whether using the central visual field test alone could result in loss of clinically valuable information.

Methods

In this prospective observational study, 167 eyes from 89 patients with suspect glaucoma or POAG were first examined with static automated perimetry (SAP), followed by a peripheral visual field test on Octopus 900 perimeter (Haag-Streit, Köniz, Switzerland). The peripheral visual field test was performed by "Auto Kinetic Perimetry" program, in which Goldmann III4e stimuli randomly moved along 16 vectors at a constant angular velocity of 5 deg/s.

Results

Glaucomatous peripheral visual field defects were seen in 18% of the eyes with a normal central visual field. In addition, 86% of glaucoma patients with moderate-to-severe central visual field defects had corresponding peripheral visual field defects in the form of localized or diffuse depression of the isopters. Furthermore, a moderate correlation was found between the central and peripheral visual fields. The median test duration was 71 s for the peripheral test and 803 s for the central test ($p < 0.001$).

Conclusions

Our study demonstrated the diversity of glaucomatous visual field defects, as well as the possibility of losing the clinically valuable information due to focusing on the central visual field test alone. The peripheral kinetic perimetry is clinically feasible to complement the central static perimetry for a comprehensive assessment of visual function in glaucoma patients.

Overview

Study design
Prospective observational study

Study device
Octopus

Number of eyes/patients
167 eyes / 89 patients

19.

Octopus 900 automated kinetic perimetry versus standard automated static perimetry in glaucoma practice

AUTHORS: Fiona J Rowe, Gabriela Czanner, Tobi Somerville, Ishaana Sood, Devindra Sood

PUBLICATION: Current Eye Research 2021 Jan;46(1):83-95. doi:10.1080/02713683.2020.1786133. Epub 2020 Jul 15

Purpose

The presence of central visual field loss does not infer the extent of peripheral visual field loss. In advanced stage glaucoma, we evaluated whether automated kinetic perimetry provided additional visual field information to that of central static perimetry.

Methods

We undertook a prospective cross-sectional study of advanced-stage glaucoma defined as stages 3-4. Visual field assessment for right and left eyes was undertaken within one clinic visit using the Octopus 900 G programme and kinetic strategy.

Results

We recruited 126 patients (170 eyes). Mean patient age at assessment was 55.86 years (SD 15.15). Mean kinetic reaction time was 1503.96 ms (SD 801.68). Kinetic I4e was plotted in 71% of eyes with an unadjusted area of 2513.68 degrees^2 (SD 2397.91) and mean isopter radius of 23.16 degrees (SD 13.07). Kinetic I2e was plotted in 53.5% of eyes with an unadjusted area of 627.07 degrees^2 (SD 1291.94) and mean isopter radius of 7.47 degrees (SD 10.59). Increased reaction time was associated with a poorer visual field ($p = .001$). Mean sensitivity, mean deviation and standard loss variance values on static perimetry were higher in patients who had a defined kinetic field boundary than in patients with no kinetic response to I4e stimulus ($p = .0001$). However, this corresponded to only small-to-medium correlation between static fields and existent kinetic fields: the presence of poor static fields did not always infer a poor kinetic visual field as poor static fields could also have good kinetic visual fields.

Conclusions

Although we confirmed a lack of agreement and only a small to medium correlation between the extents of central versus peripheral visual field loss, automated kinetic perimetry did provide additional peripheral (outside the static 30-degree central field) visual field information which was clinically useful in the presence of non-informative severely defected central visual fields.

Overview

Study design
Prospective cross-sectional study

Study device
Octopus

Number of eyes/patients
170 eyes / 126 patients

20.

Evaluation of kinetic programs in various automated perimeters

AUTHORS: Shigeki Hashimoto, Chota Matsumoto, Mariko Eura, Sachiko Okuyama, Yoshikazu Shimomura

PUBLICATION: Japanese Journal of Ophthalmology 2017 Jul;61(4):299-306. doi: 10.1007/s10384-017-0516-y. Epub 2017 Apr 25

Purpose

Kinetic programs in four automated perimeters were evaluated and compared for their clinical usefulness using four simulated visual field (VF) patterns.

Methods

Using the results of conventional Goldmann manual kinetic perimetry (MKP), simulated fields with concentric contraction, a temporal residual island only, a small central island with a temporal island, and a ring scotoma were created. Four kinetic programs, Humphrey 750i Kinetic Test (Humphrey), OCULUS Twinfield 2 Kinetic Perimetry (OCULUS), OCTOPUS 900 Goldmann Kinetic Perimetry (OCTOPUS GKP), and Kowa AP-7000 Isopter (Kowa) were tested by the 4 simulated defect patterns using stimuli of V/4e, I/4e, I/3e, I/2e, and I/1e at speeds of 3 and 5°/s.

Results

Except Humphrey, OCULUS, OCTOPUS GKP, and Kowa could obtain isopters nearly comparable to those of Goldmann MKP. However, their results were considerably influenced by the examiner's skill. Besides, Humphrey had restrictions on target presentation, and OCULUS and Kowa had problems in isopter drawing and in filling in the scotoma. OCTOPUS GKP was the only method that could correctly detect and depict all four defect patterns. It also had relatively shorter test durations among the three methods excluding Humphrey, which did not have a built-in function for test duration measurement. The perimeters' test ranges for the periphery were 90 for Humphrey, OCULUS, and OCTOPUS GKP, and 80 for Kowa.

Conclusions

To assess kinetic fields with various defect patterns, OCTOPUS GKP seems to be the most useful method.

Overview

Study design
Cross-sectional comparative study

Study device
Octopus, Humphrey, Oculus Twinfield and Kowa AP

Number of eyes/patients
Simulated visual field patterns

21.

Semi-automated kinetic perimetry: Comparison of the Octopus 900 and Humphrey visual field analyzer 3 versus Goldmann perimetry

AUTHORS: Claudia Bevers, Gauthier Blanckaert, Karel Van Keer, Jean-François Fils, Evelien Vandewalle, Ingeborg Stalmans

PUBLICATION: Acta Ophthalmologica 2019 Jun;97(4):e499-e505.doi: 10.1111/aos.13940. Epub 2018 Oct 21

Purpose

To evaluate the clinical usefulness and reproducibility of (semi-)automated kinetic perimetry of the Octopus 900 and Humphrey field analyzer 3 (HFA3) compared to Goldmann perimetry as reference technique.

Methods

A prospective interventional study of two study groups, divided into three subgroups. The first study group consisted of 28 patients, performing one visual field examination on each of the three devices. A second group of 30 patients performed four examinations, one on Goldmann and three on Octopus 900 with the following testing strategies: (1) with reaction time (RT) vector, no headphone; (2) without RT vector, no headphone; and (3) without RT vector, with headphone. Comparisons for V4e and I4e stimuli were made of the mean isopter radius (MIR) and of the distances of the isopter to the central visual axis in four directions. Statistical analysis was made with the R software version 3.2.2.

Results

For V4e stimuli, the mean isopter radius showed no statistic significant difference comparing Goldmann to HFA3 [p-value = 0.144; confidence interval (CI) −0.152 to 0.019] and comparing Goldmann to Octopus 900 without RT vector, either with (p-value = 0.347; CI −0.023 to 0.081) or without headphone (p-value = 0.130; CI −0.011 to 0.095). Octopus 900 with RT vector produced a significantly larger MIR for V4e stimuli in comparison to Goldmann (p-value < 0.001). I4e stimuli produced statistically significantly larger visual field areas when comparing HFA3 and Octopus 900 to Goldmann perimetry.

Conclusions

Humphrey field analyzer 3 and Octopus 900 without RT vector are promising successors of Goldmann perimetry.

Overview

Study design
Prospective interventional study

Study device
Octopus, Humphrey and Goldmann

Number of eyes/patients
58 eyes / 58 patients

22.

Reclaiming the periphery: automated kinetic perimetry for measuring peripheral visual fields in patients with glaucoma

AUTHORS: Vera M. Mönter, David P. Crabb and Paul H. Artes

PUBLICATION: IOVS (Investigative Ophthalmology & Visual Science) 2017 Feb 1;58(2):868-875. doi: 10.1167/iovs.16-19868

Purpose

Peripheral vision is important for mobility, balance, and guidance of attention, but standard perimetry examines only <20% of the entire visual field. We report on the relation between central and peripheral visual field damage, and on retest variability, with a simple approach for automated kinetic perimetry (AKP) of the peripheral field.

Methods

Thirty patients with glaucoma (median age 68, range 59-83 years; median Mean Deviation -8.0, range -16.3-0.1 dB) performed AKP and static automated perimetry (SAP) (German Adaptive Threshold Estimation strategy, 24-2 test). Automated kinetic perimetry consisted of a fully automated measurement of a single isopter (III.1.e). Central and peripheral visual fields were measured twice on the same day.

Results

Peripheral and central visual fields were only moderately related (Spearman's ρ, 0.51). Approximately 90% of test-retest differences in mean isopter radius were < ±4 deg. Relative to the range of measurements in this sample, the retest variability of AKP was similar to that of SAP.

Conclusions

Patients with similar central visual field loss can have strikingly different peripheral visual fields, and therefore measuring the peripheral visual field may add clinically valuable information.

Overview

Study design
Observational prospective non-interventional study

Study device
Octopus

Number of eyes/patients
30 patients

23.

Learning effect and repeatability of automated kinetic perimetry in healthy participants

AUTHORS: Kazunori Hirasawa, Nobuyuki Shoji

PUBLICATION: Current Eye Research 2014 Sep;39(9):928-37. doi: 10.3109/02713683.2014.888450. Epub 2014 Mar 3

Purpose

To evaluate the learning effect and repeatability of automated kinetic perimetry in inexperienced and experienced healthy young participants.

Methods

Forty-six eyes of 46 healthy participants (23 eyes of 23 participants in the inexperienced group and 23 eyes of 23 participants in the experienced group; mean age, 25.9 years) were enrolled in this prospective study. Automated kinetic perimetry was performed using the Octopus 900 perimeter with Goldmann stimuli III4e, I4e, I3e, I2e and I1e. The participants underwent testing at 14 predetermined meridians for each stimulus with a stimulus velocity of 3°/s. The learning effect was evaluated for kinetic sensitivity and test duration using three measurements. Repeatability was evaluated by calculating the mean square (MS) and coefficient of variance (CoV) of the kinetic sensitivity between the second and third measurements.

Results

A learning effect was seen only in the inexperienced group between the first and second measurements. The kinetic sensitivity for III4e and I4e increased by 1.5° ($p < 0.01$) and 1.1° ($p = 0.02$), respectively, and the test duration decreased to 20.1 seconds ($p = 0.02$). There was no demonstrated learning effect in the inexperienced and experienced groups between the second and third measurements. Regarding the repeatability in the inexperienced and experienced groups, the MS and CoV values of the kinetic sensitivity for I3e, I2e and I1e increased by a median of 1.2-2.7° ($p < 0.01$) and 1.6-13.6% ($p < 0.01$), respectively, compared with those of III4e and I4e.

Conclusions

The results of the first measurement in the inexperienced participants require careful evaluation, especially for III4e and I4e measured in the peripheral areas. However, because III4e and I4e both showed good repeatability in inexperienced and experienced participants, automated kinetic perimetry may be suitable for measuring the peripheral area using higher stimulus intensities such as III4e and I4e.

Overview

Study design
Prospective observational study

Study device
Octopus

Number of eyes/patients
46 eyes / 46 patients

24.

Uniocular and binocular fields of rotation measures: Octopus versus Goldmann

AUTHORS: Fiona J Rowe, Sahira Hanif

PUBLICATION: Graefe's Archive for Clinical and Experimental Ophthalmology 2011 Jun;249(6):909-19. doi: 10.1007/s00417-010-1596-2. Epub 2011 Jan 18

Purpose

To compare the range of ocular rotations measured by Octopus versus Goldmann perimetry.

Methods

Forty subjects (20 controls and 20 patients with impaired ocular movements) were prospectively recruited, age range 21-83 years. Range of uniocular rotations was measured in six vectors corresponding to extraocular muscle actions: 0°, 67°, 141°, 180°, 216°, 293°. Fields of binocular single vision were assessed at 30° intervals. Vector measurements were utilised to calculate an area score for the field of uniocular rotations or binocular field of single vision. Two test speeds were used for Octopus testing: 3°/ and 10°/second.

Results

Test duration was two thirds quicker for Octopus 10°/second than for 3°/second stimulus speed, and slightly quicker for Goldmann. Mean area for control subjects for uniocular field was 7910.45 degrees(2) for Goldmann, 7032.14 for Octopus 3°/second and 7840.66 for Octopus 10°/second. Mean area for patient subjects of right uniocular field was 8567.21 degrees(2) for Goldmann, 5906.72 for Octopus 3°/second and 8806.44 for Octopus 10°/second. Mean area for left uniocular field was 8137.49 degrees(2) for Goldmann, 8127.9 for Octopus 3°/second and 8950.54 for Octopus 10°/second. Range of measured rotation was significantly larger for Octopus 10°/second speed.

Conclusions

Our results suggest that the Octopus perimeter is an acceptable alternative method of assessment for uniocular ductions and binocular field of single vision. Speed of stimulus significantly alters test duration for Octopus perimetry. Comparisons of results from both perimeters show that quantitative measurements differ, although qualitatively the results are similar. Differences per mean vectors were less than 5° (within clinically accepted variances) for both controls and patients when comparing Goldmann to Octopus 10°/second speed. However, differences were almost 10° for the patient group when comparing Goldmann to Octopus 3°/second speed. Thus, speed of stimulus must be considered if wishing to use these perimeters interchangeably.

Overview

Study design
Prospective cross-sectional comparative study

Study device
Octopus and Goldmann

Number of eyes/patients
40 patients

25.

Semi-automated kinetic perimetry provides additional information to static automated perimetry in the assessment of the remaining visual field in end-stage Glaucoma

AUTHORS: Katarzyna Nowomiejska, Dominika Wrobel-Dudzinska, Katarzyna Ksiazek, Piotr Ksiazek, Konrad Rejdak, Ryszard Maciejewski, Anselm G Juenemann, Robert Rejdak

PUBLICATION: OPO (Ophthalmic & Physiological Optics: The Journal of the College of Optometrists) 2015 Mar;35(2):147-54. doi: 10.1111/opo.12183. Epub 2014 Nov 28

Purpose

To test the hypothesis whether semi-automated kinetic perimetry (SKP) provides additional information to static automated perimetry (SAP) in the assessment of the remaining visual field in end-stage glaucoma, as defined by disc appearance (cup-to-disc ratio worse than 0.9) and SAP criteria (MD worse than 20 dB).

Methods

Fifty eyes of 44 patients presenting with end-stage glaucoma were examined first with SAP within the central 30° using stimulus size III, followed by SKP within 90° using test targets III4e and V4e.

Results

Overall, SKP provided additional information over SAP in more than half (54%) of the cases. In 16 instances (32%), SKP revealed visual field island beyond 30° that was undetected by SAP. In eight cases (16%), SKP showed both a central island and peripheral island of visual field. In three cases (6%) altitudinal scotomatous loss was found using SKP, but not in SAP. In 23 cases (46%) the central visual field island was defined both with SAP and SKP. The mean examination duration was 4 min for SAP and 9 min for SKP.

Conclusions

In clinical practice, SKP with III4e and V4e test targets provides more information than 30° SAP regarding the remaining peripheral VF in patients with end-stage glaucoma; however, a longer test time is required for SKP.

Overview

Study design
Prospective cross-sectional comparative study

Study device
Octopus

Number of eyes/patients
50 eyes / 44 patients

26.

Normal values for the full visual field, corrected for age- and reaction time, using semiautomated kinetic testing on the Octopus 900 Perimeter

AUTHORS: Julia Grobbel, Janko Dietzsch, Chris A Johnson, Reinhard Vonthein , Katarina Stingl , Richard G Weleber , Ulrich Schiefer

PUBLICATION: TVST (Translational Vision Science & Technology) 2016 Mar 4;5(2):5.
doi: 10.1167/tvst.5.2.5. eCollection 2016 Mar

Purpose

To determine normal values of the visual field (VF), corrected for age and reaction time (RT) for semiautomated kinetic perimetry (SKP) on the Octopus 900 perimeter, create a model describing the age-dependency of these values, and assess test-retest reliability for each isopter.

Methods

Eighty-six eyes of 86 ophthalmologically healthy subjects (age 11-79 years, 34 males, 52 females) underwent full-field kinetic perimetry with the Octopus 900 instrument. Stimulus size, luminance, velocity, meridional angle, subject age, and their interactions, were used to create a smooth multiple regression mathematical model (V/4e, III/4e, I/4e, I/3e, I/2e, I/1e, and I/1a isopters). Fourteen subjects (2 from each of 7 age groups) were evaluated on three separate sessions to assess test-retest reliability of the isopters. Reaction time (RT) was tested by presenting 12 designated RT-vectors between 10° and 20° within the seeing areas for the III/4e isopter (stimulus velocity, 3°/second). Four RT- vectors were presented at the nasal (0° or 180°), superotemporal (45°), and inferior (270°) meridians.

Results

The model fit was excellent ($r^2 = 0.94$). The test-retest variability was less than 5°, and the median decrease in this deviation attributed to aging, per decade, for all age groups and for all stimulus sizes was 0.8°. No significant learning effect was observed for any age group or isopter.

Conclusions

Age-corrected and RT-corrected normative threshold values for full-field kinetic perimetry can be adequately described by a smooth multiple linear regression mathematical model.

Overview

Study design
Observational prospective study

Study device
Octopus

Number of eyes/patients
86 eyes / 86 patients

VI.

Structure-function investigations

Establishing and quantitatively characterising the relationship between structural measures of certain predefined retinal areas (e.g. retinal nerve fiber bundles, hemifields, macular EDTRS area) and the spatially corresponding visual field sector (cluster) sensitivity or mean defect (MD) is not only an exciting research area but also a clinically important analysis which may support both the early diagnosis and the early detection of progression in chronic progressing diseases like glaucoma. Currently, the structural parameters arrive from optical coherence tomography (OCT) measurements, and are expressed in µm, while the spatially corresponding visual field measures can be expressed as global or clustered sensitivity values, or cluster/sector/hemifield/global MD values expressed in dB. For routine clinical purposes it is essential to know that the global structural and visual field parameters alone do not fully describe the damage or deterioration. Isolated localized reductions may only minimally decrease the mean values, even if they have particularly high clinical significance. For example, a focal paracentral visual field deterioration, which does not considerably influence the global MD value, can rapidly extend to the central fixation area (the representation of the fovea). This results in the development of a central scotoma and diminished visual acuity. When a cluster defect or a cluster progression appears in the tested visual field the clinician needs to carefully evaluate the spatially corresponding retinal nerve fiber bundle for damage or progression, respectively, and take action if the structural defect is detected. But to that the exact location of the corresponding structural damage needs to be known, which also requires an established detailed structure – function relationship background. Octopus perimetry also offers a qualitative support tool to assist the localization of the area of interest on the peripapillary retinal nerve fibre layer. This tool is the Polar Graph for single visit (cross-sectional) evaluation and Polar Trend for progression analysis. Both tools project the defect or defect change value of each test point location on an optic disc scheme, respectively. The diagram shows the individual defect or defect change value as a radial bar at the corresponding retinal nerve fiber bundle location on the disc margin. The length of the bar reflects the defect value or the defect change value in dB. This supports clinicians in finding the retinal nerve fiber bundle of interest. In this chapter the abstracts of structure – function investigations made using Octopus perimetry are collected. The collection comprises both research oriented and clinically oriented studies.

27.
Correlation of optic nerve hemoglobin levels with structural and functional parameters in glaucoma

(Gustavo Coelho Caiado, Gustavo Albrecht Samico, Gilvan Vilarinho da Silva Filho, Sergio Henrique Teixeira, Tiago Santos Prata, Carolina Pelegrini BarbosaGracitelli, Augusto Paranhos Jr. Scientific Reports 2025 Jun 1;15(1):19190. doi: 10.1038/s41598-025-03549-9)

28.
Visual field prognosis from macula and circumpapillary spectral domain optical coherence tomography

(Davide Scandella, Mathias Gallardo, Serife S. Kucur, Raphael Sznitman, Jan Darius Unterlauft. TVST (Translational Vision Science & Technology) 2024 Jun 3;13(6):10. doi: 10.1167/tvst.13.6.10)

29.
Structure-function analysis of MP-3 microperimetry versus Octopus perimetry in central glaucomatous visual field defects

(Stefan Georgiev, Stefan Palkovits, Nino Hirnschall, Andreas Schlatter, Christoph Leisser, Oliver Findl. Ophthalmic Research 2022;65(4):437-445. doi: 10.1159/000524005. Epub 2022 Mar 10)

30.
Structure-function relationship between cluster mean defect and sector peripapillary retinal nerve fiber layer thickness in primary open angle glaucoma

(Jing Han, Wenjiu Yang, Dabo Wang, Haiqing Bai. Journal of Ophthalmology 2022 Jul 11:2022:5231545. doi: 10.1155/2022/5231545. eCollection 2022)

31.
The different structure-function correlation as measured by OCT and Octopus perimetry cluster analysis in intracranial tumor and glaucoma patients

(Xiaochun Li, Jiayin Qin, Xiaoguang Cao, Zeqin Ren, Ting Cui, Yongzhen Bao. Frontiers in Endocrinology 2022 Jul 27:13:938952. doi: 10.3389/fendo.2022.938952. eCollection 2022)

32.
Metamorphopsia score and central visual field outcomes in diabetic cystoid macular edema

(Agnieszka Kalinowska, Katarzyna Nowomiejska, Agnieszka Brzozowska , Ryszard Maciejewski , Robert Rejdak. BioMed Research International 2018 Mar 18;2018:4954532. doi: 10.1155/2018/4954532. eCollection 2018)

33.
Sampling the visual field based on individual retinal nerve fiber layer thickness profile

(Shonraj Ballae Ganeshrao, Andrew Turpin, Allison M. McKendrick. IOVS (Investigative Ophthalmology & Visual Science) 2018 Feb 1;59(2):1066-1074. doi: 10.1167/iovs.17-21979)

34.
Comparison of structure-function relationship between corresponding retinal nerve fibre layer thickness and Octopus visual field cluster defect values determined by normal and tendency-oriented strategies

(Gábor Holló. British Journal of Ophthalmology 2017 Feb;101(2):150-154.
doi: 10.1136/bjophthalmol-2015-307759. Epub 2016 Apr 22)

35.
The optic nerve head in primary open-angle glaucoma eyes with high myopia: characteristics and association with visual field defects

(Li-Wei Chen, Yu-Wen Lan, Jui-Wen Hsieh. Journal of Glaucoma 2016 Jun;25(6):e569-75. doi: 10.1097/IJG.0000000000000395)

36.
A test of a model of glaucomatous damage of the macula with high-density perimetry: Implications for the locations of visual field test points

(Donald C. Hood, Matthew Nguyen, Alyssa C. Ehrlich, Ali S. Raza, Ieva Sliesoraityte, Carlos G. De Moraes, Robert Ritch, Ulrich Schiefer. TVST (Translational Vision Science & Technology) 2014 Jun 19;3(3):5. doi: 10.1167/tvst.3.3.5. eCollection 2014 May)

37.
Structure-function relationship between the octopus perimeter cluster mean sensitivity and sector retinal nerve fiber layer thickness measured with the RTVue optical coherence tomography and scanning laser polarimetry

(Farzaneh Naghizadeh , Anita Garas, Péter Vargha, Gábor Holló. Journal of Glaucoma 2014 Jan;23(1):11-8. doi: 10.1097/IJG.0b013e318264cda2)

38.
Comparison of two different OCT systems: retina layer segmentation and impact on structure-function analysis in glaucoma

(Livia M. Brandao, Anna A. Ledolter, Andreas Schötzau, Anja M. Palmowski-Wolfe. Journal of Ophthalmology 2016:2016:8307639. doi: 10.1155/2016/8307639. Epub 2016 Feb 4)

39.
The relationship between structure and function as measured by OCT and Octopus perimetry

(Blanca Monsalve, Antonio Ferreras, Anthony P Khawaja, Pilar Calvo, Mirian Ara, Paolo Fogagnolo, Michele Iester. British Journal of Ophthalmology 2015 Sep;99(9):1230-5. doi: 10.1136/bjophthalmol-2014-305888. Epub 2015 Mar 17)

40.
Perimetric measurements with flicker-defined form stimulation in comparison with conventional perimetry and retinal nerve fiber measurements

(Folkert K. Horn, Ralf P. Tornow, Anselm G. Junemann, Robert Laemmer, Jan Kremers. IOVS (Investigative Ophthalmology & Visual Science) 2014 Apr 11;55(4):2317-23. doi: 10.1167/iovs.13-12469)

41.
Correlation between local glaucomatous visual field defects and loss of nerve fiber layer thickness measured with polarimetry and spectral domain OCT

(Folkert K. Horn, Christian Y. Mardin, Robert Laemmer, Delia Baleanu, Anselm M. Juenemann, Friedrich E. Kruse, Ralf P. Tornow. IOVS (Investigative Ophthalmology & Visual Science) 2009 May;50(5):1971-7. doi: 10.1167/iovs.08-2405. Epub 2009 Jan 17)

27.

Correlation of optic nerve hemoglobin levels with structural and functional parameters in glaucoma

AUTHORS: Gustavo Coelho Caiado, Gustavo Albrecht Samico, Gilvan Vilarinho da Silva Filho, Sergio Henrique Teixeira, Tiago Santos Prata, Carolina Pelegrini BarbosaGracitelli, Augusto Paranhos Jr.

PUBLICATION: Scientific Reports 2025 Jun 1;15(1):19190. doi: 10.1038/s41598-025-03549-9

Purpose

Glaucoma is a chronic and progressive eye disease that leads to irreversible damage to the optic nerve and retinal nerve fiber layer, resulting in visual field loss. Abnormalities in retinal blood flow and vascular regulation are increasingly recognized as key factors in glaucoma development. This study explores the relationship between optic nerve head hemoglobin (ONH Hb) levels, assessed through automated colorimetric analysis using Laguna ONhE software, and structural and functional parameters in glaucoma patients.

Methods

The study included 57 glaucoma patients (89 eyes) and evaluated correlations between ONH Hb levels, retinal nerve fiber layer thickness (RNFLT), ganglion cell layer thickness (GCLT), foveal avascular zone (FAZ) metrics, and visual field indices. Results showed significant correlations between ONH Hb levels and visual field mean defect, RNFLT, and GCLT, highlighting the potential of ONH Hb as a non-invasive marker for glaucoma-related structural changes.

Results

The findings suggest that ONH Hb assessment could serve as a practical and cost-effective tool for glaucoma diagnosis and monitoring, particularly in settings where advanced imaging technologies like OCT and OCTA are less accessible.

Conclusions

This study underscores the importance of vascular factors in glaucoma and supports the use of ONH Hb evaluation as a complementary approach to traditional diagnostic methods.

Overview

Study design
Prospective cross-sectional study

Study device
Octopus, DRI OCT Triton and IOL Master

Number of eyes/patients
89 eyes / 57 patients

28.

Visual field prognosis from macula and circumpapillary spectral domain optical coherence tomography

AUTHORS: Davide Scandella, Mathias Gallardo, Serife S. Kucur, Raphael Sznitman, Jan Darius Unterlauft

PUBLICATION: TVST (Translational Vision Science & Technology) 2024 Jun 3;13(6):10. doi: 10.1167/tvst.13.6.10

Purpose

To explore the structural-functional loss relationship from optic-nerve-head– and macula-centred spectral-domain (SD) Optical Coherence Tomography (OCT) images in the full spectrum of glaucoma patients using deep-learning methods.

Methods

A cohort comprising 5238 unique eyes classified as suspects or diagnosed with glaucoma was considered. All patients underwent ophthalmologic examination consisting of standard automated perimetry (SAP), macular OCT, and peri-papillary OCT on the same day. Deep learning models were trained to estimate G-pattern visual field (VF) mean deviation (MD) and cluster MD using retinal thickness maps from seven layers: retinal nerve fiber layer (RNFL), ganglion cell layer and inner plexiform layer (GCL + IPL), inner nuclear layer and outer plexiform layer (INL + OPL), outer nuclear layer (ONL), photoreceptors and retinal pigmented epithelium (PR + RPE), choriocapillaris and choroidal stroma (CC + CS), total retinal thickness (RT).

Results

The best performance on MD prediction is achieved by RNFL, GCL + IPL and RT layers, with R2 scores of 0.37, 0.33, and 0.31, respectively. Combining macular and peri-papillary scans outperforms single modality prediction, achieving an R2 value of 0.48. Cluster MD predictions show promising results, notably in central clusters, reaching an R2 of 0.56.

Conclusions

The combination of multiple modalities, such as optic-nerve-head circular B-scans and retinal thickness maps from macular SD-OCT images, improves the performance of MD and cluster MD prediction. Our proposed model demonstrates the highest level of accuracy in predicting MD in the early-to-mid stages of glaucoma.

Overview

Study design
Prospective cross sectional study

Study device
Octopus and Spectralis

Number of eyes/patients
5238 eyes

29.

Structure-function analysis of MP-3 microperimetry versus Octopus perimetry in central glaucomatous visual field defects

AUTHORS: Stefan Georgiev, Stefan Palkovits, Nino Hirnschall, Andreas Schlatter, Christoph Leisser, Oliver Findl

PUBLICATION: Ophthalmic Research 2022;65(4):437-445. doi: 10.1159/000524005. Epub 2022 Mar 10

Purpose

The aim of this study was to compare the structure-function relationship with microperimetry and Octopus perimetry in primary open-angle glaucoma (POAG) patients with central visual field (VF) defects.

Methods

Forty eyes of 24 patients with POAG were enrolled. Circumpapillary retinal nerve fiber layer (cpRNFL) analysis measured by spectral-domain optical coherence tomography (SD-OCT) of the superotemporal, temporal, and inferotemporal optic-nerve head sectors were related to corresponding microperimetric and Octopus VF clusters using the G2 grid-pattern with dynamic strategy, respectively. The structure-function relationships of both devices were assessed via a segmented regression, as well as linear regression across overall SD-OCT cpRNFL values and outside normative (<1%) SD-OCT cpRNFL values.

Results

Linear and segmented regression fits were similar with both devices. Across overall cpRNFL sectorial values, structure-function relations for the superotemporal, temporal, and inferotemporal sectors were R2 = 0.176 (p = <0.001), R2 = 0.008 (p = 0.069), and R2 = 0.294 (p = <0.001) for microperimetry and R2 = 0.189 (p = <0.001), R2 = 0.020 (p = 0.002), and R2 = 0.326 (p = <0.001) for Octopus perimetry. For corresponding values outside normative limits (<1%), the relationships were R2 = 0.113 (p = <0.001), R2 = 0.001 (p = 0.836), and R2 = 0.420 (p = <0.001) for microperimetry and R2 = 0.192 (p = <0.001), R2 = 0.002, (p = 0.336), and R2 = 0.366 (p = <0.001) for Octopus perimetry.

Conclusions

Structure-function analysis was similar for both devices. Fundus-tracking should be further evaluated in a longitudinal setting in patients affected by glaucoma.

Overview

Study design
Prospective cross sectional study

Study device
Octopus, Spectralis and MP-3 microperimeter

Number of eyes/patients
24 eyes

30.

Structure-function relationship between cluster mean defect and sector peripapillary retinal nerve fiber layer thickness in primary open angle glaucoma

AUTHORS: Jing Han, Wenjiu Yang, Dabo Wang, Haiqing Bai

PUBLICATION: Journal of Ophthalmology 2022 Jul 11:2022:5231545. doi: 10.1155/2022/5231545. eCollection 2022

Purpose

To determine the structure–function relationship between cluster mean defect (MD) offered by standard automated perimetry and corresponding sector peripapillary retinal nerve fiber layer thickness (pRNFLT) measured with optical coherence tomography (OCT) in primary open angle glaucoma (POAG).

Methods

39 healthy eyes (control group), 43 early POAG eyes (global MD ≤ 6 dB, early group), 30 moderate POAG eyes (global MD between 6 and 12 dB, moderate group), and 53 advanced POAG eyes (global MD > 12 dB, advanced group) underwent visual eld (VF) examination with Octopus perimeter (dynamic strategy/G2 pattern) and peripapillary retinal nerve fiber layer thickness measurements with RTVue-100 FD-OCT. Spearman analysis was used to investigate the correlation between cluster MDs provided by Octopus perimeter and corresponding sector pRNFLT for the total sample and each subgroup, respectively. Then, linear (y= a+ bx) and curvilinear (quadratic, y =a+bx + cx^2) regression analyses were employed to investigate the model for the cluster MD-sector pRNFLT pair with significant correlation. The strength of the relationship was characterized with correlation coefficient (ρ) and coefficient of determination (R^2). For the cluster–sector pair that could be fitted by both models, Wilcoxon signed rank test of absolute residuals was used to compare the goodness of fit.

Results

Correlation between cluster MDs and corresponding sector pRNFLT was significant for all clusters in the total sample (ρ values: −0.572 to 0.832, $P < 0.001$) and in the POAG group (ρ values: −0.551 to −0.777, $P < 0.001$). The highest ρ values were found for cluster-sector pair 9 and pair 3, respectively. The curvilinear (quadratic) model provided better fit for all 10 cluster-sector pairs in the total sample (R^2 values: 0.431–0.687, $P < 0.001$) and in the POAG group (R^2 values: 0.364–0.594, $P < 0.01$). The highest R^2 values were found also for cluster–sector pair 9 and pair 3, respectively. In the control group, no significant correlation was found for any cluster–sector pair ($P > 0.01$). In the early group, correlation was significant for cluster–sector pairs 3, 8, and 9 (ρ values: −0.449, −0.627, and −0.815, resp., $P < 0.01$). In the moderate group, correlation was significant for pairs 2, 3, 8, and 9 (ρ values: −0.703, −0.556, −0.680, and −0.637, resp., $P < 0.01$). In the advanced group, correlation was significant ($P < 0.01$) for all 10 pairs (ρ values: −0.395 to −0.699, $P < 0.001$) except for pairs 2, 3, and 8, and the highest ρ value was found for pair 1. For all cluster–sector pairs with significant correlation in the early, moderate, and advanced groups, only linear model could be fitted ($P < 0.01$), except for pair 9 in the early group and pair 5 in the advanced group.

Conclusions

Cluster MD of the Octopus visual field showed significant moderate-to-strong negative correlation and curvilinear (quadratic) relationship with the corresponding sector pRNFLT for POAG. This type of regional structure–function relationship varied according to the severity of POAG, and at each stage, the significantly correlated cluster–sector pairs mainly showed linear relationship. The results could provide guidance for better utilization of this regional structure–function method in the management of different stages of POAG.

Overview

Study design
Observational cross-sectional study

Study device
Octopus and RTVue

Number of eyes/patients
165 eyes

31.

The different structure-function correlation as measured by OCT and Octopus perimetry cluster analysis in intracranial tumor and glaucoma patients

AUTHORS: Xiaochun Li, Jiayin Qin, Xiaoguang Cao, Zeqin Ren, Ting Cui, Yongzhen Bao

PUBLICATION: Frontiers in Endocrinology 2022 Jul 27:13:938952. doi: 10.3389/fendo.2022.938952. eCollection 2022

Purpose

To explore the correlation between visual field (VF) defect values and retinal nerve fiber layer (RNFL) thickness for intracranial tumor and glaucoma patients.

Methods

Retrospective analysis is performed for the intracranial and glaucoma patients, whose VF defect values were measured with Octopus perimeter cluster analysis, RNFL thickness, ganglion cell layer (GCL) thickness, and optic disk parameters measured with swept-source OCT. The differences between VF and RNFL (including the data of optic disc) are calculated. The correlation between VF defect values and RNFL and GCL thickness are explored.

Results

In total 43 eyes of 29 patients with intracranial tumor and 31 eyes of 19 patients with glaucoma were enrolled. The thickness of RNFL not only for the whole (360°), but also for the four quadrants was thinner in the glaucoma group than those of the intracranial tumor group ($p<0.05$), and similar to the thickness of GCL without significance ($p>$). There is no significant difference in VF for those two groups except glaucoma having lower sLV ($p<0.05$). A stronger correlation for mean deviations (MD)s of VF ten clusters and RNFL thickness of OCT twelve sectors is found in the glaucoma patients, but few in the intracranial tumor patients. Logistic regression also shows the loss of RNFL or increasing of vertical CDR and cup volume tending to the diagnosis of glaucoma and the irregular VF damage is inclined to the diagnosis of intracranial tumor.

Conclusions

Intracranial tumor has a weak correlation between the RNFL thickness and Octopus VF MD, compared with that of glaucoma. OCT and Octopus VF might provide more helpful information for the differential diagnosis of intracranial tumor and glaucoma.

Overview

Study design
Retrospective comparative analysis study

Study device
Octopus and DRI OCT Trion

Number of eyes/patients
74 eyes / 48 patients

32.

Metamorphopsia score and central visual field outcomes in diabetic cystoid macular edema

AUTHORS: Agnieszka Kalinowska, Katarzyna Nowomiejska, Agnieszka Brzozowska , Ryszard Maciejewski , Robert Rejdak

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Purpose

To detect abnormality of the visual function in naïve patients with cystoid diabetic macular edema (DME) using M-charts, Amsler test, and white on white (W/W) and blue on yellow (B/Y) perimetry.

Methods

There were 64 eyes included in the study: 30 eyes with DME, 22 eyes with diabetes without DME, and 12 eyes of normal subjects. Conventional W/W perimetry and B/Y perimetry were performed within the central 10° of the visual field. To assess metamorphopsia, Amsler test and M-charts were used.

Results

The rate of detection of metamorphopsia was 37% with Amsler test examination and 50% with M-charts. Specificity of both tests was 100%. We found a significant difference between vertical scores of M-charts in all groups, but not in horizontal scores ($p < 0.0001$). Mean defect (MD) was 8.9 dB and 3.6 dB and loss variance (LV) 4.8 dB and 3.3 dB ($p < 0.0001$).

Conclusions

M-chart is more sensitive than Amsler test method for detection of metamorphopsia. The MD and LV are higher in b/y in comparison to W/W perimetry. B/Y perimetry and M-charts are more sensitive than conventional methods for detecting the visual function loss in cystoid DME.

Overview

Study design
Observational prospective study

Study device
Octopus and OCT-2000

Number of eyes/patients
64 eyes

33.

Sampling the visual field based on individual retinal nerve fiber layer thickness profile

AUTHORS: Shonraj Ballae Ganeshrao, Andrew Turpin, Allison M. McKendrick

PUBLICATION: IOVS (Investigative Ophthalmology & Visual Science) 2018 Feb 1;59(2):1066-1074. doi: 10.1167/iovs.17-21979

Purpose

Current perimeters use fixed grid patterns. We test whether a grid based on an individual's retinal nerve fiber layer (RNFL) thickness profile would find more visual field (VF) defects.

Methods

We describe the defect-based method for choosing test locations. First, the 26 VF locations with the highest positive predictive value to detect glaucoma from the 24-2 pattern are chosen. An additional 26 locations are chosen from a 2 x 2 degree grid based on RNFL thickness. An individualized map was used to relate VF locations to peripapillary RNFL thickness. To test whether the 52 locations chosen by the defect-based method find more defects than other test grids, we collected a 386-location (2 x 2 degree grid) VF measurement on 23 glaucoma participants and classed each location in the dataset as either abnormal or normal using a suprathreshold test. Using this data, defect-based sampling was compared to: a method that sampled VF locations uniformly around the optic nerve head (ONH); the 24-2 pattern; a polar pattern; and a reduced polar pattern. The outcome measure was the number of abnormal points that were selected as test locations.

Results

For 8 eyes, no method found more abnormal points than would be expected by chance (hypergeometric distribution, $P < 0.05$). Of the remaining 15 eyes, the defect-based method identified more abnormal locations on nine eyes, which was significantly better than the other three sampling schemes (24-2: 2 eyes, $P < 0.001$; polar: 2 eyes, $P < 0.001$; reduced polar: 2 eyes, $P < 0.004$; and uniform: 1 eye, $P < 0.001$).

Conclusions

Using structural information to choose locations to test in a VF for individual patients identifies more abnormal locations than using existing grid patterns and uniform sampling based on structure.

Overview

Study design
Cross-sectional comparative study

Study device
Octopus, Humphrey and Spectralis

Number of eyes/patients
23 eyes / 23 patients

34.

Comparison of structure-function relationship between corresponding retinal nerve fibre layer thickness and Octopus visual field cluster defect values determined by normal and tendency-oriented strategies

AUTHORS: Gábor Holló

PUBLICATION: British Journal of Ophthalmology 2017 Feb;101(2):150-154. doi: 10.1136/bjophthalmol-2015-307759. Epub 2016 Apr 22

Purpose

Previously, we found a strong structure-function relationship between Octopus visual field cluster sensitivity and corresponding sector retinal nerve fibre layer thickness (RNFLT) values, using normal strategy and 16 custom-made cluster-sector pairs. However, Octopus commercially offers 10 clusters, correction for diffuse defect (corrected clusters) and tendency-oriented perimetry (TOP) strategy. In the current investigation, we evaluated structure-function relationship for these conditions, respectively.

Methods

Twenty-four healthy, 45 ocular hypertensive and 63 glaucoma eyes underwent Octopus perimetry (normal and TOP strategies) and RNFLT measurements on the same day. Pearson's correlation between corresponding cluster defect and sector RNFLT values was investigated.

Results

Correlation between the corresponding cluster defect and sector RNFLT values was significant ($p<0.0001$) for all clusters, with both test strategies. The r values ranged from -0.3529 and -0.3877 to -0.5798 and -0.5893, respectively. The highest r values were found for the inferotemporal RNFLT sector superior and superior paracentral cluster pairs with both strategies. No difference in correlation was seen between the strategies ($p\geq0.183$). For corrected clusters, significant correlation ($p<0.01$) was seen only for two inferotemporal and one superotemporal RNFLT sectors, with both strategies (r values: -0.2446, -0.2375; -0.3526, -0.3119; -0.2392, -0.2340, respectively).

Conclusions

Octopus normal and TOP strategies provide similar, moderate-to-strong negative correlation between the corresponding cluster defect and sector RNFLT values for all 10 manufacturer-provided clusters. For corrected clusters the relationship is poor, which suggests that by correcting for diffuse sensitivity loss some local glaucomatous defect is removed. For structure-function based clinical decisions, use of TOP is possible but use of corrected clusters is not recommended.

Overview

Study design
Cross-sectional comparative study

Study device
Octopus and RTVue OCT

Number of eyes/patients
132 eyes

35.

The optic nerve head in primary open-angle glaucoma eyes with high myopia: characteristics and association with visual field defects

AUTHORS: Li-Wei Chen, Yu-Wen Lan, Jui-Wen Hsieh

PUBLICATION: Journal of Glaucoma 2016 Jun;25(6):e569-75.
doi: 10.1097/IJG.0000000000000395

Purpose

To evaluate the morphologic characteristics of optic neuropathy and its association with visual field (VF) defects in primary open-angle glaucoma (POAG) eyes with high myopia.

Methods

In this cross-sectional study, we reviewed data from 375 Taiwanese patients (375 eyes) of POAG, ages 20 to 60 years. Optic disc photographs were used for planimetric measurements of morphologic variables. The myopic refraction was divided into high myopia (<-6.0 D) and nonhigh myopia (moderate myopia to hyperopia). The optic disc area was classified as moderate (1.59 to 2.85 mm(2)), large, and small. Differences in characteristics between groups, correlations with the disc area, and factors associated with VF defects were determined.

Results

Of the 142 highly myopic eyes, 33 (23%) had a large disc, 26 (18%) had a small disc, and 55 (39%) had a tilted disc. Large discs had a higher cup-to-disc (C/D) area ratio and a higher tilt ratio; small discs had a smaller rim area and a lower tilt ratio (all P< 0.05). Characteristics associated with high myopia included a smaller rim area, a higher C/D area ratio, and a lower tilt ratio (all P< 0.001). In logistic regression, the refraction, the C/D area ratio, the rim area, and the tilt ratio (all P< 0.05) were associated with VF defects.

Conclusions

In Taiwanese individuals with POAG, our study found that tilted, large, or small discs were prevalent in highly myopic eyes. Of these characteristics, only the disc tilt and high myopia by itself were associated with the severity of glaucomatous optic neuropathy.

Overview

Study design
Cross-sectional study

Study device
Octopus and planimetry

Number of eyes/patients
375 eyes

36.

A test of a model of glaucomatous damage of the macula with high-density perimetry: Implications for the locations of visual field test points

AUTHORS: Donald C. Hood, Matthew Nguyen, Alyssa C. Ehrlich, Ali S. Raza, Ieva Sliesoraityte, Carlos G. De Moraes, Robert Ritch, Ulrich Schiefer

PUBLICATION: TVST (Translational Vision Science & Technology) 2014 Jun 19;3(3):5.
doi: 10.1167/tvst.3.3.5. eCollection 2014 May

Purpose

To use high-density perimetry to test a model of local glaucomatous damage to the macula (central visual field [VF]) and to assess the optimal placement of stimuli used to detect this damage.

Methods

Thirty-one eyes of 31 patients showing glaucomatous arcuate damage within the upper hemifield of the central 10° were tested with a customized VF with double the density of the 10-2 (2° grid) test. Individual plots of total deviation (TD) values were generated. A model, which predicts a "vulnerable macular region" (VMR) and a "less vulnerable macular region" (LVMR), was compared with the TD values without (standard model) and with (aligned model) scaling and rotating to align it with the patient's fovea-to-disc axis. Computer simulations assessed alternative VF locations for adding two points to the 6° grid pattern (e.g., 24-2 VF) typically used in the clinic.

Results

There were significantly more abnormal points in the VMR than in the LVMR. However, the aligned model did no better than the standard model in describing the data. The optimal locations for adding two points to the 24-2 (6° grid) test were (-1°, 5°) and (1°, 5°), both within the VMR.

Conclusions

The model describes the region of the superior VF vulnerable to arcuate damage.

Overview

Study design
Observational cross-sectional comparative study

Study device
Octopus, Humphrey, 3D-OCT 2000 and Spectralis

Number of eyes/patients
31 eyes / 31 patients

37.

Structure-function relationship between the octopus perimeter cluster mean sensitivity and sector retinal nerve fiber layer thickness measured with the RTVue optical coherence tomography and scanning laser polarimetry

AUTHORS: Farzaneh Naghizadeh , Anita Garas, Péter Vargha, Gábor Holló

PUBLICATION: Journal of Glaucoma 2014 Jan;23(1):11-8.
doi: 10.1097/IJG.0b013e318264cda2

Purpose

To determine structure-function relationship between each of 16 Octopus perimeter G2 program clusters and the corresponding 16 peripapillary sector retinal nerve fiber layer thickness (RNFLT) values measured with the RTVue-100 Fourier-domain optical coherence tomography (RTVue OCT) and scanning laser polarimetry with variable corneal compensation (GDx-VCC) and enhanced corneal compensation (GDx-ECC) corneal compensation.

Methods

One eye of 110 white patients (15 healthy, 20 ocular hypertensive, and 75 glaucoma eyes) were investigated. The Akaike information criterion and the F test were used to identify the best fitting model.

Results

Parabolic relationship with logarithmic cluster mean sensitivity and linear sector RNFLT values provided the best fit. For RTVue OCT, significant ($P<0.0001$) coefficients of determination (R) were found for all 16 RNFLT sectors. The R values were highest for the temporal, superotemporal, and inferotemporal RNFLT sectors (0.4483 to 0.5186). For GDx-VCC/ECC, significant ($P<0.01$) parabolic relationship was seen for all but the temporal and nasal RNFLT sectors. The overall highest R value (0.6943) was found for a superotemporal RNFLT sector with GDx-ECC. For some RNFLT sectors, the goodness of fit differed significantly between the imaging methods. Structure-function relationship was similar for the total population and the glaucoma subgroup, whereas no relationship ($P>0.05$) was found for the control eyes.

Conclusions

Mean sensitivity of the Octopus visual field clusters showed significant parabolic relationship with the corresponding peripapillary RNFLT sectors. The relationship was more general with the RTVue OCT than GDx-VCC or GDx-ECC. The results show that visual field clusters of the Octopus G program can be applied for detailed structure-function research.

Overview

Study design
Observational cross-sectional comparative study

Study device
Octopus, RTVue, GDx-VCC and GDx-ECC

Number of eyes/patients
110 eyes / 110 patients

38.

Comparison of two different OCT systems: retina layer segmentation and impact on structure-function analysis in glaucoma

AUTHORS: Livia M. Brandao, Anna A. Ledolter, Andreas Schötzau, Anja M. Palmowski-Wolfe

PUBLICATION: Journal of Ophthalmology 2016:2016:8307639.
doi: 10.1155/2016/8307639. Epub 2016 Feb 4

Purpose

To compare two different spectral-domain optical coherence tomography (OCT) systems in regard to full macular thickness (MT) and ganglion cell layer-inner plexiform layer (GCIPL) measures and in regard to structure-function correlation when compared to standard automated perimetry (SAP).

Methods

Seventeen primary open angle glaucoma patients and 16 controls (one eye per subject) were enrolled. MT and GCIPL thicknesses were measured by Cirrus and Spectralis OCTs. Octopus Perimeter 101 (G2 protocol) reports sensitivity in mean defect (dB). Differences between measurements were assessed with Student's t-test and Bland Altman. Diagnostic performance was also compared between each parameter calculating the areas under the operator receiver (ROC). Linear models were used to investigate structure-function association between OCT and SAP.

Results

Disagreement between OCTs in both MT and GCIPL values was significant. Spectralis values were thicker than Cirrus. Average difference between OCTs was 21.64 µm (SD 4.5) for MT and 9.8 µm (SD 5.4) for GCIPL ($p < 0.001$). Patients differed significantly from controls in both OCTs, in both measurements. MT and GCIPL were negatively associated with MD ($p < 0.001$).

Conclusions

Although OCT values were not interchangeable, both machines differentiated patients from controls with statistical significance. Structure-function analysis results were comparable, when either OCT was compared to SAP.

Overview

Study design
Observational cross-sectional comparative study

Study device
Octopus, Cirrus, Spectralis

Number of eyes/patients
33 eyes / 33 patients

39.

The relationship between structure and function as measured by OCT and Octopus perimetry

AUTHORS: Blanca Monsalve, Antonio Ferreras, Anthony P Khawaja, Pilar Calvo, Mirian Ara, Paolo Fogagnolo, Michele Iester

PUBLICATION: British Journal of Ophthalmology 2015 Sep;99(9):1230-5.
doi: 10.1136/bjophthalmol-2014-305888. Epub 2015 Mar 17

Purpose

To determine the structure–function relationship between equivalent visual field areas obtained with the Octopus perimeter (OP), and the peripapillary retinal nerve fibre layer (RNFL) thickness measured with spectral-domain optical coherence tomography (OCT) in healthy individuals and patients with glaucomatous optic neuropathy.

Methods

Eighty-eight normal subjects and 150 patients with open-angle glaucoma were prospectively recruited. Eligible participants for the glaucoma group were required to have elevated intraocular pressure and glaucomatous optic nerve head morphology. All participants underwent reliable automated perimetry with OP, and optic nerve head imaging with the Cirrus OCT. Principal component analysis of the mean threshold values for the visual field test points were performed independently for each hemifield. Pearson correlations were calculated between visual field regions and RNFL thickness sectors.

Results

Mild to moderate correlations were observed between the visual field regions and the peripapillary RNFL thicknesses. Each visual field region was significantly correlated with more than one RNFL sector, and vice versa. The strongest correlation was observed between the RNFL thickness at 5 and 7 clock-hour positions and the superonasal region of OP (r=0.63).

Conclusions

Retinal sensitivity evaluated with OP correlated moderately well with the RNFL thickness measured by OCT. There was an overlap of the visual field regions within the optic disc.

Overview

Study design
Prospective comparative cross-sectional study

Study device
Octopus and Cirrus

Number of eyes/patients
238 eyes / 238 patients

40.

Perimetric measurements with flicker-defined form stimulation in comparison with conventional perimetry and retinal nerve fiber measurements

AUTHORS: Folkert K. Horn, Ralf P. Tornow, Anselm G. Junemann, Robert Laemmer, Jan Kremers

PUBLICATION: IOVS (Investigative Ophthalmology & Visual Science) 2014 Apr 11;55(4):2317-23. doi: 10.1167/iovs.13-12469

Purpose

We compared the results of flicker-defined form (FDF) perimetry with standard automated perimetry (SAP) and retinal nerve fiber layer (RNFL) thickness measurements using spectral domain optical coherence tomography (OCT).

Methods

A total of 64 healthy subjects, 45 ocular hypertensive patients, and 97 ''early'' open-angle glaucoma (OAG) patients participated in this study. Definition of glaucoma was based exclusively on glaucomatous optic disc appearance. All subjects underwent FDF perimetry, SAP, and peripapillary measurements of the RNFL thickness. The FDF perimetry and SAP were performed at identical test locations (G1 protocol). Exclusion criteria were subjects younger than 34 years, SAP mean defect (SAP MD) > 5 dB, eye diseases other than glaucoma, or nonreliable FDF measurements. The correlations between the perimetric data on one hand and RNFL thicknesses on the other hand were analyzed statistically.

Results

The age-corrected sensitivity values and the local results from the controls were used to determine FDF mean defect (FDF MD). The FDF perimetry and SAP showed high concordance in this cohort of experienced patients (MD values, $R = -0.69$, $P < 0.001$). Of a total of 42 OAG patients with abnormal SAP MD, 38 also displayed abnormal FDF MD. However, FDF MD was abnormal in 28 of 55 OAG patients with normal SAP MD. The FDF MD was significantly ($R = -0.61$, $P < 0.001$) correlated with RNFL thickness with a (nonsignificantly) larger correlation coefficient than conventional SAP MD ($R = -0.48$, $P < 0.001$).

Conclusions

The FDF perimetry is able to uncover functional changes concurrent with the changes in RNFL thickness. The FDF perimetry may be an efficient functional test to detect early glaucomatous nerve atrophy.

Overview

Study design
Prospective cross-sectional comparative study

Study device
Octopus, Spectralis and HEP

Number of eyes/patients
206 eyes

41.

Correlation between local glaucomatous visual field defects and loss of nerve fiber layer thickness measured with polarimetry and spectral domain OCT

AUTHORS: Folkert K. Horn, Christian Y. Mardin, Robert Laemmer, Delia Baleanu, Anselm M. Juenemann, Friedrich E. Kruse, Ralf P. Tornow

PUBLICATION: IOVS (Investigative Ophthalmology & Visual Science) 2009 May;50(5):1971-7. doi: 10.1167/iovs.08-2405. Epub 2009 Jan 17

Purpose

To study the correlation between local perimetric field defects and glaucoma-induced thickness reduction of the nerve layer measured in the peripapillary area with scanning laser polarimetry (SLP) and spectral domain optical coherence tomography (SOCT) and to compare the results with those of a theoretical model.

Methods

The thickness of the retinal nerve fiber layer was determined in 32 sectors (11.25 degrees each) by using SLP with variable cornea compensation (GDxVCC; Laser Diagnostics, San Diego, CA) and the newly introduced high-resolution SOCT (Spectralis; Heidelberg Engineering, Heidelberg, Germany). Eighty-eight healthy subjects served as control subjects, to determine the thickness deviation in patients with glaucoma. The relationship between glaucomatous nerve fiber reduction and visual field losses was calculated in six nerve fiber bundle–related areas. Sixty-four patients at different stages of open-angle glaucoma and 26 patients with ocular hypertension underwent perimetry (Octopus G1; Haag-Streit, Köniz, Switzerland) and measurements with the two morphometric techniques.

Results

Sector-shaped analyses between local perimetric losses and reduction of the retinal nerve fiber layer thickness showed a significant association for corresponding areas except for the central visual field in SLP. Correlation coefficients were highest in the area of the nasal inferior visual field (SOCT, −0.81; SLP, −0.57). A linear model describes the association between structural and functional damage.

Conclusions

Localized perimetric defects can be explained by reduced nerve fiber layer thickness. The data indicate that the present SOCT is useful for determining the functional-structural relationship in peripapillary areas and that association between perimetric defects and corresponding nerve fiber losses is stronger for SOCT than for the present SLP. (ClinicalTrials.gov number, NCT00494923.).

Overview

Study design
Cross-sectional observational study

Study device
Octopus, Spectralis and GDx-VCC

Number of eyes/patients
178 eyes

VII.

Relationship between ocular perfusion and visual field

A new approach, similar to the "classic" structure – function investigations, which are discussed in another chapter of this book, has gained a role in research in the last years. Optical coherence tomography angiography (OCT angiography) is a new non-invasive method which can also be used for correlation investigations. The perfusion – function relationship has been established for the central 30-degree visual field mean defect, the hemifields defects, the upper and lower EDTRS area values, as well as the superotemporal and inferotemporal retinal nerve fiber bundles in glaucoma, respectively. OCT angiography seems to provide capillary perfusion values that are more variable along time than the classic structural parameters (e.g. retinal nerve fiber layer thickness), but at the same time the dynamic range of the OCT angiography parameters is considerably larger than that of the classic structural parameters. Therefore, the use of OCT angiography parameters for perfusion – function investigations extends the range in the disease severity spectrum, in which an informative relationship can be determined.

In the current chapter we collected the abstracts of investigations in which the relationship between the corresponding OCT angiography and Octopus perimetry parameters is analysed.

42.
High-density perimetry in the assessment of foveal avascular zone and macular structure in glaucoma
(Gustavo Coelho Caiado , Gustavo Albrecht Samico , Gilvan Vilarinho da Silva Filho, Sergio Henrique Teixeira, Tiago Santos Prata, Carolina Pelegrini Barbosa Gracitelli, Augusto Paranhos Jr. PLoS One 2025 Oct 9;20(10):e0333363. doi: 10.1371/journal.pone.0333363)

43.
Relationship between OCT angiography temporal peripapillary vessel-density and Octopus perimeter paracentral cluster mean defect

(Holló, Gábor. Journal of Glaucoma 2017 May;26(5):397-402. doi: 10.1097/IJG.0000000000000630)

44.
Relationship between optical coherence tomography sector peripapillary angioflow-density and Octopus visual field cluster mean defect values

(Holló, Gábor. PLoS One. 2017 Feb 2;12(2):e0171541. doi: 10.1371/journal.pone.0171541. eCollection 2017.PMID: 28152106)

42.

High-density perimetry in the assessment of foveal avascular zone and macular structure in glaucoma

AUTHORS: Gustavo Coelho Caiado , Gustavo Albrecht Samico , Gilvan Vilarinho da Silva Filho, Sergio Henrique Teixeira, Tiago Santos Prata, Carolina Pelegrini Barbosa Gracitelli, Augusto Paranhos Jr.

PUBLICATION: PLoS One 2025 Oct 9;20(10):e0333363.doi:10.1371/journal.pone.0333363

Purpose

To evaluate the association between foveal avascular zone (FAZ) parameters (area, perimeter and circularity) with macular high density perimetry (Octopus Macular program), macular vessel density (mVD) and ganglion cells layer thickness (GCLT) in glaucoma patients.

Materials and Methods

This cross-sectional study included 89 eyes from 57 glaucoma patients. All participants underwent high-density perimetry (Octopus 900 Macular and G programs). FAZ metrics and mVD were obtained via Optical Coherence Tomography Angiography (OCTA) (Triton, Topcon), and GCLT was measured across global, superior, and inferior sectors. FAZ parameters were automatically extracted using ImageJ with axial length correction. Structure–structure and structure–function associations were assessed using mixed-effects linear regression models, adjusting for inter-eye correlation, age, and GCLT when appropriate.

Results

Mean age was 66.67 ± 7.49 years old. FAZ area and perimeter were significantly associated with mean defect of macular program (mMD), central mVD, and GCLT ($p < 0.05$). FAZ area remained significantly associated with GCLT even after controlling for age ($p < 0.05$). FAZ perimeter and circularity were independently associated with age. FAZ perimeter and circularity were mainly age-related, while area was linked to glaucomatous damage. FAZ parameters were more strongly related to superior than inferior GCLT. Glaucoma severity was categorized using Brusini's Glaucoma Staging System. Higher mMD values were observed in more advanced stages of glaucoma.

Conclusions

FAZ morphology reflects both glaucomatous damage and age-related vascular changes. By controlling for confounding variables, this study reinforces the role of FAZ metrics as complementary biomarkers for assessing structure-function relationships in glaucoma. High-density macular perimetry further improves spatial correspondence with anatomical alterations.

Overview

Study design
Cross-sectional study

Study device
Octopus and Triton

Number of eyes/patients
89 eyes / 57 patients

43.

Relationship between OCT angiography temporal peripapillary vessel-density and Octopus perimeter paracentral cluster mean defect

AUTHORS: Holló, Gábor

PUBLICATION: Journal of Glaucoma 2017 May;26(5):397-402.
doi: 10.1097/IJG.0000000000000630

Purpose

The purpose of the study was to investigate the relationship between optical coherence tomography angiography angioflow vessel-density (PAFD) measured in the retinal nerve fiber layer in the temporal peripapillary sector and the average of the spatially corresponding superior and inferior paracentral cluster mean defect values (mean paracentral MD) measured with Octopus perimetry.

Materials and Methods

Spaerman's correlation between temporal peripapillary PAFD acquired with the Angiovue OCT and mean paracentral MD measured with the Normal and tendency-oriented perimetry strategy of Octopus G2 perimetry, respectively, was determined on 1 eye of 13 healthy participants, 22 medically controlled ocular hypertensive, and 27 stable early to moderate glaucoma patients. Octopus perimetry was made within 3 months from optical coherence tomography angiography imaging.

Results

Strong negative relationship was found irrespective to Octopus test strategy between temporal sector peripapillary PAFD and mean paracentral MD for the total population (r-values: −0.5525 and −0.4496, respectively, $P \leq 0.002$), the glaucoma group (r-values: −0.4901 and −0.4936, respectively, $P < 0.01$) and the ocular hypertensive group (r-values: −0.4445 and −0.4496, $P \leq 0.0382$). For the healthy eyes, and for all groups when correction for the diffuse defect component of global MD was made using the perimeter's software, no significant relationship was found.

Conclusions

Strong negative relationship exists between the temporal peripapillary sector PAFD measured with Angiovue OCT angiography in the retinal nerve fiber layer and mean paracentral cluster MD determined with uncorrected Normal and tendency-oriented perimetry strategies of Octopus perimetry. This relationship may be usefully applied in research when eyes with paracentral scotomas are investigated.

Overview

Study design
Cross-sectional comparative study

Study device
Octopus and RTVue

Number of eyes/patients
62 eyes

44.

Relationship between optical coherence tomography sector peripapillary angioflow-density and Octopus visual field cluster mean defect values

AUTHORS: Holló, Gábor

PUBLICATION: PLoS One. 2017 Feb 2;12(2):e0171541. doi: 10.1371/journal.pone.0171541. eCollection 2017.PMID: 28152106

Purpose

To compare the relationship of Octopus perimeter cluster mean-defect (cluster MD) values with the spatially corresponding optical coherence tomography (OCT) sector peripapillary angioflow vessel-density (PAFD) and sector retinal nerve fiber layer thickness (RNFLT) values.

Methods

High quality PAFD and RNFLT images acquired on the same day with the Angiovue/RTVue-XR Avanti OCT (Optovue Inc., Fremont, USA) on 1 eye of 27 stable early-to-moderate glaucoma, 22 medically controlled ocular hypertensive and 13 healthy participants were analyzed. Octopus G2 normal visual field test was made within 3 months from the imaging.

Results

Total peripapillary PAFD and RNFLT showed similar strong positive correlation with global mean sensitivity (r-values: 0.6710 and 0.6088, P<0.0001), and similar (P = 0.9614) strong negative correlation (r-values: -0.4462 and -0.4412, P≤0.004) with global MD. Both inferotemporal and superotemporal sector PAFD were significantly (≤0.039) lower in glaucoma than in the other groups. No significant difference between the corresponding inferotemporal and superotemporal parameters was seen. The coefficient of determination (R^2) calculated for the relationship between inferotemporal sector PAFD and superotemporal cluster MD (0.5141, P<0.0001) was significantly greater than that between inferotemporal sector RNFLT and superotemporal cluster MD (0.2546, P = 0.0001). The R^2 values calculated for the relationships between superotemporal sector PAFD and RNFLT, and inferotemporal cluster MD were similar (0.3747 and 0.4037, respectively, P<0.0001).

Conclusions

In the current population the relationship between inferotemporal sector PAFD and superotemporal cluster MD was strong. It was stronger than that between inferotemporal sector RNFLT and superotemporal cluster MD. Further investigations are necessary to clarify if our results are valid for other populations and can be usefully applied for glaucoma research.

Overview

Study design
Cross-sectional comparative study

Study device
Octopus and RTVue

Number of eyes/patients
62 eyes / 62 patients

VIII.

Neuro-ophthalmological aspects

The clinical field of neuro-ophthalmology comprises various central nervous system diseases, among them conditions that involve the optic nerve, its perfusion, as well as the whole visual pathway between the optic nerve head in the eye and the visual cortex in the brain. In this respect the border between glaucoma and all other neuro-ophthalmologic diseases is not biological. Glaucoma is considered as the subject of a different subspeciality, therefore it is not included in this chapter. Even in the era of the modern central nervous system and retinal imaging technologies perimetry remains essential for the detection of functional deterioration and its long-term follow-up. Both static perimetry (threshold and suprathreshold perimetry) and kinetic perimetry remain essential. The Octopus perimeter family offers both static neurological programs and automated kinetic perimetry tests which are quite unique in the modern times since classic manual Goldmann kinetic perimetry is less and less used. Article abstracts in the neuro-ophthalmology subspeciality area that investigate or employ Octopus perimetry programs are listed in the current chapter.

45.
Detection of visual field loss in pituitary disease: Peripheral kinetic versus central static

(Fiona J Rowe , Christopher P Cheyne, Marta García-Fiñana, Carmel P Noonan, Claire Howard, Jayne Smith, Joanne Adeoye. Neuro-Ophthalmology 2015 May 13;39(3):116-124. doi: 10.3109/01658107.2014.990985. eCollection 2015 Jun)

46.
Comparison of Octopus semi-automated kinetic perimetry and Humphrey peripheral static perimetry in neuro-ophthalmic cases

(Fiona J. Rowe, Carmel Noonan, Melanie Manuel. ISRN Ophthalmology. 2013 Jul 15:2013:753202. doi: 10.1155/2013/753202. eCollection 2013)

45.

Detection of visual field loss in pituitary disease: Peripheral kinetic versus central static

AUTHORS: Fiona J Rowe , Christopher P Cheyne, Marta García-Fiñana, Carmel P Noonan, Claire Howard, Jayne Smith, Joanne Adeoye

PUBLICATION: Neuro-Ophthalmology 2015 May 13;39(3):116-124.
doi: 10.3109/01658107.2014.990985. eCollection 2015 Jun

Purpose

Visual field assessment is an important clinical evaluation for eye disease and neurological injury. We evaluated Octopus semi-automated kinetic peripheral perimetry (SKP) and Humphrey static automated central perimetry for detection of neurological visual field loss in patients with pituitary disease.

Methods

We carried out a prospective cross-sectional diagnostic accuracy study comparing Humphrey central 30-2 SITA threshold programme with a screening protocol for SKP on Octopus perimetry. Humphrey 24-2 data were extracted from 30-2 results.

Results

Results were independently graded for presence/absence of field defect plus severity of defect. Fifty patients (100 eyes) were recruited (25 males and 25 females), with mean age of 52.4 years (SD = 15.7). Order of perimeter assessment (Humphrey/Octopus first) and order of eye tested (right/left first) were randomised. The 30-2 programme detected visual field loss in 85%, the 24-2 programme in 80%, and the Octopus combined kinetic/static strategy in 100% of eyes. Peripheral visual field loss was missed by central threshold assessment. Qualitative comparison of type of visual field defect demonstrated a match between Humphrey and Octopus results in 58%, with a match for severity of defect in 50%. Tests duration was 9.34 minutes (SD = 2.02) for Humphrey 30-2 versus 10.79 minutes (SD = 4.06) for Octopus perimetry.

Conclusions

Octopus semi-automated kinetic perimetry was found to be superior to central static testing for detection of pituitary disease-related visual field loss. Where reliant on Humphrey central static perimetry, the 30-2 programme is recommended over the 24-2 programme. Where kinetic perimetry is available, this is preferable to central static programmes for increased detection of peripheral visual field loss.

Overview

Study design
Prospective cross-sectional diagnostic accuracy study

Study device
Octopus and Humphrey

Number of eyes/patients
100 eyes / 50 patients

46.

Comparison of Octopus semi-automated kinetic perimetry and Humphrey peripheral static perimetry in neuro-ophthalmic cases

AUTHORS: Fiona J. Rowe, Carmel Noonan, Melanie Manuel

PUBLICATION: ISRN Ophthalmology. 2013 Jul 15:2013:753202. doi: 10.1155/2013/753202. eCollection 2013

Purpose

To compare semikinetic perimetry (SKP) on Octopus 900 perimetry to a peripheral static programme with Humphrey automated perimetry.

Methods

Prospective cross-section study comparing Humphrey full field (FF) 120 two zone programme to a screening protocol for SKP on Octopus perimetry. Results were independently graded for presence/absence of field defect plus type and location of defect.

Results

64 patients (113 eyes) underwent dual perimetry assessment. Mean duration of assessment for SKP was 4.54 minutes ±0.18 and 6.17 ± 0.12 for FF120 ($P = 0.0001$). 80% of results were correctly matched for normal or abnormal visual fields using the I4e target versus FF120, and 73.5% were correctly matched using the I2e target versus FF120. When comparing Octopus results with combined I4e and I2e isopters to the FF120 result, a match for normal or abnormal fields was recorded in 87%.

Conclusions

Humphrey perimetry test duration was generally longer than Octopus SKP. In the absence of kinetic perimetry, peripheral static suprathreshold programme options such as FF120 may be useful for detection of visual field defects. However, statokinetic dissociation may occur. Octopus SKP utilising both I4e and I2e targets provides detailed information of both the defect depth and size and may provide a more representative view of the actual visual field defect.

Overview

Study design
Prospective cross-section study

Study device
Octopus and Humphrey

Number of eyes/patients
113 eyes / 64 patients

IX.

Miscellaneous clinical studies

The main research areas in which perimetry plays a major role are glaucoma, macular diseases and neuro-ophthalmology. However, other clinical and psycho-physiological research areas also use Octopus perimetry for various purposes. In this chapter these studies arriving from different research fields are presented. The studies included contain research in pediatric ophthalmology, report on the development of software provided perimetric analyses, and evaluate the perimetric effects of different pupil sizes.

47.
Detection and characterisation of visual field defects using Octopus perimetry in congenital glaucoma

(L Morales-Fernández , J M Martínez-de-la-Casa , F Sáenz-Francés , P Perez-García , L Borrego-Sanz , J García-Feijóo. Archivos de la Sociedad Española de Oftalmología 2024 Mar;99(3):91-97. doi: 10.1016/j.oftale.2023.11.015)

48.
Validation of a new static perimetric thresholding strategy (GATE)

(Annette Franziska Luithardt, Christoph Meisner, Matthias Monhart, Elke Krapp, Andrea Mast, Ulrich Schiefer. British Journal of Ophthalmology 2015 Jan;99(1):11-5. doi: 10.1136/bjophthalmol-2013-304535. Epub 2014 Jul 22)

49.
Influence of test strategy on Octopus Perimeter cluster mean defect values: adaptive bracketing normal strategy versus tendency-oriented perimetry

(Holló, Gábor. Journal of Glaucoma 2016 Oct;25(10):830-834. doi: 10.1097/IJG.0000000000000456)

50.
Development of visual field screening procedures: A case study of the Octopus Perimeter

(Andrew Turpin, Jonathan S. Myers, Allison M. McKendrick. TVST (Translational Vision Science & Technology) 2016 May 9;5(3):3. doi: 10.1167/tvst.5.3.3. eCollection 2016 May)

51.
Study of Optimal Perimetric Testing in Children (OPTIC): Feasibility, reliability and repeatability of perimetry in children

(Dipesh E. Patel, Phillippa M. Cumberland, Bronwen C. Walters, Isabelle Russell-Eggitt, Jugnoo S. Rahi, OPTIC study group. PLoS One 2015 Jun 19;10(6):e0130895. doi: 10.1371/journal.pone.0130895. eCollection 2015)

52.
Effect of pharmacological pupil dilation on dark-adapted perimetric sensitivity in healthy subjects using an Octopus 900 Perimeter

(Austin D. Igelman, Cristy Ku, Sam Mershon, Mariana Matioli da Palma, J. Jason McAnany, Robert A. Hyde, Jason C. Park, Paul Yang, Mark E. Pennesi. TVST (Translational Vision Science & Technology) 2021 Dec 1;10(14):18. doi: 10.1167/tvst.10.14.18)

53.
Comparison of tendency-oriented perimetry and dynamic strategy in Octopus perimetry as a screening tool in a clinical setting: a prospective study

(M Scherrer , J C Fleischhauer, H Helbig, K Johann Auf der Heide, F K Sutter. Klinische Monatsblätter für Augenheilkunde 2007 Apr;224(4):252-4. doi: 10.1055/s-2007-962849)

54.
Smaller fixation target size is associated with more stable fixation and less variance in threshold sensitivity

(Kazunori Hirasawa, Kana Okano, Risako Koshiji, Wakana Funaki, Nobuyuki Shoji. PLoS One 2016 Nov 9;11(11):e0165046. doi: 10.1371/journal.pone.0165046. eCollection 2016)

55.
Effects of mydriasis and miosis on kinetic perimetry findings in normal participants

(Kazunori Hirasawa, Nobuyuki Shoji, Chieko Kobashi, Ayaka Yamanashi. Graefe's Archive for Clinical and Experimental Ophthalmology 2015 Aug;253(8):1341-6. doi: 10.1007/s00417-015-3048-5. Epub 2015 May 19)

56.
A deep learning approach to automatic detection of early glaucoma from visual fields

(Şerife Seda Kucur, Gábor Holló, Raphael Sznitman. PLoS One. 2018 Nov 28;13(11):e0206081. doi: 10.1371/journal.pone.0206081. eCollection 2018)

47.

Detection and characterisation of visual field defects using Octopus perimetry in congenital glaucoma

AUTHORS: L Morales-Fernández , J M Martínez-de-la-Casa , F Sáenz-Francés , P Perez-García , L Borrego-Sanz , J García-Feijóo

PUBLICATION: Archivos de la Sociedad Española de Oftalmología 2024 Mar;99(3):91-97.
doi: 10.1016/j.oftale.2023.11.015

Purpose

To detect and characterise visual field (VF) defects using static Octopus perimetry in patients with primary congenital glaucoma (PCG) and to determine VF quality and time duration.

Methods

Eighty-eight eyes of 70 patients diagnosed with PCG were included. Assessments were performed using an Octopus 900 and each eye was assessed with the tendency-oriented perimetry (G-TOP) algorithm. Quantitative VF data were collected: quality data (false positive and negative response, and time duration) and results of mean deviation (MD) and square root of loss variance (sLV). Qualitative data were collected: the presence of diffuse and localized defects, the affected hemifield and grade of defects using the Aulhorn and Karmeyer classification. Correlations between perimetric results and clinical variables were analysed.

Results

Median age was 11 (8-17) years. 65.9% (58/88) of PCG eyes showed VF defects. Diffuse defects were observed in 10/58 eyes (16.94%) (mean MD = 23.92 [SD: 2.52]) dB) and localized defects in 48/58 eyes (82.75%). The most frequent defect was spot-like/stroke-like/incipient paracentral scotoma (n = 15), nasal step (n = 8), adding arcuate defect (n = 2), half ring-shaped (n = 13) and concentric defect with a central island (n = 9). And the most frequent affected visual hemifield was inferior hemifield. Mean test duration was 2 min 12 s (SD: 21.6 s). MD and sLV values were correlated with best corrected visual acuity (BCVA), cup to disc ratio and number of antiglaucoma surgeries (all P < .001).

Conclusions

A high number of diffuse and localized defects were identified using Octopus perimetry in PCG patients. The most frequent defect was paracentral scotoma and inferior hemifield was the most affected.

Overview

Study design
Observational cross sectional descriptive study

Study device
Octopus

Number of eyes/patients
88 eyes / 70 patients

48.

Validation of a new static perimetric thresholding strategy (GATE)

AUTHORS: Annette Franziska Luithardt, Christoph Meisner, Matthias Monhart, Elke Krapp, Andrea Mast, Ulrich Schiefer

PUBLICATION: British Journal of Ophthalmology 2015 Jan;99(1):11-5.
doi: 10.1136/bjophthalmol-2013-304535. Epub 2014 Jul 22

Purpose

To validate the EyeSuite version of German Adaptive Threshold Estimation (GATE), a new thresholding algorithm for automated static perimetry.

Methods

Specification of agreement and its clinical evaluation as validation criteria. Comparison of local differential luminance sensitivity (DLS) and test time values between the prototype version of GATE (GATEp) and a clinical trial version, implemented in EyeSuite (GATEe), by means of modified Bland–Altman plots. All examinations were performed on the Octopus 900 perimeter (Haag-Streit Inc., Köniz, Switzerland). Visually impaired patients (anterior ischaemic optic neuropathy [n=3], glaucomatous optic neuropathy [n=15], (post-)chiasmal visual pathway lesion [n=6], retinitis pigmentosa [n=6]) were either tested with grid 30A (30° excentricity, 83 test locations) or grid 84NO (90° excentricity, 109 test locations, patients with RP only).

Results

The comparison of local DLS values showed good-to-acceptable agreement between GATEp and GATEe (bias <2 dB, limits of agreement [LOA] <5 dB) and very good repeatability for GATEp (bias <0.5 dB, LOA<3 dB). Median test times for GATEp and GATEe were 7.8 and 8.8 min for the 30° grid and 6.7 and 7.8 min for the 90° grid.

Conclusions

GATEp and GATE, implemented in the commercially available EyeSuite software package (GATEe), show good agreement regarding local differential luminance sensitivity. GATEe can thus be also recommended for clinical practice. **Clinical trial number:** NCT01265628.

Overview

Study design
Cross-sectional validation study

Study device
Octopus

Number of eyes/patients
30 patients

49.

Influence of test strategy on Octopus Perimeter cluster mean defect values: adaptive bracketing normal strategy versus tendency-oriented perimetry

AUTHORS: Holló, Gábor

PUBLICATION: Journal of Glaucoma 2016 Oct;25(10):830-834. doi: 10.1097/IJG.0000000000000456.

Purpose

Using adaptive bracketing "normal" (N) strategy it has been shown that cluster trend analysis is useful for early detection of glaucomatous progression with Octopus perimetry. However, in clinical practice "tendency-oriented perimetry" (TOP) is mostly used. In TOP, responses given at neighboring points modify the threshold values, and this process does not respect cluster borders. In the current investigation, we evaluated the influence of test strategy on the cluster mean defect (cluster MD) values.

Methods

Sixty-nine eyes with normal visual field and 63 glaucoma eyes with predominantly mild to moderate glaucomatous visual field defect underwent Octopus perimetry with N and TOP strategy on the same day. Cluster MD values and global parameters were compared between test strategies in each group.

Results

In the normal group, all global parameters ($P \leq 0.0003$) and cluster MD for 6 uncorrected and 5 corrected clusters differed significantly between the strategies ($P \leq 0.0052$). In the glaucoma group, no significant difference was seen for global mean sensitivity and global MD, but square loss variance reflecting inhomogeneity was 1.0 dB lower with TOP ($P < 0.0001$). Two uncorrected and 3 corrected clusters differed significantly ($P \leq 0.0026$) and several other clusters differed almost significantly between the strategies. The differences spread up to 1.9 dB without any systematic direction.

Conclusions

Using TOP, cluster MD determined for one cluster is statistically and clinically significantly influenced by responses given at points outside the cluster. This may also influence cluster trend analysis for glaucomatous progression. Therefore, TOP, although fast and easily performed, is not the optimal procedure for cluster and corrected cluster analyses.

Overview

Study design
Cross-sectional comparative study

Study device
Octopus

Number of eyes/patients
132 eyes

50.

Development of visual field screening procedures: A case study of the Octopus Perimeter

AUTHORS: Andrew Turpin, Jonathan S. Myers, Allison M. McKendrick

PUBLICATION: TVST (Translational Vision Science & Technology) 2016 May 9;5(3):3. doi: 10.1167/tvst.5.3.3. eCollection 2016 May

Purpose

We develop a methodology for designing perimetric screening procedures, using Octopus perimeters as a case study.

Methods

The process has three stages: analytically determining specificity and number of presentations required for different multisampling suprathreshold schemes at a single location of the visual field, ranking visual field locations by their positive predictive value (PPV) for glaucoma, and determining a pass/fail criteria for the test. For the case study the Octopus G-program visual field test pattern is used, and a dataset of 385 glaucoma and 86 normal patients.

Results

Using a 1-of-3 sampling strategy at a level equal to the 95 percentile of normal observers gave the most robust specificity under the influences of false-negative responses using an average of 1.5 presentations per location. The PPV analysis gave 19 locations that completely classified our glaucomatous data. A further 9 points were added to screen for nonglaucomatous loss. The final stage found that insisting that 3 locations are missed for the screening to fail gave a simulated specificity and sensitivity of approximately 95% for unreliable responders.

Conclusions

Our method gives a principled approach to choosing between the many parameters of a visual field screening procedure. We have developed a procedure for the Octopus that should terminate in less than 1 minute for normal observers with high specificity and sensitivity to glaucoma.

Overview

Study design
Observational prospective study

Study device
Octopus

Number of eyes/patients
471 patients

51.

Study of Optimal Perimetric Testing in Children (OPTIC): Feasibility, reliability and repeatability of perimetry in children

AUTHORS: Dipesh E. Patel, Phillippa M. Cumberland, Bronwen C. Walters, Isabelle Russell-Eggitt, Jugnoo S. Rahi, OPTIC study group

PUBLICATION: PLoS One 2015 Jun 19;10(6):e0130895. doi: 10.1371/journal.pone.0130895. eCollection 2015

Purpose

To investigate feasibility, reliability and repeatability of perimetry in children.

Methods

A prospective, observational study recruiting 154 children aged 5–15 years, without an ophthalmic condition that affects the visual field (controls), identified consecutively between May 2012 and November 2013 from hospital eye clinics. Perimetry was undertaken in a single sitting, with standardised protocols, in a randomised order using the Humphrey static (SITA 24–2 FAST), Goldmann and Octopus kinetic perimeters. Data collected included test duration, subjective experience and test quality (incorporating examiner ratings on comprehension of instructions, fatigue, response to visual and auditory stimuli, concentration and co-operation) to assess feasibility and reliability. Testing was repeated within 6 months to assess repeatability.

Results

Overall feasibility was very high (Goldmann=96.1%, Octopus=89% and Humphrey=100% completed the tests). Examiner rated reliability was 'good' in 125 (81.2%) children for Goldmann, 100 (64.9%) for Octopus and 98 (63.6%) for Humphrey perimetry. Goldmann perimetry was the most reliable method in children under 9 years of age. Reliability improved with increasing age (multinomial logistic regression (Goldmann, Octopus and Humphrey), $p<0.001$). No significant differences were found for any of the three test strategies when examining initial and follow-up data outputs (Bland-Altman plots, n=43), suggesting good test repeatability, although the sample size may preclude detection of a small learning effect.

Conclusions

Feasibility and reliability of formal perimetry in children improves with age. By the age of 9 years, all the strategies used here were highly feasible and reliable. Clinical assessment of the visual field is achievable in children as young as 5 years, and should be considered where visual field loss is suspected. Since Goldmann perimetry is the most effective strategy in children aged 5–8 years and this perimeter is no longer available, further research is required on a suitable alternative for this age group.

Overview

Study design
Prospective observational study

Study device
Octopus, Goldmann and Humphrey

Number of eyes/patients
154 patients

52.

Effect of pharmacological pupil dilation on dark-adapted perimetric sensitivity in healthy subjects using an Octopus 900 Perimeter

AUTHORS: Austin D. Igelman, Cristy Ku, Sam Mershon, Mariana Matioli da Palma, J. Jason McAnany, Robert A. Hyde, Jason C. Park, Paul Yang, Mark E. Pennesi

PUBLICATION: TVST (Translational Vision Science & Technology) 2021 Dec 1;10(14):18. doi: 10.1167/tvst.10.14.18

Purpose

To determine whether dilation status has a clinically meaningful effect on sensitivity in normal subjects undergoing two-color dark-adapted perimetry, which can be useful to assess rod function.

Methods

A perimeter measured naturally and pharmacologically dilated scotopic sensitivities using a test grid consisting of 16 points across the horizontal meridian ranging from 60° temporal to 45° nasal using cyan (500 nm wavelength) or red (650 nm wavelength) stimuli. The primary outcome was average overall sensitivity based on dilation status, which was compared using a linear mixed effect model for each color stimuli. A difference of 2 dB or more was considered clinically significant.

Results

Twenty-nine eyes from 15 subjects (nine female) ages 23 to 63 with no known retinal pathology were included. Pharmacologically dilated eyes were 0.54 dB (95% confidence interval [CI], 0.05 dB to 1.03 dB; P = 0.032) more sensitive to a red stimulus than naturally dilated eyes, but this was not statistically significant after correction for multiple comparisons. Pharmacologically dilated eyes were 0.03 dB (95% CI, −0.20 dB to 0.14 dB; P = 0.734) less sensitive to a cyan stimulus compared to naturally dilated eyes.

Conclusions

These findings show no clinically significant differences in sensitivity of scotopic perimetry in eyes without retinal pathology based on dilation status for both cyan and red stimuli.

Overview

Study design
Observational comparison study

Study device
Octopus

Number of eyes/patients
29 eyes / 15 patients

53.

Comparison of tendency-oriented perimetry and dynamic strategy in Octopus perimetry as a screening tool in a clinical setting: a prospective study

AUTHORS: M Scherrer , J C Fleischhauer, H Helbig, K Johann Auf der Heide, F K Sutter

PUBLICATION: Klinische Monatsblätter für Augenheilkunde 2007 Apr;224(4):252-4.
doi: 10.1055/s-2007-962849

Purpose

The aim of this study was to compare the results of tendency-oriented perimetry (TOP) and a dynamic strategy in octopus perimetry as screening methods in clinical practice.

Design

A prospective single centre observational case series was performed.

Methods

In a newly opened general ophthalmologic practice 89 consecutive patients (171 eyes) with a clinical indication for octopus static perimetry testing (ocular hypertension or suspicious optic nerve cupping) were examined prospectively with TOP and a dynamic strategy. The visual fields were graded by 3 masked observers as normal, borderline or abnormal without any further clinical information.

Results

83% eyes showed the same result for both strategies. In 14% there was a small difference (with one visual field being abnormal or normal, the other being borderline). In only 2.9% of the eyes (5 cases) was there a contradictory result. In 4 out of 5 cases the dynamic visual field was abnormal and TOP was normal. 4 of these cases came back for a second examination. In all 4 the follow-up examination showed a normal second dynamic visual field.

Conclusions

Octopus static perimetry using a TOP strategy is a fast, patient-friendly and very reliable screening tool for the general ophthalmological practice. We found no false-negative results in our series.

Overview

Study design
Prospective single centre observational study

Study device
Octopus

Number of eyes/patients
171 eyes / 89 patients

54.

Smaller fixation target size is associated with more stable fixation and less variance in threshold sensitivity

AUTHORS: Kazunori Hirasawa, Kana Okano, Risako Koshiji, Wakana Funaki, Nobuyuki Shoji

PUBLICATION: PLoS One 2016 Nov 9;11(11):e0165046. doi: 10.1371/journal.pone.0165046. eCollection 2016

Purpose

The aims of this randomized observational case control study were to quantify fixation behavior during standard automated perimetry (SAP) with different fixation targets and to evaluate the relationship between fixation behavior and threshold variability at each test point in healthy young participants experienced with perimetry.

Methods

SAP was performed on the right eyes of 29 participants using the Octopus 900 perimeter, program 32, dynamic strategy. The fixation targets of Point, Cross, and Ring were used for SAP. Fixation behavior was recorded using a wearable eye-tracking glass. All participants underwent SAP twice with each fixation target in a random fashion. Fixation behavior was quantified by calculating the bivariate contour ellipse area (BCEA) and the frequency of deviation from the fixation target. The BCEAs (deg2) of Point, Cross, and Ring targets were 1.11, 1.46, and 2.02, respectively.

Results

In all cases, BCEA increased significantly with increasing fixation target size ($p < 0.05$). The logarithmic value of BCEA demonstrated the same tendency ($p < 0.05$). A positive correlation was identified between fixation behavior and threshold variability for the Point and Cross targets ($\rho = 0.413$-0.534, $p < 0.05$).

Conclusions

Fixation behavior increased with increasing fixation target size. Moreover, a larger fixation behavior tended to be associated with a higher threshold variability. A small fixation target is recommended during the visual field test.

Overview

Study design
Prospective randomized observational study

Study device
Octopus

Number of eyes/patients
29 eyes / 29 patients

55.

Effects of mydriasis and miosis on kinetic perimetry findings in normal participants

AUTHORS: Kazunori Hirasawa, Nobuyuki Shoji, Chieko Kobashi, Ayaka Yamanashi

PUBLICATION: Graefe's Archive for Clinical and Experimental Ophthalmology 2015 Aug;253(8):1341-6. doi: 10.1007/s00417-015-3048-5. Epub 2015 May 19

Purpose

To evaluate the effects of pharmacologically induced mydriasis and miosis on kinetic perimetry findings in normal participants.

Methods

Thirty-eight eyes of 38 healthy young participants underwent kinetic perimetry (Octopus 900 perimeter) with III4e, I4e, I3e, I2e, and I1e stimuli. For each participant, 24 predetermined meridians with 15° intervals were automatically tested with a velocity of 3°/s under normal, mydriatic, and miotic conditions. Mydriasis and miosis were induced by one drop of 0.4 % tropicamide and 2 % pilocarpine hydrochloride, respectively. The isopter area and kinetic sensitivity were compared between the three pupil conditions.

Results

The average pupil size in the normal condition was 5.6 ± 0.9 mm, and it significantly increased to 8.5 ± 0.7 mm after mydriasis ($p < 0.01$) and decreased to 3.4 ± 0.8 mm after miosis ($p < 0.01$). Compared to the normal pupil, the isopter area of the dilated pupil was not significantly different under the III4e stimulus; however, it significantly decreased under the I4e, I3e, I2e, and I1e stimuli ($p < 0.01$). Compared to the normal pupil, the isopter area of the constricted pupil significantly decreased ($p < 0.01$) with the III4e stimulus and significantly increased with the I3e and I2e stimuli ($p < 0.05$).

Conclusions

For both pupil conditions, kinetic sensitivity at each meridian showed a similar trend to the isopter area under each stimulus. The isopter area of the dilated pupil generally decreased, whereas the isopter area of the constricted pupil showed various findings. Therefore, careful attention should be paid to changes in the isopter area associated with changes in the pupil size.

Overview

Study design
Prospective comparative study

Study device
Octopus

Number of eyes/patients
38 eyes / 38 patients

56.

A deep learning approach to automatic detection of early glaucoma from visual fields

AUTHORS: Şerife Seda Kucur, Gábor Holló, Raphael Sznitman

PUBLICATION: PLoS One. 2018 Nov 28;13(11):e0206081. doi: 10.1371/journal.pone.0206081. eCollection 2018)

Purpose

To investigate the suitability of multi-scale spatial information in 30° visual fields (VF), computed from a Convolutional Neural Network (CNN) classifier, for early-glaucoma vs. control discrimination.

Methods

Two data sets of VFs acquired with the OCTOPUS 101 G1 program and the Humphrey Field Analyzer 24-2 pattern were subdivided into control and early-glaucomatous groups, and converted into a new image using a novel voronoi representation to train a custom-designed CNN so to discriminate between control and early-glaucomatous eyes. Saliency maps that highlight what regions of the VF are contributing maximally to the classification decision were computed to provide classification justification. Model fitting was cross-validated and average precision (AP) score performances were computed for our method, Mean Defect (MD), square-root of Loss Variance (sLV), their combination (MD+sLV), and a Neural Network (NN) that does not use convolutional features.

Results

CNN achieved the best AP score (0.874±0.095) across all test folds for one data set compared to others (MD = 0.869±0.064, sLV = 0.775±0.137, MD+sLV = 0.839±0.085, NN = 0.843±0.089) and the third best AP score (0.986 ±0.019) on the other one with slight difference from the other methods (MD = 0.986±0.023, sLV = 0.992±0.016, MD+sLV = 0.987±0.017, NN = 0.985±0.017). In general, CNN consistently led to high AP across different data sets. Qualitatively, computed saliency maps appeared to provide clinically relevant information on the CNN decision for individual VFs.

Conclusions

The proposed CNN offers high classification performance for the discrimination of control and early-glaucoma VFs when compared with standard clinical decision measures. The CNN classification, aided by saliency visualization, may support clinicians in the automatic discrimination of early-glaucomatous and normal VFs.

Overview

Study design
Cross-sectional comparative study

Study device
Octopus and Humphrey

Number of eyes/patients
268 eyes / 268 patients

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