

# INTERNATIONAL PERIMETRIC SOCIETY



## PROGRAM AND ABSTRACTS

May 9th - 12th, 1988  
Vancouver, Canada

*The Neuro-Ophthalmology Congress*

*and*

*International Perimetric Society*

*gratefully acknowledge generous support provided by*

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## ***Greetings From Your Host***

*It gives me great pleasure to welcome all of you to Vancouver in 1988. It has taken almost eight years to be able to bring together the many Neuro-Ophthalmological societies with the International Perimetric Society at one time and side by side. The fact that this has become a reality testifies to the recognition on both sides that such a meeting will be both pleasant but above all useful. There have been advances in the psychophysical sciences, of which perimetry is but one, which have made an impact on the recognition of many neuro-ophthalmological entities and in spite of the tremendous technological revolution in imaging, which has rewritten the place of perimetry in the investigation of neurological disease, the new advances have a place in the improved diagnostic capabilities of our profession.*

*I hope that good weather will allow you some of the joys of the grandeur of our location. Having lived in this part of the world for a long time you will have noted that we have given your spouses umbrellas as part of the required equipment. The last time we did this the umbrellas were unnecessary and merely constituted a memento of the visit to Vancouver. I am hoping that we shall be equally lucky this time.*

*If there is anything that we as hosts can do to make your stay comfortable please do not hesitate to call on those of us who are wearing blue ribbons. Thank you for coming and good wishes for a pleasant stay.*



*Stephen M. Drance, OC, MD*

*Host*

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# ***PROGRAM AT A GLANCE***

## Monday, May 9th, 1988

1330h-1500h      IPS Registration and Free Afternoon

## Tuesday, May 10th, 1988

0830h-1000h IPS/INOS Combined Session I      Park Ballroom A & C  
Abstracts: IPS/INOS-01 to IPS/INOS-07

1030h-1200h IPS/INOS Combined Session II      Park Ballroom A & C  
Abstracts: IPS/INOS-08 to IPS/INOS-14

1330h-1500h IPS Session III      Park Ballroom C  
Abstracts: IPS-15 to IPS-17  
Abstracts: IPS/NO-01 to IPS/NO-09 (Posters)

1500h-1600h Business Meeting      Park Ballroom C

## Wednesday, May 11th, 1988

0830h-1000h IPS Session IV      Park Ballroom C  
Abstracts: IPS-18 to IPS-24

1030h-1200h IPS Session V      Park Ballroom C  
Abstract: IPS-25 to IPS-31

1330h-1500h Free Afternoon

## Thursday, May 12th, 1988

0830h-1000h IPS Session VI      Park Ballroom C  
Abstracts: IPS-32 to IPS-38

1030h-1200h IPS Session VII      Park Ballroom C  
Abstracts: IPS/Poster-10 to IPS/Poster-28

1330h-1500h IPS Session VIII      Park Ballroom C  
Abstracts: IPS/Poster-29 to IPS/Poster-48

## ***Instructions For Speakers***

Please be present in the meeting room 30 minutes before the start time of the session during which you are to present.

1. All communications and discussions will be in English.
2. Please remember that your speaking time is limited. You are therefore asked to:
  - a) Please note the length of time allocated for your presentation.
  - b) Please rehearse your presentation several times to shorten it so that you can read it comfortably well within the time limit, without reading too quickly.
3. A time-keeper will be present and presentations going over time will have to be interrupted.
4. Please speak into the microphone from a distance of about 30 cm and do not put anything in front of your microphone.

***Please ensure that you are present in the meeting room and have checked in your slides at least 30 minutes prior to the session during which your presentation is scheduled. Thank you!***

## ***Instructions For Poster Presentations***

International Perimetric Society Posters will be displayed in the Arbutus Room (third floor). This room will be open for authors to place their posters from 1300h – 1700h on Monday, May 9th, 1988.

All IPS Posters should be in place by 1700h on Monday, May 9th, 1988.

International Perimetric Society Posters will be discussed:

IPS/Neuro-Ophthalmology Poster Review

Tuesday, May 10th – Park Ballroom C – 1400h – 1500h

IPS Poster Review

Thursday, May 12th – Park Ballroom C – 1030h – 1230h

Thursday, May 12th – Park Ballroom C – 1330h – 1500h

***Removal of posters is required by 1900h on Thursday, May 12th, 1988.***

# Program

**Tuesday, May 10th, 1988 — Park Ballroom A & C**

International Perimetric Society and International Neuro-Ophthalmology Society

Combined Session

IPS/INOS Session I

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Co-Chair: Dr. S.M. Drance and Dr. E. Aulhorn

Moderator: Dr. J.L. Keltner

- 0830h-0842h Dr. J.R. Charlier, Dr. S. DeFoort, Dr. J.F. Rouland, Dr. J.C. Hache  
"Comparison of Kinetic and Static Automated Perimetry in Neuro-ophthalmology"  
IPS/INOS - 01
- 0842h-0854h Dr. L. Wedemeyer, Dr. C.A. Johnson, Dr. J.L. Keltner  
"Statokinetic Dissociation of Optic Nerve Disease"  
IPS/INOS - 02
- 0854h-0906h Dr. M. Wall, Dr. J. Dalali  
"Contrast Sensitivity, Colour Vision and Perimetry in Patients with Optic Neuropathies and Normal Snellen Acuity"  
IPS/INOS - 03
- 0906h-0918h Dr. A. Polizzi, Dr. C. Mosci, Dr. R. De Marco, Dr. E. Gandolfo, Dr. G.P. Camoriano, Dr. F. Bandini  
"Comparative Evaluation of Various Functional Tests for Early Diagnosis of Optic Neuropathies"  
IPS/INOS - 04
- 0918h-0930h Dr. K. Kitahara, Dr. H. Gunji, Dr. A. Kandatsku, Dr. Jun Noji, Dr. H. Matsuzaki  
"The Usefulness of Sensitivity Measurement on a White Background for Detecting Minor Changes in Visual Disturbances in Optic Nerve Diseases"  
IPS/INOS - 05
- 0930h-0942h Dr. D.J. MacFadyen, Dr.S.M. Drance, Dr.G.R. Douglas, Dr. I.A. Chisholm, K. Wijsman, Dr. E. Blau  
"Automated Perimetry and the Visual Evoked Potential in Multiple Sclerosis"  
IPS/INOS - 06

0942h-0954h Dr. C. Mann, Dr. A. Orr, Dr. M. Rubillovicz, Dr. R. LeBlanc  
**"Automated Static Perimetry in Chloroquine and  
Hydroxychloroquine Therapy"**  
IPS/INOS - 07

1000h-1030h Coffee Break

***Tuesday, May 10th, 1988 — Park Ballroom A & C***

IPS/INOS Session II

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Chair: Dr. A. Matsuo  
Moderator: Dr. H.S. Thompson

1030h-1042h Dr. R.A. Lewis, Dr. C.A. Johnson, Dr. J.L. Keltner  
**"Visual Field Abnormalities in Classic Migraine"**  
IPS/INOS - 08

1042h-1054h Dr. L.N. Johnson, Dr. F.G. Baloh  
**"Confrontation Visual Field Test in Comparison with  
Automated Perimetry"**  
IPS/INOS - 09

1054h-1106h Dr. J.M. Wild, Dr. T.A. Betts  
**"The Influence of Systemic Antihistamine on Central Visual  
Field Assessment"**  
IPS/INOS - 10

1106h-1118h Dr. J. Ambuhl, Dr. H. Mattle, Dr. J. Flammer, Dr. R. Seiler  
**"Visual Field in Patients with Perichiasmal Tumors Assessed  
by Octopus Automated Perimetry" and "Recovery of Visual  
Field Defects with Pituitary Tumors after Operation"**  
(combined paper)  
IPS/INOS - 11

1118h-1130h Dr. P.J.M. Lavin  
**"The Inverted or Reversed Isopter (Imploded Visual Field)"**  
IPS/INOS - 12

1130h-1142h Dr. M. Leys, Dr. G. Verriest, Dr. S. deBie  
**"Results of Manual and Automated Perimetry After Closed  
Head Injury"**  
IPS/INOS - 13

1142h-1154h Dr. W.B. Wilson, Dr. R.L. Shields  
**"Watershed Visual Field Loss"**  
IPS/INOS - 14



1200h-1330h Lunch Break

**Tuesday, May 10th, 1988 — Park Ballroom C**

IPS Session III

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Co-Chair: Dr. H. Bynke and Dr. F. Dannheim  
Moderator: Dr. R.P. Mills

1330h-1342h Dr. T.A. Cox , Dr. G.R. Douglas  
"High Pass Resolution Perimetry in Multiple Sclerosis"  
IPS - 15

1342h-1354h Dr. S.E. Feldon, Dr. J.E. Leemaster, Dr. O.I. Traustason,  
Dr. J.M. Weiner  
"Anterior Ischemic Optic Neuropathy: Classification of  
Field Defects by Octopus Automated Static Perimetry"  
IPS - 16

1354h-1406h Dr. A.B. Safran, Dr. C. Mermoud  
"A Neuro-Ophthalmological Evaluation of Visual Field,  
Based on a Decision System Allowing fast and Quantified  
Assessment, Developed on Octopus Measurement Unit"  
IPS - 17

1406h-1500h Poster Review - IPS/Neuro-Ophthalmology Posters

Dr. P. Brusini, Dr. R. Budai, Dr. P. Dal Mas, Dr. G. Della Mea, Dr. B.  
Lucci, Dr. R. Viel  
"Sub-Clinical Optic Nerve Damage In Multiple Sclerosis"  
IPS/NO POSTER - 01

Dr. H. Bynke  
"Advantages and Disadvantages of Computerized Perimetry in Neuro-  
Ophthalmology"  
IPS/NO POSTER - 02

Dr. F. Dannheim, Dr. F. Abramo, Dr. D. Verlohr  
"Comparison of Automated Conventional and Spatial Resolution Perimetry in  
Glaucoma"  
IPS/NO POSTER - 03

Dr. F. Dannheim, Dr. C. Roggenbuck  
"Comparison of Automated Conventional and Spatial Resolution Perimetry in  
Chiasmal Lesions"  
IPS/NO POSTER - 04

Dr. J.G. Flannagan, Dr. G.F.A. Harding  
"Objective and Subjective Assessment of the Visual Field in Compression  
Lesions of the Chiasm"  
IPS/NO POSTER - 05

Dr. J.F. Kozak, Dr. R. Lakowski, Dr. D.J. Crockett  
"Assessment of Multiple Sclerosis Through Static Chromatic Perimetry"  
IPS/NO POSTER - 06

Dr. P.J.M. Lavin, Dr. C. Ellenberger Jr.  
"Traquair's Monocular Hemianopic Junctional Scotoma- A Sign of Optic Nerve  
Compression"  
IPS/NO POSTER - 07

Dr. K. Yabuki, Dr. M. Sakai, Dr. H. Suzumura, Dr. N. Endo, Dr. H. Matsuo  
"A Comparison of Kinetic and Static Perimetry for Lesions in the Visual  
Pathway"  
IPS/NO POSTER - 08

Dr. H. Ujike, Dr. S. Shioiri, Dr. M. Ikeda  
"Capability of Reading Sentences With Artificially Narrowed Fields"  
IPS/NO POSTER - 09

1500h-1600h      IPS Business Meeting

### ***Wednesday, May 11th, 1988 — Park Ballroom C***

International Perimetric Society  
IPS Session IV

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Chair:            Dr. E.L. Greve  
Moderator:      Dr. Y. Kitazawa

- 0830h-0842h      Dr. B.C. Chauhan, Dr. S.M. Drance, Dr. G.R. Douglas  
"The Effect of Long-term Intraocular Pressure Reduction on  
the Differential Light Sensitivity in Glaucoma Suspects"  
IPS - 18
- 0842h-0856h      Dr. A. Tuulonen, Dr. J. Koponen, Dr. H.I. Alanko, Dr. P.J.  
Airaksinen  
"Laser Trabeculoplasty vs. Medical Treatment as Primary  
Therapy. A Prospective Randomized Follow-up Study"  
IPS - 19
- 0856h-0906h      Dr. A.C. Crichton, Dr. S.M. Drance, Dr. G.R. Douglas  
"Asymmetry of Field and Pressure in Low Tension Glaucoma  
Patients"  
IPS - 20

- 0906h-0918h Dr. Y. Kitazawa, Dr. S. Hisayuki  
 "The Effect of Ca<sup>2+</sup> - Antagonist on Visual Field in Low Tension Glaucoma"  
 IPS - 21
- 0918h-0930h Dr. C. Prunte, Dr. J. Flammer  
 "Choroidal Angiography Findings in Patients with Glaucoma-like Visual Field Defects"  
 IPS - 22
- 0930h-0942h Dr. A. Heijl, Dr. A. Lindgren, Dr. G. Lindgren  
 "Inter-point Correlations of Threshold Values in Normal and Glaucomatous Visual Fields"  
 IPS - 23
- 0942h-0954h Dr. A. Heijl, Dr. A. Lindgren, Dr. G. Lindgren  
 "Pointwise Inter-test Threshold Variability in Glaucomatous Visual Fields"  
 IPS - 24
- 1000h-1030h Coffee Break

***Wednesday, May 11th, 1988 — Park Ballroom C***

International Perimetric Society  
 IPS Session V

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Chair: Dr. M. Zingirian  
 Moderator: Dr. J. Flammer and Dr. J.T. Langerhorst

- 1030h-1042h Dr. L. Frisen  
 "Assessing Criterion Levels and "Functional Channel Fractions" in High-pass Resolution Perimetry"  
 IPS - 25
- 1042h-1056h Dr. R. De Natale, Dr. J. Flammer  
 "The Relationship Between the Lens Opacity Meter 701 Readings and the Visual Field"  
 IPS - 26
- 1056h-1106h Dr. C.T. Langerhorst, Dr. T.J.T.P. vanden Berg, Dr. E.L. Greve  
 "Fluctuation and General Health in Automated Perimetry in Glaucoma"  
 IPS - 27

- 1106h-1118h Dr. R.P. Mills, Dr. M. Schulzer, Dr. R.H. Hopp, Dr. S.M. Drance  
**"Variance Estimates from Threshold Grid Patterns"**  
 IPS - 28
- 1118h-1130h Dr. E. Werner, Dr. B. Petrig, Dr. T. Krupin, Dr. K. Bishop  
**"Variability of Automated Visual Fields in Clinically Stable Glaucoma Patients"**  
 IPS - 29
- 1130h-1142h Dr. N. Katsumori, Dr. K. Mizokami  
**"Clinicopathological Studies of the Retinal Nerve Fiber Layer in the Early Glaucomatous Visual Field Damage"**  
 IPS - 30
- 1142h-1154h Dr. W.M. Hart  
**"Blue/Yellow Colour Contrast Perimetry Compared to Conventional Kinetic Perimetry in Patients with Established Glaucomatous Visual Field Defects"**  
 IPS - 31
- 1200h-1330h Lunch Break

***Thursday, May 12th, 1988 — Park Ballroom C***

International Perimetric Society  
 IPS Session VI

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Chair: Dr. F. Fankhauser  
 Moderator: Dr. L. Frisen

- 0830h-0842h Dr. A. Heijl, Dr. B. Bengtsson  
**"Detection of Developing Glaucoma with Computerized Threshold Perimetry and Flicker Comparisons of Disc Photographs"**  
 IPS - 32
- 0842h-0856h Dr. C.A. Johnson, Dr. A.J. Adams, Dr. R.A. Lewis  
**"Automated Perimetry of Blue-sensitive Mechanisms in Ocular Hypertension and Early Glaucoma"**  
 IPS - 33
- 0856h-0906h Dr. B. Drum, Dr. M. Sevens, Dr. D. O'Leary, Dr. R. Massof, Dr. H. Quigley, Dr. M. Breton, Dr. T. Krupin  
**"Pattern Discrimination and Light Detection Test Different Aspects of Glaucomatous Damage"**  
 IPS - 34

- 0906h-0918h Dr. B. Lachenmayr, Dr. H. Rothbacher, Dr. M. Gleissner  
**"Automated Flicker Perimetry Versus Quantitative Static Perimetry in Early Glaucoma"**  
 IPS - 35
- 0918h-0930h Dr. P.J. Airaksinen, Dr. A. Tuulonen, Dr. J. Valimaki, Dr. H.I. Alanko  
**"High-pass Resolution Perimetry and Retinal Nerve Fiber Layer in Glaucoma"**  
 IPS - 36
- 0930h-0942h Dr. M. Zulauf, Dr. J. Flammer  
**"Visual Field Indices and Their Correlation with Contrast Sensitivity in Glaucoma. Preliminary Results"**  
 IPS - 37
- 0942h-0954h Dr. J. Weber, Dr. R. Geiger  
**"Grey Scale Display of Perimetric Results - the Influence of Different Interpolation Procedures"**  
 IPS - 38
- 1000h-1030h Coffee Break

***Thursday, May 12th, 1988 — Park Ballroom C***

International Perimetric Society  
 IPS Session VII

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Chair: Dr. E. Campos  
 Moderator: Dr. A. Heijl

1030h-1200h **Poster Review - IPS Posters**

Dr. E. Aulhorn, Dr. G. Kost  
**"Noise-Field Campimetry- A New Perimetric Method"**  
 IPS Poster - 10

Dr. P. Asman, Dr. J.M. Britt, Dr. R.P. Mills, Dr. A. Heijl  
**"Evaluation of Adaptive Spatial Enhancement in Supraliminal Visual Field Screening"**  
 IPS Poster - 11

Dr. A. Beffa, Dr. T.J. Smith,  
**"The Visual Field Indices Index of Clumping and Spatial Correlation"**  
 IPS Poster - 12

Dr. P. Capris, Dr. E. Gandolfo, Dr. G. Corallo, Dr. G.P. Camoriano, Dr. M. Zinigirian

**"Kinetic Visual Field Indices"**

IPS Poster - 13

Dr. B.C. Chauhan, Dr. D.B. Henson, Dr. A.J. Hopley

**"Cluster Analysis in Visual Field Quantification"**

IPS Poster - 14

Dr. G.R. Douglas, Dr. S.M. Drance, Dr. F.S. Mikelberg, Dr. M. Schulzer, K. Wijsman,

**"Learning Effect and Variability of Frisen's High Pass Resolution Perimetry"**

IPS Poster - 15

Dr. J.G. Flanagan, Dr. J. Hovis

**"Coloured Targets in the Assessment of Differential Light Sensitivity"**

IPS Poster - 16

Dr. A. Funkhouser

**"The BSPOT SAPRO Data Evaluation Program for the PC"**

IPS Poster - 17

Dr. A. Heijl, Dr. P. Asman

**"Clustering of Depressed Points in the Normal Visual Field"**

IPS Poster - 18

Dr. D.B. Henson, Dr. R. Anderson

**"Thresholds Using Single and Multiple Stimulus Presentations"**

IPS Poster - 19

Dr. A. Iwase, Dr. H. Shirai, Dr. T. Ido, Dr. U. Shimizu, Dr. Y. Kitazawa

**"The Analysis of Normal Fields with the Humphrey Statpac"**

IPS Poster - 20

Dr. H. Kaufmann, Dr. J. Flammer

**"Clinical Experience with the Bebie-Curve"**

IPS Poster - 21

Dr. L. Martin-Boglund, Dr. P. Wanger

**"The Influence of Feed-Back Devices, Learning and Cheating on the Results of High-Pass Resolution Perimetry"**

IPS Poster - 22

Dr. S. Nagata, Dr. K. Kani

**"A New Perimetry Based on Eye Movement"**

IPS Poster - 23

Dr. J. Olsson, Dr. H. Rootzen, Dr. A. Heijl  
"Maximum Likelihood Estimation of the Frequency of False Positive and False Negative Answers from the Up-And-Down Staircases of Computerized Perimetry"  
IPS Poster - 24

Dr. L.R. Shapiro, Dr. C.A. Johnson, Dr. R.L. Kennedy  
"Kraken: A Computer Simulation Program for Static, Kinetic, Suprathreshold Static and Heuristic Perimetry"  
IPS Poster - 25

Dr. M. Tomonaga, Dr. Y. Ohta  
"Retinal Sensitivity of the Macula Within 6 Degrees of Circles From the Fovea in Diabetic Retinopathy"  
IPS Poster - 26

Dr. J. Sturmer, Dr. C. Vollrath-Junger, Dr. K. Lauterbach, Dr. B. Gloor  
"Computerized Visual Field Analysis"  
IPS Poster - 27

Dr. J.M. Wild, Dr. M. Dengler-Harles, Dr. M.K. Hussey, Dr. S.J. Crews  
"Regression Techniques in the Analysis of Visual Field Loss"  
IPS Poster - 28

1200h-1330h          Lunch Break

### ***Thursday, May 12th, 1988 — Park Ballroom C***

International Perimetric Society

IPS Session VIII

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Chair:                Dr. J.M. Enoch  
Moderator:         Dr. G.R. Douglas

1330h-1500h          Poster Review - IPS Posters

Dr. E. Brussell, Dr. M. Muermans, Dr. D. Krasowski, Dr. G. Balazsi  
"Chromatic Flicker Deficits in Glaucoma Patients and Suspects"  
IPS Poster - 29

Dr. R. Fellman, Dr. J. Lynn, Dr. R. Starita  
"Clinical Importance of Spatial Summation in Glaucoma"  
IPS Poster - 30

Dr. A.L. Haas, Dr. R.P. LeBlanc, Dr. U.C. Schneider  
"The Significance of Peripheral Suprathreshold Measurements in the Octopus Program G1"  
IPS Poster - 31

Dr. A. Jenni  
**"The Nasal Step in Glaucomatous Visual Fields"**  
IPS Poster - 32

Dr. F.S. Mikelberg, Dr. A.C. Farinelli, Dr. S.M. Drance, Dr. G.R. Douglas,  
Dr. M. Schulzer, K. Wijsman  
**"Acute Reduction of IOP in Ocular Hypertensive Patients"**  
IPS Poster - 33

Dr. K. Mizokami, Dr. T. Asai  
**"Contrast Sensitivity, Visual Field Defect and Retinal Nerve Fiber Defect in  
Glaucoma"**  
IPS Poster - 34

Dr. A. Orr, Dr. M. Rubillovicz, Dr. R. LeBlanc, Dr. C. Seamone, Dr. C. Mann  
**"Strategies for the Interpretation of the Nasal Suprathreshold Points of the  
Octopus G1 Program"**  
IPS Poster - 35

Dr. C. Seamone, Dr. R. LeBlanc, Dr. C. Mann, Dr. M. Rubillovicz, Dr. A. Orr  
**"The Value of Indices in the Central and Peripheral Visual Field in the  
Detection of Glaucoma"**  
IPS Poster - 36

Dr. A. Pearson, Dr. T.J. Smith  
**"The Transformed Q-Statistic In Glaucoma and Ocular Hypertension"**  
IPS Poster - 37

Dr. R. Zamber, Dr. R.P. Mills  
**"Peripheral Vs. Central Confirmatory Testing"**  
IPS Poster - 38

Dr. S.M. Drance, Dr. G.R. Douglas, Dr. M. Schulzer, K. Wijsman  
**"The Correlation Between Neuroretinal Rim and Visual Field Indices"**  
IPS Poster - 39

Chair: Dr. J.M. Enoch  
Moderator: Dr. E. Werner

Poster Review - IPS Posters

Dr. J. Faubert, Dr. A.G. Balazsi, Dr. M. Muermans, Dr. E.M. Brussell, Dr. O.  
Kasner  
**"Multi-Flash Campimetry and Optic Nerve Structure in Early Chronic Open  
Angle Glaucoma"**  
IPS Poster - 40



Dr. F.W. Fitzke, Dr. D. Poinosawmy, Dr. S. Nagasubramanian, Dr. R.A. Hitchings

**"Peripheral Displacement Thresholds in Glaucoma and Ocular Hypertension"**  
IPS Poster - 41

Dr. H.D. Hoskins, Dr. N. Jensvold

**"Rate of Progression of Discrete Areas of the Visual Field"**  
IPS Poster - 42

Dr. M. Isashiki, Dr. Y. Nakashima, Dr. F. Nagasako, Dr. N. Ohba

**"Improvement of the Visual Field Following Reattachment of Rhegmatogenous Retinal Detachment"**  
IPS Poster - 43

Dr. H. Kosaki, Dr. K. Tsukamoto, Dr. T. Iida, Dr. H. Nakatani, Dr. H. Kiboshi

**"Determination of the Glaucoma Stage by Automated Perimetry -- Detection of Abnormalities in the Keyhole Areas -- "**  
IPS Poster - 44

Dr. G.N. Lambrou, Dr. P.H. Schalk, Dr. T.J.T.P. vandenBerg, Dr. C.T. Langerhorst, Dr. E.L. Greve

**"Estimation of Optic Nerve Fiber Loss From Computer-Assisted Quantification of Visual Fields"**  
IPS Poster - 45

Dr. Y. Miyashita, Dr. K. Matsuda, Dr. I. Azuma, Dr. M. Ohkura

**"The Ability of Sequential Form Recognition in Ocular Hypertension"**  
IPS Poster - 46

Dr. T. Ogawa, Dr. T. Nonaka, Dr. F. Furuno, Dr. H. Matsuo

**"Effects of Oral Acetazolamide on Glaucomatous Visual Field Changes"**  
IPS Poster - 47

Dr. G. Sanfelici, Dr. E. Gandolfo, Dr. G. Corallo, Dr. M. Zingirian

**"Perimetric Follow-Up of Secondary Cataract"**  
IPS Poster - 48

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COMPARISON OF KINETIC AND STATIC AUTOMATED PERIMETRY IN NEUROOPHTHALMOLOGY

J.R. Charlier, U279 INSERM, S. DEFOORT, J.F. ROULAND, J.C. HACHE, C.H.U.

LILLE -FRANCE-

83 patients with various neuroophthalmic diseases have been submitted to a standard automated protocol including kinetic and static perimetry. The examinations were performed on the Vision Monitor System. The kinetic protocol is made of three isopters : peripheral, intermediate and central with an automated determination of the testing level for the 2 central isopters, and the blind spot contour determination. The static protocol includes the fast thresholding of 79 points within the pericentral field (plus minus 30 degrees of eccentricity) and a 4-2-2-2 foveolar threshold determination.

Discrepancies between the results of the two protocols have been found, in particular in compressive pathologies.

The origin of these discrepancies has been investigated. The effects of selective attention associated with the order of stimulus presentation is discussed.

**STATOKINETIC DISSOCIATION IN OPTIC NERVE DISEASE**

Linda Wedemeyer, Chris A. Johnson and John L. Keltner  
Department of Ophthalmology, Univ. of Calif., Davis

Statokinetic dissociation (SKD) refers to an impairment of detection sensitivity for stationary targets relative to the detection sensitivity for moving stimuli. Clinically, SKD may be observed as a local and/or diffuse visual field loss with static perimetric testing, and normal or greatly improved visual fields with kinetic perimetric testing. SKD was originally reported by Riddoch for a subset of patients with post-chiasmal visual pathway lesions, although it has subsequently been reported to be manifested by some patients with optic neuropathies and chiasmal disorders. We sought to provide a more quantitative evaluation of this phenomenon by measuring detection sensitivity for stationary and moving targets at different velocities (1,2,4 and 8 degrees per second) in a group of patients with optic neuropathies and a clinical history of SKD. All testing was performed with the SQUID automated perimeter in order to provide accurate control of kinetic test parameters, monitor fixation, and perform static and kinetic testing on the same device using equivalent background and target size properties for all evaluations. In comparison to results in normal subjects, SKD patients showed greater detection sensitivity differences between stationary and moving targets. However, there were no appreciable sensitivity changes for moving targets at the velocities we tested. Sensitivity deficits in SKD thus appear to be restricted to stationary and slowly moving (less than 1 degree per second) targets. The implications of our findings for theoretical explanations of SKD will be discussed.

## **IPS / INOS — 03**

### **CONTRAST SENSITIVITY, COLOUR VISION AND PERIMETRY IN PATIENTS WITH OPTIC NEUROPATHIES AND NORMAL SNELLEN ACUITY**

Michael Wall, M.D. and Michael Dalali, B.S.

In order to determine the relative merits of contrast sensitivity and colour vision testing we have reviewed the testing results on patients with optic neuropathies with Snellen acuity of 20/20 or better. There were 100 eyes fulfilling the criteria.

Automated perimetry was abnormal in 27/40 eyes (67%) and Goldmann perimetry was 39/60 eyes (65%). The Lanthony desaturated 15 hue test showed deficits in 33/52 eyes (63%). The A/O colour plate showed loss in 22% and the Farnsworth 15 hue was abnormal in 8/39 (20%). Contrast sensitivity loss using the Vistech contrast test system was present in 38/76 eyes (50%).

A comparison of results of contrast sensitivity and perimetry in these eyes show 18% of eyes with abnormal contrast sensitivity had a normal visual field. Thirty percent of eyes had only visual field loss. A comparison of the abnormal colour with normal perimetry show 21/51 eyes (24%) with abnormal colour with normal perimetry. Twenty-four percent also had only visual field loss.

Contrast testing and the Lanthony 15 hue test are sensitive examinations and may give useful information in patients with optic neuropathies and normal Snellen acuity.

## **IPS / INOS — 04**

### **COMPARATIVE EVALUATION OF VARIOUS FUNCTIONAL TESTS FOR EARLY DIAGNOSIS OF OPTIC NEUROPATHIES**

Polizzi A, Mosci C, De Marco R, Gandolfo E, Camoriano GP, Bandini F\*

University Eye Clinic, Genoa - University Neurology Institute, Genoa\* (Italy)

A group of 30 subjects with suspected multiple sclerosis and normal visual acuity underwent a series of functional tests in order to detect the first signs of optic neuropathy: visual field examination (Goldman Kinetic quantitative perimetry, Humphrey 630, program 24-1 with Statpac analysis, chromatic sense examination (100 Hue Farnsworth test, Lantony New Color test), contrast sensitivity (by means of a particular octotype in which letters are presented at contrasts varying from 4.3 to 85.6%) and V.E.P. assessment (pattern reversal 2/sec.). Chromatic (red/green and blue/yellow axis) and contrast sensitivity (middle and high frequencies) abnormalities were found to be well correlated with mild visual field defects (paracentral scotomata or SF increase) and V.E.P. alterations (latency increase). All the functional visual tests utilized showed good reliability in the detection of early optic nerve involvement, if performed by sufficiently refined and precise methodologies. Nevertheless, the authors conclude that only the association of various exams can facilitate the diagnosis of optic neuropathy.



THE USEFULNESS OF SENSITIVITY MEASUREMENT ON A WHITE BACKGROUND FOR DETECTING MINOR CHANGES IN VISUAL DISTURBANCES IN OPTIC NERVE DISEASES

Kenji Kitahara, Hisato Gunji, Atsushi Kandatsu, Jun Noji and Hiroshi Matsuzaki

The Jikei University School of Medicine, Tokyo, Japan

We have found that the sensitivity for the blue cone system was much more vulnerable than the red and green cone system in most optic nerve diseases. In this study we investigated whether or not the sensitivity on a white background could be useful in detecting early stages or minor visual disturbances in optic nerve diseases. The spectral sensitivity was measured using a Maxwellian view optical system for 1°, 200ms test flashes on a 1000 photopic troland white background in optic nerve diseases with minor visual disturbances. Consequently, slight decrease in sensitivity of blue cone system was found in some of the patients even though the visual acuity and the Goldman perimetry returned to normal.

As a result, it was felt that the sensitivity measurements on a white background might be useful to diagnose minor visual disturbances in optic nerve diseases.

AUTOMATED PERIMETRY AND THE VISUAL EVOKED POTENTIAL IN MULTIPLE SCLEROSIS.

DJ MacFadyen, SM Drance, GR Douglas, IA Chisholm, K. Wijsman, E. Blau, Saskatoon, and Vancouver, Canada.

In a prospective study of two groups of multiple sclerosis (MS) patients (57 in Vancouver, 78 in Saskatoon) visual evoked potentials (VEP), FM 100-Hue color vision (CV) and automated perimetry were performed. Retinal nerve fiber layer (RNFL) photography and neuroretinal rim (NRR) are measurements were done in the Vancouver (Vanc) group. Perimetric studies in all patients in the Vanc group were by Competer and, in 44 patients, also by Octopus (program G1). In the Saskatoon group (Sktn) all patients were examined by Octopus program 31. The two groups were very similar in age and disease duration but the Sktn group was more disabled by its MS and had a higher prevalence of reduced visual acuity. A normal Competer "P" value was determined to be 444 (P=0.05) in 20 normal eyes. Octopus G1 normal parameters were as in the program and Octopus 31 normal mean deviation (MD) in 30 normal eyes was found to be 3.2 (P=0.05). In all probably or definite MS patients with a history of optic neuritis (ON) the VEP was alightly more often abnormal than perimetry: Vanc VEP=74%, Competer "P"=65%, MD (G1)=67%; Sktn VEP=88%, Octopus 31 MD=81%. In definite or probable MS patients with no history of ON the VEP was also slightly more sensitive than perimetry except in the case of MD(G1): Vanc VEP abnormal in 46%, Competer "P" in 41%; Sktn VEP abnormal in 52%, Octopus 31 MD in 50%. In general, large or deep scotomata were uncommon. The corrected loss variance (CLV) in the G1 examined eyes is a statistical measure of localized defects and in Vanc definite and probable eyes it was abnormal in 39%. Of all eyes with an abnormal VEP 45% had an abnormal "P", 52% an abnormal MD(G1) and 73% an abnormal Octopus 31 MD. It is not clear whether the above perimetric abnormalities are the result of demyelination or axonal loss but they are notably diffuse/multifocal.

**AUTOMATED STATIC PERIMETRY IN CHLOROQUINE  
AND HYDROXYCHLOROQUINE THERAPY**

C. Mann, MD., A. Orr, MD., M. Rubillowicz, MD., R. LeBlanc, MD.

Department of Ophthalmology, Dalhousie University, Halifax, Nova Scotia, Canada

The charts and visual field examinations of 145 patients followed every six months while on chloroquine or hydroxychloroquine therapy for rheumatoid arthritis or systemic lupus erythematosus were examined retrospectively. The purpose of this study was to determine whether there were any trends in the behaviour of the visual field as a whole as measured by automated static perimetry.

At each visit the visual field was tested using the Octopus program 11. The drug taken, daily and cumulative dosages, and duration of therapy at the time of visit were determined. There were 668 examinations, left and right eyes inclusive, of patients on chloroquine and 186 of patients on hydroxychloroquine. Of these, 579 and 172 examinations, respectively, had complete drug information available. Examinations from one eye of each patient were then randomly chosen. Indices were calculated for each examination and were correlated with daily and cumulative dosages and with duration of therapy. No significant correlation existed between mean sensitivity, mean defect, short-term fluctuation and corrected loss variance and the daily and cumulative dosages and duration of therapy for either chloroquine or hydroxychloroquine.

**VISUAL FIELD ABNORMALITIES IN CLASSIC MIGRAINE**

Richard A. Lewis MD, Chris A. Johnson PhD, John L. Keltner MD  
Department of Ophthalmology, Univ. of Calif, Davis  
Sacramento, California

Ocular symptomatology is a common component of classic migraine. Although the visual aura is usually a transient phenomenon, permanent visual field disturbances have been described. To date, detailed perimetric studies of migraine patients have not been completed using current automated static threshold techniques. This study sought to determine the incidence of visual field loss in patients over 55 years of age with migraine (as determined by a neurologist) compared to age matched normals. Each patient was screened for prior medical or ocular problems in addition to determination of visual acuity, refraction, IOP, and disc evaluation. Only patients with best corrected visual acuity of 20/40 or better and no anterior or posterior segment abnormalities were included in the study. Testing was performed with the 30-2 program of the Humphrey Visual Field Analyzer and analyzed with STAT-PAC and subjective interpretation. Our current results for 10 migraine patients revealed one with a homonymous hemianopic defect and two with unilateral arcuate defects. This preliminary study suggests that permanent visual field loss may be more common than previously considered in migraine. Furthermore, this information may be useful in uncovering the relationship between migraine and low tension glaucoma. An extended study of patients with migraine is in progress.

**CONFRONTATION VISUAL FIELD TEST IN COMPARISON WITH AUTOMATED PERIMETRY**

Johnson LN, Baloh FG: The M.S. Hershey Med Center, The Pennsylvania State Univ (Hershey, Pennsylvania)-USA

The accuracy of confrontation visual field test has previously been compared with Goldmann kinetic perimetry, but to our knowledge no comparison has been made with static automated perimetry, a more sensitive test. This study assessed the accuracy of confrontation test in comparison with static automated perimetry. The sensitivity to anterior visual field defects was only 12.2%. With the exclusion of nonspecific patchy defects, the sensitivity of detecting anterior visual field defects increased to 42.9%. Arcuate scotoma from compressive optic neuropathy and glaucoma had a very low sensitivity of 22.2%. In contrast, anterior lesions producing altitudinal defects and central scotomas had high sensitivities (100%). The overall sensitivity for detection of posterior visual field defects was 64.9%. The sensitivity was high for junctional scotomas and homonymous hemianopsias at approximately 75%, but low (40%) for parasellar lesions producing bitemporal hemianopsias. Confrontation test underestimated the size of the visual field defect in 62% of cases. The overall sensitivity of confrontation test in detecting visual field defects was 41.7%. The overall sensitivity increased to 51.0% when nonspecific patchy defects were excluded. The high specificity (92.3%) and predictive value (70.7%) obtained with confrontation test indicated that defects indentified on confrontation test were often real. Confrontation test is useful, but an understanding of its shortcomings should be remembered.

**THE INFLUENCE OF SYSTEMIC ANTIHISTAMINE ON CENTRAL VISUAL FIELD ASSESSMENT**

J.M. Wild, Department of Vision Sciences, Aston University, Aston Triangle, Birmingham B4 7 ET, U.K.

T.A. Betts, Department of Psychiatry, Queen Elizabeth Hospital, Birmingham B15 2TH, U.K.

The clinical profile of the classical antihistamines demonstrates undesirable CNS effects and also anticholinergic effects. The influence of the various types of antihistamines on the outcome of clinical perimetry, however, is unknown.

A double blind placebo controlled four-armed treatment study using single dosage 10 mg triprolidine (a classical antihistamine) and 10 and 20 mg loratadine ( a known effect long-acting histamine blocker at the H<sub>1</sub> - receptor site with a non-sedating profile and with no apparent impairment of psycho-motor performance) was undertaken on a sample of 8 age-matched (mean 20.52 years; SD 0.86 years) trained, female subjects who conformed to rigid inclusion criteria. The central visual field of the right eye was investigated with the Humphrey Field Analyser 630 (Program 30-2) on four occasions each separated by a wash out period of at least one week.

Differences in results between the four groups will be presented in terms of the indices: mean defect, short-term fluctuation and pattern standard deviation and also in terms of the number of presentations, fixation losses and catch trials. The results were then compared to those obtained from a crossover design using alcohol/placebo administered on a weight related dose to produce a blood alcohol weight of 50mg%.

In a separate investigation, using the same subjects, a single-dose response study of Terfenadine 60mg and 120mg (a non-centrally acting anti-histamine) was undertaken using a placebo controlled balanced order design. Results were similarly analysed in terms of the indices and catch trials.

## IPS / INOS — 11

### Visual field in patients with perichiasmal tumors assessed by Octopus automated perimetry

J. Ambuhl\*, H. Mattle+, J. Flammer\*, R. Seiler"

Departments of Ophthalmology\*, Neurology+, and Neurosurgery"

University of Berne, Inselspital, CH-3010, Berne, Switzerland

46 patients with perichiasmal tumor were examined on the Octopus automated perimeter. All patients were examined before they underwent surgery. A quantitative program (32) was used covering the inner 30° of the visual field. The mean loss and a grand average were calculated by computer. 34 patients had a pituitary adenoma with suprasellar extension compressing the chiasm from below. Only a few normal visual fields were found while most showed rather symmetric visual field damage. The damage was most pronounced in the upper and lower temporal quadrants, less in the upper nasal quadrant and even less in the lower nasal quadrant. This sequence of damage was observed in all patients having visual field defects. 6 patients with pituitary adenoma without suprasellar extension also showed relative defects in their visual fields, but these defects were small and randomly distributed in all four quadrants. Four patients with meningiomas compressing the chiasm from one side had a severe visual loss in all quadrants of the ipsilateral eye. In the contralateral eye the temporal quadrants were also severely affected, whereas the defects in the nasal quadrants of the contralateral eye were only small. Two patients with craniopharyngeomas compressing the chiasm from above showed the most prominent defects in the lower quadrants, slightly more prominent in the temporal than in the nasal quadrant. Computer-aided static perimetry confirms results obtained by earlier investigators with manual kinetic perimetry.

## IPS / INOS — 11

### Recovery of visual field defects with pituitary tumors after operation

H. Mattle+, J. Ambuhl\*, J. Flammer\*, R. Seiler"

Departments of Ophthalmology\*, Neurology+, and Neurosurgery"

University of Berne, Inselspital, CH-3010 Berne, Switzerland

The aim of the present study was to assess the recovery of visual field defects in patients with pituitary adenomas. Patients were examined by Octopus automated perimetry before (n=22) and one week (n=22) and if abnormal also three months (n=13) after operation. 7 patients were followed up to one year. All patients were operated through a trans-sphenoid approach. Pre-operatively the average visual field damage was most pronounced in the upper and lower temporal quadrants followed by the upper and lower nasal quadrants. Recovery could be observed already one week after the operation and continued. The recovery occurred in all quadrants and the quadrants with the least damage were normalized first (lower nasal), the quadrants with the most pronounced damage recovered last (upper temporal). If recovery does not take place or if there is deterioration of the visual field after operation, the physician must be aware of complications such as post-operative hemorrhage or recurrence of the tumour.

**THE INVERTED OR REVERSED ISOPTER (IMPLODED VISUAL FIELD)**

Patrick J.M. Lavin, M.D., Vanderbilt Univ. Med. Ctr, Nashville.

Patients with functional visual loss virtually always have some form of visual field defect. Typically such patients have constricted visual fields, occasionally hemianopic field (which do not respect the vertical), spiraling or crossing isopters. Recently, I have observed an unusual response during quantitative perimetry (Goldmann) in patients with well documented functional visual loss.

Typically, during the visual field examination the patient responds to a kinetic target moving along a meridian only after it crosses the fixation point (by as much as 5 - 10 °). This response is repeated consistently when the target is moved in the opposite direction, and also along the other medians used in kinetic perimetry. Fixation is observed throughout the test. This phenomenon cannot be explained by any known anatomical lesion, a direction specific perceptual defect, slow reaction time or poor fixation. I have observed this phenomenon in four patients with well documented functional visual loss, including other visual field defects, and add it to the long list of clinical findings in patients with functional visual field loss.

**RESULTS OF MANUAL AND AUTOMATED PERIMETRY AFTER CLOSED HEAD INJURY**

Monique Leys<sup>1</sup>, Guy Verriest<sup>1</sup> and Sylvia de Bie<sup>2</sup> - Department of Ophthalmology (1) and Medical Genetics (2), University Hospital Ghent (Belgium)

Forty-four patients who suffered from post commotional syndrome after closed head trauma have been submitted successively to kinetic Goldmann perimetry and static automated perimetry by means of the Humphrey Visual Field Analyser (both the macular threshold test and the neurological 20 threshold test were performed). For comparison also 34 normal age-matched subjects have been tested with the same computerized programs.

Among patients the typical functional changes of the kinetic visual fields were concentric narrowing, inward spiraling, oscillating and enlargement of the blind spot. The static automated fields revealed statistically significant higher fluctuation rates, more false negative answers, more fixation losses and more localized sensitivity losses than among normals for the neurological 20 threshold test. The macular threshold test showed only significantly higher fluctuation rates and more localized sensitivity losses. No correlation between abnormalities of the Goldmann field and any of the static perimetry evaluation parameters was found.

The results indicated that the neurological threshold test of the Humphrey Visual Field Analyser detected more, but less specific, abnormalities than the classical Goldmann perimetry and that the results of both methods were not correlated.

## IPS / INOS — 14

### WATERSHED VISUAL FIELD LOSS

W. Bruce Wilson, M.D., University of Colorado, Denver  
Robert L. Shields, M.D.,

Detailed automated static (Octopus) and manual kinetic (Goldmann) visual fields were performed on two young men, both of whom had suffered a cardiac arrest with prolonged coma and resultant loss of vision.

The basic visual field defect was a relative loss of sensitivity over the whole field of vision but varied considerably from locus to locus. Most strikingly, however, the area of greatest loss was 5-10° on either side of the midline vertical line and stretched nearly from the top to the bottom of the field of vision.

It is postulated that this type of visual field defect is predictable on the basis that hypoxia was greatest in a border zone or watershed area on either side of the lateral border of area 17. This border coincides with the vertical line through the field of vision.

Various strategies will be discussed that seemed to enhance the defect—static, short interval short duration stimuli presentation, etc.

## IPS — 15

### HIGH-PASS RESOLUTION PERIMETRY IN MULTIPLE SCLEROSIS

Terry A. Cox, M.D., and Gordon R. Douglas, M.D., Department of Ophthalmology, University of British Columbia, Vancouver, B.C.

High-pass resolution (Frisen) and Octopus perimetry were compared in 36 patients (70 eyes) seen at the University of British Columbia Multiple Sclerosis Clinic. The Octopus fields were done using the G1 program. The ocular examination was abnormal in 39 eyes; Octopus fields were abnormal in 43 eyes. Using the Octopus G1 as the standard, the sensitivity of the Frisen test was 69.6% and the specificity was 54.2%. Using the ocular examination as the standard, the sensitivities of high-pass and Octopus techniques were 82.1% and 79.5%, respectively, while the specificities were 64.5% and 51.6%, respectively. Correlations with general neurological examination and laboratory studies will be discussed.

**ANTERIOR ISCHEMIC OPTIC NEUROPATHY: CLASSIFICATION OF FIELD DEFECTS BY OCTOPUS™ AUTOMATED STATIC PERIMETRY**

Steven E. Feldon, MD; Jay E. Leemaster, MD; Oli I. Traustason, MD;  
John M. Weiner, PhD

Departments of Ophthalmology, Neurological Surgery and Medicine, University of Southern California School of Medicine, and the Doheny Eye Institute, Los Angeles

Visual fields of patients with anterior ischemic optic neuropathy (AION) were classified according to quantitative criteria, using the OCTOPUS™ perimeter. Although a significant altitudinal pattern of field loss was found in 55% of perimetric examinations, the "spared" hemifields routinely showed some loss of sensitivity. This finding, along with the diffuse loss of sensitivity in a high percentage of visual fields, indicates more extensive involvement of the circulation of the anterior optic nerve head than has previously been suggested. Furthermore, patients with diabetes mellitus only were found to have a statistically separable pattern of visual field loss. The pathophysiologic implications of the visual fields in AION and their relationship to the clinical findings were investigated.

**A NEURO-OPHTHALMOLOGICAL EVALUATION OF VISUAL FIELD, BASED ON A DECISION SYSTEM ALLOWING FAST AND QUANTIFIED ASSESSMENT, DEVELOPED ON OCTOPUS MEASUREMENT UNIT.**

A.B. SAFRAN, M.D., and C. MERMOUD

Neuro-Ophthalmology Unit, Geneva University Hospital, Geneva, Switzerland

Test location mainly allows assessment of horizontal and vertical meridian areas; macula; temporal crescent; and blind spot area. It also takes into account possible field rotation due to extraocular muscle imbalance, and avoids artefacts resulting from hemianopia or hemineglect.

The procedure involves three possible phases :

Phase I is a screening test using a 2-level strategy at the above locations, excluding blind spot area. If necessary, evaluation can be interrupted at this stage, and the results printed-out.

Phase II is a decision procedure. It analyses with normal strategy the central 28° area only at locations where light spots were perceived during phase I. In addition, tests are repeated once at a few locations, to obtain "visual field indices". The print-out combines data from phases I and II.

Phase III examines blind spot area, using a single-level strategy at mean normal threshold minus 15 dB. It is performed in a limited test grid. If performed after phases I and II, phase III is indicated only when sites located around the presumed blind spot area perceived light at a threshold at least equal to this value (i.e. mean normal threshold -15 dB).

## **IPS / NO POSTER — 01**

### SUB-CLINICAL OPTIC NERVE DAMAGE IN MULTIPLE SCLEROSIS

Brusini P., Budai R.\*, Dal Mas P., Della Mea G., Lucci B.\*\*, Viel R.\*\*  
Department of Ophthalmology - \* Department of Neurophysiopathology -  
\*\* Department of Neurology  
General Hospital of Udine (Italy)

Centro-coecal light sensitivity was examined with automatic static perimetry in a group of multiple sclerosis patients without evident optic nerve involvement.

The Humphrey Field Analyzer, using a 50-point threshold grid custom test was employed.

The mean sensitivity in the centro-coecal area was abnormal in over half the eyes examined.

All the patients were also tested using visual evoked potential and the Farnsworth 100 Hue colour vision test.

Although the agreement among these tests was not always perfect, on the whole high resolution static examinations of the centro-coecal area seems to have a greater sensitivity in showing sub-clinical optic nerve damage.

## **IPS / NO POSTER — 02**

### ADVANTAGES AND DISADVANTAGES OF COMPUTERIZED PERIMETRY IN NEURO-OPHTHALMOLOGY

Hans Bynke, Dept. of Neuro-ophthalmology, University Eye Clinic, Lund

Automated perimetry facilitates clinical work. In addition, computerized instruments provided with suitable threshold programmes, e.g. the 'Competer', can test the visual field more accurately than is feasible with manual perimetric methods.

All patients with CNS disorders cannot cooperate adequately with computerized perimetry. Malfixation may cause false negative defects. Somnolence, inattention, eye closures, minor epileptic fits, apraxia, etc., produce false positive defects, which may be hard to separate from real positive defects. Simplification of the automated strategy may solve some of these problems, but in most cases manual perimetry is the best choice, since there is a need of personal attendance during the whole test.

In 1987, 717 perimetric examinations were performed in 334 patients with verified or suspected CNS lesions. At 405 examinations (56.5 %) 'Competer 750' was used as the single method with excellent results as regards detection, classification and follow-up. At 276 examinations (38.5 %) manual kinetic testing with Goldmann's perimeter was chosen, usually because general condition was relatively poor. 36 examinations (5.0 %) were started with 'Competer 750', but since this instrument produced inconclusive records, testing with Goldmann's perimeter was added. There was also a number of patients, in whom only confrontation tests could be made.

Conclusions: 'Competer 750' facilitated clinical work, was more informative than Goldmann's perimeter, and could replace that instrument in the majority of these examinations.



COMPARISON OF AUTOMATED CONVENTIONAL AND SPATIAL RESOLUTION PERIMETRY IN GLAUCOMA

F. Dannheim, F. Abramo & D. Verlohr, Dept. of Ophthalmology, University of Hamburg, West Germany

The visual fields of 55 patients with chronic and low tension glaucoma, ocular hypertension and juvenile glaucoma have been evaluated both with the Octopus computer perimeter, program G1, and with a video screen perimeter using ringshaped targets of varying size for stimulation ("Ringtest"). 82 eyes had field defects for the Octopus, which were divided into 3 classes according to the severity. In 69 eyes both methods showed corresponding results. From 23 eyes with discrepancies, the spatial resolution perimetry revealed more involvement in 21, less in two eyes.

Differences between the two methods are calculated in terms of average scores for visual field quadrants, and clinical implications are discussed.

COMPARISON OF AUTOMATED CONVENTIONAL AND SPATIAL RESOLUTION PERIMETRY IN CHIASMAL LESIONS.

F. Dannheim & C. Roggenbuck, Dept. of Ophthalmology, University of Hamburg, West Germany.

The visual fields of 71 eyes of patients with chiasmal lesions have been evaluated both with the Octopus computer perimeter, program 32, and with a video screen perimeter using ring-shaped targets of varying size for stimulations ("Ringtest"). The defective fields were divided into 5 classes according to the severity. In 60 eyes there was correspondence between the tests. Discrepancies of results for the two methods occurred in both directions with the same frequency, but only by one class of severity.

Differences between the two techniques are calculated in terms of average scores for quadrants, and clinical implications are discussed.

## **IPS / NO POSTER — 05**

### OBJECT AND SUBJECTIVE ASSESSMENT OF THE VISUAL FIELD IN COMPRESSIVE LESIONS OF THE CHIASM

J.G. Flanagan, University of Waterloo, Canada and  
G.F.A. Harding, Aston University, U.K.

Objective assessment of the visual field using electrodiagnostic techniques has always proven somewhat controversial in the literature. There have been claims however, that multi-channel, pattern reversal, transient VEPs are capable of detecting early compressive lesions of the chiasm in the absence of demonstrable visual field loss<sup>1</sup>. Contradictory findings have also been reported claiming that VEPs are not reliable even when a bitemporal hemianopsia is clearly recordable<sup>2</sup>.

Ten patients with well documented and diagnosed pituitary adenoma were investigated in an attempt to quantify the extent of visual field loss and correlate the diagnostic capabilities of topographically recorded VEPs following full and half field stimulus presentations of various field and check sizes. Differential light thresholds were measured using projection automated perimetry and quantified according to Drasdo's graticule for the neural representation of visual space<sup>3</sup>. Results show a strong correlation between the degree of information loss and the diagnostic value of the VEP. The objective assessment was however, capable of detecting abnormality in the absence of recordable subjective field loss when large field and check sizes were used.

1. Halliday et al. (1976). Brain 99:357-374.
2. Aminoff et al. (1984). In: Visual Evoked Potentials: Clinical Applications. Butterworths, 329-334.
3. Drasdo and Peaston (1980). Brit. J. Ophthalmol. 64:705-712.

## **IPS / NO POSTER — 06**

### ASSESSMENT OF MULTIPLE SCLEROSIS THROUGH STATIC CHROMATIC PERIMETRY

J.F. Kozak, R. Lakowski, D.J. Crockett, Department of Psychology, U. of British Columbia, Vancouver, Canada

The purpose of the present study was to examine whether or not luminance thresholds through static, chromatic perimetry could be used to distinguish visual field threshold losses in multiple sclerosis (MS) from normals.

Both MS patients and age-matched normals were tested with an extensively modified version of the Fieldmaster F225 Automatic Perimeter. Thresholds were established for an achromatic, blue, and red stimulus along a 15<sup>0</sup>-195<sup>0</sup> meridian. Testing was done using a 45 apostilb background, to which the patients and normals were preadapted prior to testing.

Results indicated that there were extensive losses in the chromatic thresholds for the MS patients as compared to the normals. The typical "swiss cheese" field defects reported in the clinical literature for MS were evident only for the achromatic and blue stimuli. No irregular profiles were found for the red stimulus.

TRAQUAIR'S MONOCULAR HEMIANOPIC JUNCTIONAL SCOTOMA - A SIGN OF OPTIC NERVE COMPRESSION.

Patrick J.M. Lavin, M.D., Vanderbilt Univ. Med. Ctr., Nashville, TN; Carl Ellenberger, Jr., M.D., Mt. Gretna, PA

Traquair first reported a monocular hemianopic scotoma, attributed to multiple sclerosis (MS), in 1949. Since then scattered reports have ascribed similar hemianopic visual field defects to both MS, and to aneurysms of the internal carotid artery. All seven patients with monocular hemianopic field defects, seen by us, had optic nerve compression. Three patients had craniopharyngioma's, two had meningiomas, one had an anaplastic suprasellar astrocytoma and one had an aneurysm of the internal carotid artery. Each patient had acute or subacute monocular visual loss with an ipsilateral afferent pupillary defect. Each monocular hemianopic defect, whether complete or incomplete, respected the vertical meridian.

These findings support the hypothesis that the crossing nasal fibers in the optic nerve separate anterior to the chiasm, indeed before von Willibrand's anterior knee.

The finding of a monocular hemianopic visual field defect should direct attention to the anterior chiasm in the search for a remediable cause.

A COMPARISON OF KINETIC AND STATIC PERIMETRY FOR LESIONS IN THE VISUAL PATHWAY

Kazuko YABUKI, Mie SAKAI, Hirotaka SUZUMURA, Naruyoshi ENDO and Harutake MATSUO

Tokyo Medical College, Tokyo, JAPAN

It has been reported that different results are yielded by kinetic and static perimetry for various lesions in the visual pathway. A typical representation is the Riddoch phenomenon. We compared the results of kinetic and static perimetry in 163 eyes of 102 patients suffering from dysfunction of areas from the optic nerve to the visual cortex. There were 66 cases of optic neuritis, 53 bitemporal defects and 44 eyes with homonymous hemianopsia.

The results showed that no significant difference was obtained between kinetic and static perimetry in 80 percent of each group of abnormalities. Furthermore static perimetry was more sensitive in detecting the defects than the kinetic method in 20 percent of all groups of abnormalities. On the other hand, kinetic perimetry was more sensitive than the static method in 3 percent of optic neuropathies.

This suggested that the reasons for differences between kinetic and static perimetry were not simple, but that various elements, characteristics of diseases, condition of measurement, etc., were involved.

**CAPABILITY OF READING SENTENCES WITH ARTIFICIALLY NARROWED VISUAL FIELDS**

H. Ujike, S. Shioiri, and M. Ikeda  
Tokyo Institute of Technology, Yokohama, Japan

It is qualitatively known that the visual function deteriorates for achieving various tasks, such as reading sentences, perceiving patterns and searching targets, when the visual field becomes narrower. It is therefore important to quantitatively assess these abilities for patients with narrowed visual fields. In the present paper the deterioration was quantitatively investigated for the task in which subjects read a Japanese sentence composed of about 30 letters when the subjects' visual fields were artificially narrowed with the aid of a TV monitor and an eye movement detector. The reading speed of the sentence was measured as a function of the visual field size. The reading speed linearly decreased as the visual field became smaller. For example, the speed decreased from about 7 letters per sec to 4 letters per sec as the visual field was narrowed down by a factor of 3 in lateral size. In another experiment a sentence was preceded by an illustration that was correlated to its contents so that the subjects could have preknowledge of the sentence and the reading speed might be increased. With the aid of the preceding illustration the reading speed became faster, but its effect appeared only for visual fields larger than 1/3 of the picture size. The relationship between the artificial visual field size and the reading speed should present a method by which the effective functional visual field size can be estimated for patients with narrowed visual field by measuring their reading speed.

**THE EFFECT OF LONG-TERM INTRAOCULAR PRESSURE REDUCTION ON THE DIFFERENTIAL LIGHT SENSITIVITY IN GLAUCOMA SUSPECTS.**

Balwantray C. Chauhan, Stephen M. Drance, and Gordon R. Douglas,  
Departments of Ophthalmology, University of British Columbia,  
Vancouver, Canada.

This study was undertaken to observe the effect on the differential light sensitivity in glaucoma suspects produced by a long-term reduction in intraocular pressure (IOP) with Timolol Maleate. We present fine-grid meridional data recorded by automated perimetry from 46 glaucoma suspects of whom 24 were randomly selected for Timolol treatment and 22 for non-treatment. The data were collected every four months over a six year period. Methods of analyzing the profile sensitivity, the profile slope and the sensitivity of specific locations over the follow-up period are described. The results show that the long-term threshold fluctuation in the two groups was not significantly different ( $p=0.395$ ) and that the sensitivity at most of the locations remained stable. The number of stable locations was not significantly different in the two groups ( $p=0.412$ ) and there was also no difference in the number of locations where the sensitivity appeared to decrease ( $p=0.193$ ) or increase ( $p=0.540$ ). Analysis of covariance showed that the profile sensitivity and the profile slope also remained stable in both groups over the six year period. Although the treated group maintained a consistently lower IOP than the untreated controls, our results show that long-term pressure reduction with Timolol in glaucoma suspects does not alter the behaviour of the differential light threshold in 6 years of follow-up.

LASER TRABECULOPLASTY VS. MEDICAL TREATMENT AS PRIMARY THERAPY.  
A PROSPECTIVE RANDOMIZED FOLLOW-UP STUDY.

A. Tuulonen, J. Koponen, H.I. Alanko, and P.J. Airaksinen  
Department of Ophthalmology, University of Oulu, Oulu, Finland

Patients with open angle glaucoma were randomly assigned to receive either laser trabeculoplasty or medical therapy as primary treatment for their newly diagnosed glaucoma. The overall follow-up of this prospective study will be five years. In this report the results of the first 39 patients (19 in the laser treated group and 20 in the medically treated group) with a follow-up of one to two years will be analyzed.

The visual fields of the patients were examined with the Humphrey visual field analyzer in the beginning and at the end of the study period. In addition, the area of neuroretinal rim was measured from the optic disc photographs.

In regard to success rate, intraocular pressure drop and visual field changes there were no statistically differences between the two groups. Half of the laser treated patients had their intraocular pressures < 22mmHg without any medical treatment. The results will be discussed.

ASYMMETRY OF FIELD AND PRESSURE IN LOW TENSION GLAUCOMA PATIENTS  
A.C. Crichton, S.M. Drance, and G.R. Douglas,  
U. of British Columbia, Vancouver, Canada

60 charts of low tension glaucoma patients (highest IOP < 24) were classified with respect to equality or inequality of IOP and symmetry or asymmetry of visual field defects. 7 of 7 patients with a mean IOP difference of  $\geq 1.5$  mm Hg had corresponding asymmetric visual field defects. Only 18 of 37 patients with asymmetric visual fields had unequal intra-ocular pressures. The findings confirm that even in low tension glaucoma IOP appears to be a significant factor. Asymmetry of the visual field defect, however, was more often unassociated with unequal intra-ocular pressure.

## IPS — 21

### THE EFFECT OF Ca<sup>2+</sup> -ANTAGONIST ON VISUAL FIELD IN LOW TENSION GLAUCOMA

Yoshiaki Kitazawa, Hisayuki Shirai, Gifu University and Fu Jin Go, University of Tokyo, Japan.

We carried out a prospective study in an attempt to evaluate the effects of Ca<sup>2+</sup> - antagonist on visual field in low tension glaucoma (LTG). Seventeen consecutive cases (34 eyes) with LTG received nifedipine 30mg/day per os for 6 months. Visual field was tested with Octopus 201 (program G1) prior to and every 1 month during the period of nifedipine administration. Tonometry with a Goldmann applanation tonometer and the measurements of resting systemic blood pressure and pulse rate were made prior to and monthly during nifedipine therapy. The reactivity of peripheral vessels was estimated prior to and during nifedipine administration by determining the response of skin temperature of a finger to cold water (4 °C).

Twelve eyes (6 patients) showed a constant improvement of visual field as expressed with an increase in mean sensitivity (MS). There was a statistically significant difference in age, MS prior to nifedipine administration, diastolic blood pressure during nifedipine therapy and the recovery rate of skin temperature between those who showed the improvement of visual field and those who failed to. Canonical discriminant analysis demonstrated that the visual field is likely to improve with systemic nifedipine in patients who are younger, have a higher initial MS, and have less of a decrease in diastolic blood pressure with the nifedipine administration and better recovery of skin temperature after being soaked in cold water.

## IPS — 22

### CHOROIDAL ANGIOGRAPHY FINDINGS IN PATIENTS WITH GLAUCOMA-LIKE VISUAL FIELD DEFECTS

Christian Prunte and Josef Flammer

Examples of patients with visual field defects, typical for glaucoma, but with no other indications of glaucoma are shown. All patients had normal intra-ocular pressure and a physiological optic disc, but had a history of frequent cold hands and feet and migraine headaches. In the capillary microscopy of the nailfold, a tendency for vasospasm was found. By a new method of choroidal angiography, the arterial and capillary filling times in the choroid and the amount of capillary perfusion of the choricocapillaris were determined. Some of these patient showed increased filling times and all patients showed a diminution of the perfusion of the choricocapillaris.

Normalization of the visual field occurred following treatment with Nifedipine. The capillary microscopy of the nailfold and the parameters of choroidal blood-flow returned to normal values.

We conclude that in cases where the visual field appears glaucomatous, but no other glaucoma symptoms are present, a vasospastic syndrome may be suspected, which may respond to Nifedipine treatment.

## INTER-POINT CORRELATIONS OF THRESHOLD VALUES IN NORMAL AND GLAUCOMATOUS VISUAL FIELDS

Anders Heijl, Anna Lindgren and Georg Lindgren, Malmö and Lund, Sweden

We studied the dependence of measured threshold values within individual visual fields in 84 fields from 84 normal subjects and 90 fields of 90 patients with glaucoma of varying severity. Central 30° full threshold fields obtained with the 30-2 program of the Humphrey Field Analyzer were used. In each visual field we computed the correlations between the pointwise deviations of the measured threshold values from the age-corrected normal threshold values as obtained from the Statpac program.

The correlations between these deviations were larger for neighbouring points than for points situated further away from one another. The correlations were larger in pathological than in normal fields.

The visual field was also divided in 15 sectors according to the projection of the retinal nerve fibre layer. In the glaucoma fields mean correlation coefficients were approximately 0.1 units higher for points within the same sector, than for points located at the same distance but in another sector. This difference was largest in moderately disturbed fields (MD between -6 and -15 dB), but was present also in almost normal fields from glaucomatous eyes. In the the normal group of subjects, on the other hand, the correlations were the same whether the points were situated in the same sector or not.

The results show that in both normal and abnormal fields points with low sensitivities tend to cluster. This is of importance for the interpretation of visual field data. It also emphasizes the importance not to regard individual threshold measurements in one field chart as independent measurements. It should be possible to use inter-point correlations for the classification of visual fields, particularly if correlation coefficients are separately calculated within and between sectors.

## POINTWISE INTER-TEST THRESHOLD VARIABILITY IN GLAUCOMATOUS VISUAL FIELDS

Anders Heijl, Anna Lindgren and Georg Lindgren, Dept of Ophthalmology in Malmö and Mathematical Statistics, University of Lund, Sweden

The large inter-test variability of computerized threshold fields renders the interpretation of consecutive fields difficult. Better knowledge of the variation of glaucomatous visual fields might facilitate follow-up of patients with this disease. We studied the variation in such fields by testing 51 glaucomatous eyes of 51 patients with threshold-measuring computerized perimetry using the 30-2 program of the Humphrey perimeter. Each eye was tested four times with one week inter-test intervals.

We found the threshold variation at each point to be large and to depend on and increase with defect depth. Already at a defect depth of approximately 6 dB the 95% threshold prediction interval for individual points included all sensitivities from normal to a maximum luminosity defect. Variability also increased with eccentricity, just as in normal fields. The homogenous component of the long-term fluctuation was large reflecting a strong correlation between individual point values. It also depended on the degree of abnormality. There was a significant, but small, effect of perimetric learning despite the fact that all patients had previous experience of computerized perimetry.

The large threshold variation and its dependence on defect depth means, that even if the sensitivity at the point is only moderately depressed, no conclusions can be drawn from threshold changes between two tests in a single point, regardless of the magnitude of that change. MD also varies considerably, but if the degree of abnormality is taken into account (i.e. the magnitude of MD itself) it is possible to establish clinically useful prediction intervals for acceptable inter-test changes in this index. The clear effect of perimetric learning in these already initially experienced subjects is worth considering. It shows that perimetric studies, e.g. regarding the effects of drug treatment, should be designed to eliminate the confounding effects of increased perimetric training.

## **IPS — 25**

### ASSESSING CRITERION LEVELS AND "FUNCTIONAL CHANNEL FRACTIONS" IN HIGH-PASS RESOLUTION PERIMETRY

Lars Frisén, University of Göteborg, Sweden

One of the most useful qualities of acuity perimetry is the well-defined relationship between level of function and an neuroanatomical parameter: the minimum angle of resolution is exactly proportional (but for stochastic deviations) to the angular separation of functional retinal ganglion cells. The magnitude of the proportionality factor  $P$  is governed by internal as well as external variables, e g, criterion setting and contrast level.  $P$  can be determined easily.

Even under constant physical conditions, normal subjects show considerable variability of  $P$  as a reflection of their different criterion settings. The measured  $P$  values can be used to correct for practice effects and also to tighten normal limits. The latter effect amounted to a 57% reduction in standard deviation for a group of normal subjects. The technique cannot be used for abnormal subjects, however.

The proportionality model can also be used for individual estimation of the functional fraction of retinocortical neural channels. This is useful for assessing the severity of disease in truly quantitative terms, and for improving staging schemes.

## **IPS — 26**

### THE RELATIONSHIP BETWEEN THE LENS OPACITY METER 701 READINGS AND THE VISUAL FIELD.

De Natale R., Flammer J., University Eye Clinic of Basle,  
Switzerland

The patients for this study were selected from the inpatients who were awaiting cataract surgery. The cataract density was measured in each patient prior to surgery with the Lens Opacity Meter 701, which gives us a numerical quantification of the opacity of the lens. The visual field of these patients was measured before and after the cataract surgery with the computerized perimeter Octopus 201 using the profile program F along the horizontal axis.

The correlation between the Lens Opacity Meter 701 readings and the improvement in the post-operative field will be presented.



FLUCTUATION AND GENERAL HEALTH IN AUTOMATED PERIMETRY IN GLAUCOMA

CT Langerhorst, TJTP van den Berg, EL Greve  
Eye Clinic of the University of Amsterdam, and the Netherlands Ophthalmic  
Research Institute

Ten normal controls, 10 ocular hypertensive patients, 10 high tension, 12 medium tension and 9 low tension glaucoma patients were studied prospectively by means of double threshold measurements during a time period of at most 3 years. One of the aspects studied was the relation between general health based on the medical history on the one hand, and Individual General Sensitivity (IGS), Short-term Fluctuation (SF) and Long-term Fluctuation (LF) on the other.

A relation was found between general health and SF and to a lesser degree LF, but there was no relation in our population between general health and general sensitivity of the visual field.

VARIANCE ESTIMATES FROM THRESHOLD GRID PATTERNS

R.P. Mills, M. Schulzer, R.H. Hopp, and S.M. Drance  
Seattle, U.S.A. and Vancouver, Canada

Previously we had demonstrated that single determinations of threshold at close intervals along a visual field meridian could be used to produce estimates of the variance which correlated closely with direct estimates of the mean square based on double determinations at the same points. In this study, we tested 62 eyes of 62 patients using three consecutive repetitions of a Humphrey 24-2 full threshold program. The resulting grid patterns were analyzed using two different statistical methods.

First, a modification of the technique of trend-surface analysis was developed, whereby, in turn, bilinear, biquadratic, and bicubic polynomial surfaces were fitted to the data over the grid. Second, a modification of the Holt-Winters forecasting algorithm was applied following a spiral pattern across the visual field. The residual variances after detrending using either method correlated very well with the direct estimates based on the triple observations at each point (correlation coefficients of log-transforms of 0.8 and better). We conclude that short-term fluctuation (the square root of the variance) can be estimated with good reliability from grids of single threshold determinations.

VARIABILITY OF AUTOMATED VISUAL FIELDS IN CLINICALLY STABLE GLAUCOMA PATIENTS. Elliot Werner, Benno Petrig, Theodore Krupin, Kim Bishop, Scheie Eye Institute, University of Pennsylvania School of Medicine, Department of Ophthalmology, Philadelphia, PA

The variability of the Octopus (program 32) visual fields of 20 patients with open-angle glaucoma was measured. Inclusion criteria were IOP < 20; no change in optic disc appearance and no change in medication during follow-up period. The four most recent visual fields of each patient were analyzed.

Each visual field was divided into ten sectors. The mean threshold of 95% of the sectors in the sample varied over a range of less than 7 db, and 99% varied over a range of less than 8 db. By applying a binomial probability formula to the data, criteria for progressive visual field loss can be based on the expected range of variability of individual sectors within a patient's visual fields.

Number of sectors varying by more than specified range	Visual field sector range of variability	
	p<0.05*	p<0.01*
1	8 db	9 db
2	7 db	8 db
3	6 db	7 db
4	4 db	6 db

probability that change of this amount is due to random variability

CLINICOPATHOLOGICAL STUDIES OF THE RETINAL NERVE FIBER LAYER IN THE EARLY GLAUCOMATOUS VISUAL FIELD DAMAGE

N.Katsumori and K.Mizokami\*

Akashi Shimin Hospital, Akashi, Japan

\*Dept.of Ophthalmol., Kobe University, Kobe, Japan

Retinal nerve fiber layer defect (NFLD) is one of the most important appearance in the diagnosis of glaucoma. In this study, we examined by light and electron microscopy the retina of human eyes with early glaucoma.

In this case (5ly.o. female), there was the wedge shaped NFLD in inferior arcuate area and a small scotoma in Bjerrum area superiorly in the right eye, and no visual field damage in the left eye.

Thinning of retinal nerve fiber layer was markedly observed corresponding to the area with clinically detected NFLD. By electron microscopy, many axons were dropped out and remained axons were also affected. Furthermore, nerve fiber layer surrounding such region showed numerous cystic spaces enclosed with Müller's cell processes, especially in the superficial layer. In the retina without visual field damage, cystic spaces were also seen by electron microscopy. The quantitative study in these axons suggested 40% loss of nerve fiber compared with the fellow eye.

In conclusion, our findings suggest that nerve fiber damage occurred in whole retina even in the early stage glaucoma.

**BLUE/YELLOW COLOR CONTRAST PERIMETRY COMPARED TO CONVENTIONAL KINETIC PERIMETRY IN PATIENTS WITH ESTABLISHED GLAUCOMATOUS VISUAL FIELD DEFECTS.** W.M. Hart, Jr., Department of Ophthalmology, Washington University School of Medicine, St. Louis, MO

Patients with ocular hypertension and glaucoma are known to have a high incidence of type III acquired dyschromatopsia (a tritan-like confusion of blue/yellow hues), suggesting that blue/yellow hue discrimination in the visual field may be preferentially impaired by glaucomatous optic nerve damage. As a first test of this possibility, I examined 19 eyes of 15 patients with the established diagnosis of primary open angle glaucoma, and compared the results of conventional, manual kinetic perimetry with the Goldmann instrument to those obtained by manual kinetic color contrast (blue/yellow) perimetry with a color video tangent screen. Eyes were selected for having typical glaucomatous visual field defects (nerve fiber bundle defects, including combinations of arcuate scotomas, paracentral scotomas and nasal steps). The color video screen had a yellow adapting background (red and green phosphors with combined luminance of 15 foot lamberts) and test objects were generated by addition of blue phosphor output with simultaneous, equiluminant subtraction of yellow component. Maximum blueness of test objects was 10% of the available range in the yellow-to-blue shift through color space, and equiluminance was individually determined for each patient by heterochromatic flicker photometry. In all but one eye, all defects detected by conventional perimetry were similarly demonstrable by the color contrast method, and in no case was there a color contrast defect that could not be simultaneously detected by the conventional method. The type III acquired dyschromatopsia of glaucoma may have no specificity for the detection of glaucomatous damage, just as isopter constriction or generalized visual field depression are common but non-specific findings in the glaucomatous visual field.

**DETECTION OF DEVELOPING GLAUCOMA WITH COMPUTERIZED THRESHOLD PERIMETRY AND FLICKER COMPARISONS OF DISC PHOTOGRAPHS**

Anders Heijl and Boel Bengtsson, Dept. of Ophthalmology, Malmö General Hospital, Sweden

One hundred and thirty-one hypertensive eyes with normal visual fields of 81 individuals were prospectively followed for 9 to 72 (mean 40) months. Computerized threshold perimetry and disc photography was performed every three months. Visual fields were judged according to predetermined criteria. Disc photographs were compared to baseline photographs using a specially designed instrument based on flicker chronoscopy, and classified into one of four groups: no change (0), slight (1) and high (2) suspicion of change and definite change (3).

Disc	0	1	2	3
VFD+	1	1	2	8
VFD-	108	7	2	2

Using this sensitive method of disc analysis the correspondance between the development of visual field defects (VFD+) and disc changes was surprisingly high: Alterations in disc anatomy were usually very discrete, and often impossible to detect when photographs were compared in the standard way, without using the flicker method. Changes of disc anatomy did not precede disturbances in the visual field more often than vice versa. The results indicate, that when ocular hypertensives are followed, computerized threshold perimetry can detect early developing glaucoma as early as sensitive longitudinal disc comparisons, and earlier than standard comparisons of disc photographs.

### AUTOMATED PERIMETRY OF BLUE-SENSITIVE MECHANISMS IN OCULAR HYPERTENSION AND EARLY GLAUCOMA

Chris A. Johnson<sup>1</sup>, Anthony J. Adams<sup>2</sup>, and Richard A. Lewis<sup>1</sup>

1 Department of Ophthalmology, Univ. of Calif., Davis

2 School of Optometry, Univ. of California, Berkeley

Many recent studies have reported deficits for short-wavelength stimuli as an early indicator of glaucomatous damage, often preceding the presence of visual field defects. Frequently, these measures have been restricted to the foveal region, have not been corrected for short wavelength attenuation by the ocular media, and have not been compared to the most sensitive current automated perimetric techniques. In the present study, we used a modified Humphrey Field Analyzer to test the central 30 degrees. Visual field tests included standard automated static perimetry (Program 30-2), automated perimetry of blue-sensitive mechanisms (blue size V target on a yellow 630 asb background) and a high luminance background control condition (yellow size V target on a yellow 630 asb background). Ocular media attenuation of short wavelength stimuli was determined by measuring scotopic thresholds at 20 degrees for long and short wavelength targets, and a correction was applied to the blue-on-yellow perimetry values. Both eyes of 36 patients with ocular hypertension, 24 patients with early glaucomatous visual field loss and 60 normal control subjects (20 each in the age groups of 20-40, 41-60 and over 60) were tested. Our results suggest that when short wavelength sensitivity losses are present in ocular hypertension patients (after ocular media correction), these losses occur diffusely across the central 30 degree visual field. However, automated perimetry of blue-sensitive mechanisms does not appear to be significantly more sensitive to early glaucomatous changes than standard automated perimetric tests employing statistical comparisons to age-matched normal controls.

PATTERN DISCRIMINATION AND LIGHT DETECTION TEST DIFFERENT ASPECTS OF GLAUCOMATOUS DAMAGE. Bruce Drum\*, Matthew Sevens\*,<sup>†</sup> David O'Leary\*, Robert Massof\*, Harry Quigley\*, Michael Breton<sup>†</sup> and Theodore Krupin<sup>†</sup>.

\*Wilmer Eye Institute, Johns Hopkins University School of Medicine, Baltimore, MD 21205

<sup>†</sup>LKC Technologies, Inc., 2 Professional Drive, Gaithersburg, MD 20879

<sup>†</sup>Scheie Eye Institute, Presbyterian-University of Pennsylvania Medical Center, Philadelphia, PA 19104

We tested glaucoma patients, glaucoma suspects and control subjects with a new type of perimetry based on pattern discrimination instead of light detection. Patients were asked to detect a patch of nonrandom dots embedded in a surrounding field of dynamic random dots. The stimulus had the same fraction of black and white dots as the surround, so there were no luminance cues to detection. We varied the regularity, or "coherence" of the stimulus dots to find the 50% detection threshold. The fully coherent target was a static, 1 sec duration, 20x20-dot checkerboard. Coherence was reduced by reversing the contrast of randomly selected black-white dot pairs. A new set of dots was reversed with each background frame. Patient groups were based on intraocular pressure and conventional perimetry (Humphrey program 30-2 or Octopus program 32). Pattern discrimination thresholds were measured with a brief staircase procedure at a subset of the Humphrey 30-2 test positions. We tested two locations at a time, diametrically opposite the fixation point. This procedure minimized uncertainty about the target location while still avoiding fixation bias.

Using a new criterion-free ROC analysis derived from signal detection theory, we estimated the separation of the normal data distributions from the suspect and glaucoma distributions for both the pattern discrimination and conventional tests. The pattern discrimination test produced greater separations than conventional perimetry for both patient groups. However, details of field defects for the two tests were poorly correlated, and pattern discrimination and conventional mean defects for the same patient often differed by several standard deviations. These results suggest that pattern discrimination and light detection test different aspects of visual function that can be unequally affected in glaucoma.

Supported in part by NEI SBIR grant #EY05136 to LKC Systems, Inc. The pattern discrimination perimeter is protected by U.S. Patent No. 4634243.

## AUTOMATED FLICKER PERIMETRY VERSUS QUANTITATIVE STATIC PERIMETRY IN EARLY GLAUCOMA

LACHENMAYR B., ROTHBÄCHER H., GLEISSNER M.,  
Eye Clinic of the University of Munich, F.R.G.

An automated flicker perimeter was constructed measuring CFF over the central 40 deg of the visual field with a test point pattern of high resolution. 80 eyes of patients suffering from glaucoma, suspected glaucoma, ocular hypertension and low-tension glaucoma were examined with a standard program of 89 test points (81 up to 30 deg) and compared to an age matched normal population. As a reference all eyes were subjected to a quantitative static perimetry using program G1 of the OCTOPUS 201.

The majority of "normal" eyes without any visual field defects or impairment in static perimetry already showed moderate to marked decrease of CFF over wide areas of the visual field. In many cases of detectable visual field damage in program G1 flicker perimetry yielded deeper and larger scotomas than static perimetry often in combination with an overall depression of CFF in the entire visual field.

Thus flicker perimetry measuring temporal resolution of the central visual field seems to be more sensitive to glaucomatous damage than is quantitative static perimetry. A long-term follow-up study of our patients is planned in order to prove the prognostic value of flicker perimetry in the diagnosis of early glaucoma.

## HIGH PASS RESOLUTION PERIMETRY AND RETINAL NERVE FIBER LAYER IN GLAUCOMA

P.J. Airaksinen, A.Tuulonen, J. Välimäki, H.I. Alanko  
Department of Ophthalmology, University of Oulu, Oulu, Finland

High-pass resolution perimetry (Ring perimetry) was introduced by Lars Frisen in the IPS meeting of 1986. This acuity perimeter produces indices such as: mean score, mean retest change, form index, functional channel fraction, and relative criterion level.

Functional channel fraction is an estimate expressing the number of viable ganglion cells in the retina. It was therefore of interest to examine how Ring perimetry tests results correlate with magnification corrected neuroretinal rim area of the optic disc and semiquantitative estimate of the retinal nerve fiber layer.

We examined 36 ocular hypertensives and 39 patients with manifest glaucoma. Ganglion cell estimated calculated from Ring perimetry were correlated with nerve fiber layer damage score and neuroretinal rim area. Results will be presented and discussed.

## **IPS — 37**

### **VISUAL FIELD INDICES AND THEIR CORRELATION WITH CONTRAST SENSITIVITY IN GLAUCOMA. PRELIMINARY RESULTS.**

Zulauf M <sup>1</sup>, Flammer J <sup>2</sup>

1 Eye Clinic, Cantonal Hospital, CH-6000 Lucerne 16, Switzerland.

2 Eye Hospital, Mittlere Strasse 91, CH-4056 Basle, Switzerland.

In three groups of 60 patients (with normal visual field indices; moderately disturbed visual fields; markedly damaged visual fields), contrast sensitivity was measured following a visual field examination with programm G1 on the automated perimeter OCTOPUS 201. The highest correlation was found between the mean contrast sensitivity at all spatial frequencies and the mean sensitivity of the central 5 test locations of the visual field ( $r=0.74$ ,  $p < 0.001$ ), followed by the mean sensitivity of the entire field ( $r=0.6$ ,  $p < 0.001$ ), CLV ( $r=0.34$ ,  $p=0.008$ ) and short term fluctuation ( $r=0.36$ ,  $p=0.004$ ).

Clinical relevance of these findings will be discussed.

## **IPS — 38**

### **GREY SCALE DISPLAY OF PERIMETRIC RESULTS - THE INFLUENCE OF DIFFERENT INTERPOLATION PROCEDURES**

Weber J, Geiger R, Universitats-Augenklinik, Cologne

There are three main methods for the interpolation of two-dimensional values: linear interpolation, the use of a squared distance factor, and a step-by-step center point interpolation. The display results are shown for different shapes of scotomas. There are marked differences between the methods. The linear interpolation resembles the natural shape of the scotomas most closely.

**NOISE-FIELD CAMPIMETRY - A NEW PERIMETRIC METHOD**

E. Aulhorn and G. Kost

University-Eye-Clinic Tübingen, FRG

A patient with a circumscribed scotoma will perceive his scotoma as a grey or dark area when looking with steady fixation at a large flickering field. The area seems to flicker less than the surrounding area might even be perceived as being completely stationary. A condition for this self-perception of one's own scotoma is that the elements of the flickering area are of a certain contrast and size and have an optimal flicker frequency. A computer is best suited to produce a flickering field of reproducible characteristics on a monitor. The self-perception can be used as a screening method to be followed by an exact manual or automated perimetry only of the pathological parts of the visual field. This saves a considerable amount of time compared to conventional perimetry, as the thorough examination is confined to the abnormal parts of the visual field. Screening and exact perimetry can be performed quickly and efficiently on the same monitor-given appropriate programming of the computer.

A special advantage of the "monitor-perimetry" is that it can also be performed with a target that is darker than its surroundings.

**EVALUATION OF ADAPTIVE SPATIAL ENHANCEMENT  
IN SUPRALIMINAL VISUAL FIELD SCREENING**P. Asman, J.M. Britt, R.P. Mills, A. Heijl  
Malmö, Sweden and Seattle, U.S.A.

63 normal and 94 abnormal subjects were tested in the central visual field using a threshold-related, eccentricity compensated, spatially adaptive suprathreshold screening program and a full threshold program on the Humphrey Field Analyzer. The initial stimulus locations on the screening test were identical to those of the threshold test; additional screening stimuli were presented surrounding each missed initial stimulus. Surprisingly, this spatial enhancement strategy did not improve either sensitivity or specificity of the screening beyond that achieved by considering the initial stimulus locations alone. Instead, the results at the additional points tended to confirm the finding at the initial point in normals and abnormals alike.

There was a high correlation between the results of the screening and the threshold tests. Thus, points missed during screening often showed a depressed sensitivity (measured threshold > 6dB below an age corrected normal reference value) in the same area of the threshold field. This was true in fields from both abnormal and normal subjects. The finding of persistent shallow defects in the same test session among otherwise normal persons has disturbing implications for the importance of "confirmed" defects in the diagnosis of disease.

## **IPS / POSTER — 12**

### **THE VISUAL FIELD INDICES INDEX OF CLUMPING AND SPATIAL CORRELATION**

**A Beffa, TJ Smith, Division of Ophthalmology  
Veterans Administration Hospital Lexington, KY USA**

Since the introduction by Flammer and Drance of the indices mean defect (MD) and corrected loss variance (CLV), the importance of whole field indices as a modality of visual field interpretation has been recognized. Nonetheless, despite the attempts of Brechner and Whalen to popularize the Q statistic, no new indices have established their usefulness. Hirsch has suggested that the new indices index of clumping (IC) and spatial correlation (SC) might be of value.

In order to determine the usefulness of these statistics we analyzed the visual fields of 30 glaucoma suspects and 15 patients with chronic open angle glaucoma. All visual fields were performed on Octopus 2000R automated perimeter and the visual field data were downloaded to an IBM compatible computer where the statistics MD, CLV, IC, and SC were calculated according the formula of Flammer and Hirsch.

We found that the IC did not correlate with any other index and rose asymptotically as the visual field approached an MD of 0. The SC, on the other hand, correlated very well to MD ( $r = .48$ ,  $p = .0004$ ,  $n = 48$ ) and CLV ( $r = .87$ ,  $p < .0001$ ,  $n = 48$ ).

We conclude that the index of clumping is unlikely to be of any use in visual field analysis, but that spatial correlation is a potentially useful statistic which merits further research.

## **IPS / POSTER — 13**

### **KINETIC VISUAL FIELD INDICES**

**Capris P, Gandolfo E, Corallo G, Camoriano GP, Zingirian M  
University Eye Clinic, Genoa (Italy)**

One of the advantages of computerized perimetry is the possibility of processing data recorded during one or more visual field examinations in order to obtain statistical information. The visual field indices suggested by Flammer for the Octopus perimeter and modified by Heijl for the Humphrey perimeter provide great help for the correct evaluation of single visual fields or for the comparison of successive perimetric results during follow-up.

We have tried to adapt these concepts to kinetic perimetry elaborating indices obtainable with the computerized Goldmann kinetic perimeter "Perikon". The results of this study, based on normal visual fields recorded during five years, allowed us to identify the following parameters:

- 1) Kinetic Short-term Fluctuation (KSF)
- 2) Kinetic Mean Defect (KMD)
- 3) Kinetic Loss Variance (KLV)
- 4) Kinetic Corrected Loss Variance (KCLV)

The results of the utilization of these indices on a sample of normal subjects are reported.



## CLUSTER ANALYSIS IN VISUAL FIELD QUANTIFICATION

Balwantray C. Chauhan<sup>1</sup>, David B. Henson<sup>1</sup> and Angela J. Hopley<sup>2</sup>, <sup>1</sup>University of Wales, Cardiff, UK, <sup>2</sup>Bristol Eye Hospital, Bristol, UK.

Although several quantification indices are available for the analysis and interpretation of visual field loss, they do not utilise the spatial relationship between locations with depressed sensitivities. The purpose of this investigation was to examine this relationship and develop a technique, or a cluster analysis, for the evaluation of visual field data.

The central visual fields of 1105 normal and 87 glaucoma patients were measured using a threshold related suprathreshold strategy. The effects of altering the cluster radius sheds light on the nature of visual field defects in the two groups. Approximately 13% of normals have clusters; the great majority of these individuals have one cluster of two defects. Most clusters in normals are formed artifactually due to angioscotoma and/or physiological variations in the blind spot position. Analysis of the foci or centroids of the clusters show that they are found with equal frequencies in the superior and inferior fields in normal patients but with a greater frequency in the superior fields of glaucoma patients.

Using the results from this large normal sample and looking at other visual field properties such as depth and location of defects, it is possible to devise an accurate scoring system. The incorporation of cluster analysis in visual field quantification is both sensitive and specific in the detection of glaucomatous visual field defects.

## LEARNING EFFECT AND VARIABILITY OF FRISEN'S HIGH PASS RESOLUTION PERIMETRY

S.M. Drance, G.R. Douglas, M. Schulzer, F.S. Mikelberg, and K. Wijsman.  
U. of British Columbia, Vancouver, Canada.

Thirty seven eyes of 37 patients (15 normotensive normals, 10 ocular hypertensives and 12 chronic open angle glaucomas) were subjected to five consecutive determinations of their visual fields on the Frisen H.P.R.P. The net patient variation within diagnostic groups was least in central points (1.447), greater in mid-peripheral points (0.998) and greatest in the outermost points (1.35844). Using analysis of variance the variations of normals and ocular hypertensives was found to be statistically smaller when compared to the glaucomas ( $p=.001$ ). Similar differences were found in all field quadrants. There is an increase in mean threshold with age of 0.035 db per year. No significant overall time-trends were found for the total scores or for scores in four quadrants. Regressions of successive total scores on their immediate antecedent scores showed a significant flattening of the line predicting the second score measurements ( $X_2$ ) from the first ones ( $X_1$ ) [ $X_2 = .67X_1 + .7$ ], indicating a significant improvement in score from first to second determinations. No further improvements could be found in any of the later pairs of successive readings.

The mean difference in the total scores, between second and first determinations, was -0.297 db (initial mean score 4.324 db) which, after covariate adjustment for the initial score, showed a highly significant learning effect ( $p < .005$ ). The score from the quadrants showed analogous behaviour. Learning took place between the first and second consecutive determinations. No subsequent learning effects could be detected.

## **IPS / POSTER — 16**

### COLOURED TARGETS IN THE ASSESSMENT OF DIFFERENTIAL LIGHT SENSITIVITY J.G. Flanagan and J. Hovis, University of Waterloo, Canada

Projection automated perimeters have encouraged a renewed interest in colour perimetry. The Humphrey Field Analyser for example, offers blue, red and green targets but warns that the results are invalid as the instrument remains calibrated for the white target. The aim of this study was to investigate the relative sensitivity of coloured versus white targets on the Humphrey perimeter for both normal and abnormal subjects using the standard 31.5 asb background luminance. Thirty normal subjects between the ages of 20 and 30 years were examined using the macula threshold programme with target size III. Red and white target sizes I-V were also used to investigate the effect of spatial summation. The transmission characteristics of each filter was determined in order to calibrate the coloured target luminance for the standard observer.

Following computer-assisted calibration there was no significant difference between the sensitivity and slope of the white, green and red targets, thus indicating that the standard observer  $v_\lambda$  function adequately calibrates the green and red targets used in the Humphrey perimeter. Inappropriate calibration may indicate a selective sensitivity loss which is actually due to the lower luminance of the uncalibrated coloured target. Overall "reductions in sensitivity" could also mask genuine focal field loss. The blue target was slightly but significantly different with a higher sensitivity and a unique slope. It is proposed that the latter observation was due to variation in macula pigmentation and possible rod interaction. The sensitivity versus target size functions for the red and white targets were identical, thus demonstrating similar spatial summation for the red and white targets when appropriately calibrated. A variety of abnormalities of the visuum were investigated to illustrate the discussion.

## **IPS / POSTER — 17**

### The BSPOT SAPRO Data Evaluation Program for the PC

A. Funkhouser, University Eye Clinic, Bern, Switzerland

A program running on a PC has been devised to display visual field data determined using the SAPRO spatially adaptive program (available for the Octopus 201 automated perimeter). In its present form, the program is able to display a 23 x 23 numerical table from a SAPRO examination, a histogram of the data, determine the center of gravity of a scotoma along with its area and "volume", plot vertical and horizontal profiles through the data, and provide a synopsis of the subprogram parameters that were used for the examination. Some examples of blind spot evaluation using the program will be shown and its use will be demonstrated.

## CLUSTERING OF DEPRESSED POINTS IN THE NORMAL VISUAL FIELD

Anders Heijl and Peter Åsman, Dept. of Ophthalmology, Malmö General Hospital,  
University of Lund, Sweden

It is often assumed that visual fields with several adjacent depressed points have a high likelihood of being abnormal. This assumption, however, does not agree with our clinical impression and with the results of some recent studies indicating that even in normal fields important correlations exist between threshold measurements in neighbouring points.

We wanted to study the tendency of depressed points in normal fields to occur in groups. One hundred and thirty-two eyes of 132 normal subjects were subjected to static threshold perimetry using the 30-2 program of the Humphrey perimeter. Points were defined as abnormal if significantly depressed ( $p < 0.05$  or  $p < 0.01$  respectively) in the probability maps of the Statpac program. In each field we counted the number of abnormal points at these two levels, and the percentage of such points which were located in clusters. These percentages were plotted versus total number of depressed points and the results were compared to the outcome of computer simulations where abnormal points were randomly distributed.

The depressed points of actually measured fields were clustered to a much greater extent than those of the simulated fields. The differences were most pronounced in fields with moderate numbers of depressed points, or when using the stricter of the two criteria for abnormality.

Our results indicate that in fields from normals, depressed points have a tendency to occur in clusters. In interpretation of visual fields individual threshold values should not be regarded as independent observations. Small clusters of depressed points is no proof of pathology, even if each point reaches statistical significance.

## THRESHOLDS USING SINGLE AND MULTIPLE STIMULUS PRESENTATIONS

D B Henson and R Anderson University of Wales, Cardiff.

The purpose of this research was to establish whether there is any difference between thresholds measured with single and multiple stimulus techniques.

Three different techniques were used to measure retinal thresholds (i) multiple stimulus, (ii) single stimulus and (iii) a criterion free 2 alternative forced choice technique. With each technique stimuli were presented at 7 different intensities which straddled the estimated threshold. At least 20 presentations were made at each intensity level.

The results indicate no significant difference in the threshold estimate between the multiple stimulus and forced choice techniques while those from the single stimulus technique were on average approximately 1 db lower. The SD of the threshold estimates were lowest with the multiple stimulus technique and highest with the single stimulus technique.

The increased variability of the single stimulus technique is believed to be the result of factors such as attention and fatigue. Subjects found it difficult to maintain attention during the single stimulus technique in which their task was to press a key everytime they saw a stimulus. Contrary to widespread belief the more complex task of reporting the number of stimuli seen better maintained patient attention, reduced testing time and reduced variance.

## **IPS / POSTER — 20**

### THE ANALYSIS OF NORMAL FIELDS WITH THE HUMPHREY STATPAC

Aiko Iwase, Hisayuki Shirai, Tadayoshi Ido, Umeji Shimizu and Yoshiaki Kitazawa, Department of Ophthalmology, Gifu University, Japan

The Humphrey Field Analyzer's statistical package (STATPAC) gives the global indices similar to Octopus 201. The indices are presented with the probability than any given value is seen in normal subjects.

We attempted to evaluate the validity of the probability figures of the STATPAC. One hundred thirty clinically normal eyes (100 consecutive subjects) had their visual fields tested with a Humphrea Field Analyzer (program 30-2). The incidence of global indices that are unlikely to be normal with the probability of one out of twenty ranged from 1.5 to 3.1% and no eyes had any global indices that are unlikely to be normal with the chance of one out of one hundred. The mean and the distribution of each index were as follows: mean deviation: -0.40 dB and 96.2% of eyes were within  $\pm 2.5$  dB, short term fluctuation: 1.34 dB and 99.2% of eyes were within  $\pm 0 - 2.5$  dB, pattern standard deviation: 1.96 dB and 96.9% were within  $0 - 3$  dB, corrected pattern standard deviation: 1.14 dB on the average with an apparently bimodal distribution.

## **IPS / POSTER — 21**

### CLINICAL EXPERIENCE WITH THE BEBIE-CURVE

H. Kaufmann and J. Flammer

A visual field can have diffuse and local changes.

In the absence of local defects, diffuse damage can easily be recognized with the help of the visual field indices.

In the presence of scotomas, diffuse damage in the remaining better or "normal" part of the retina is more difficult to recognize and quantify.

Bebié et al published a new method to present the outcome of a visual field in relation to the normal values. They represented the results with the help of a cumulative defect curve, a method which we called the "Bebié-curve". This method allows an easy recognition of diffuse as well as local damage. This study evaluates the clinical application of the Bebié-curve in different diseases and for the follow up of the visual fields.

THE INFLUENCE OF FEED-BACK DEVICES, LEARNING AND CHEATING ON  
THE RESULTS OF HIGH-PASS RESOLUTION PERIMETRY.

Lene Martin-Boglund and Peter Wanger,  
Sabbatsberg Hospital, Stockholm, Sweden.

The recently developed computerized acuity perimetry, using high-pass filtered stimuli, has been reported to be of value in glaucoma diagnosis. The intra- and interindividual variability creates practical problems in the evaluation of results from computerized perimetry. In high-pass resolution perimetry (HRP) the variability was reported to be rather low. This may be due to the properties of the high-pass stimulus or an effect of the feed-back devices in the HRP system.

In the current study, normal subjects were examined with and without the feed-back devices. No difference in the examination results was found. However, all subjects preferred the examination, which included feed-back routines.

Serial HRP examinations were performed in normal subjects.

A small learning effect was observed.

Subjects with experience and knowledge about perimetric principles were requested to try to deceive the system by not maintaining stable fixation and actively scanning the screen for the stimulus. The examination results deteriorated slightly but not to pathological level. The fixation control, consisting of periodic presentation of a suprathreshold stimulus in the blind spot, did not reliably detect this "cheating strategy".

In the studied aspects, the HRP system seems adequate for clinical use.

A NEW PERIMETRY BASED ON EYE MOVEMENT

S. Nagata and K. Kani

Dept. of Ophthalmology, Shiga University of Medical Science,  
Otsu

Due to the difficulty of maintaining eye fixation during the assessment of visual fields, we developed a new method of perimetry utilizing eye movements to the target. A test target is displayed on a screen by computer, and the subject's eye movements are monitored through measurement of the corneal reflex. When eye movement to the target occurs, the computer recognizes it as a visual response and displays a new target.

## **IPS / POSTER — 24**

### **MAXIMUM LIKELIHOOD ESTIMATION OF THE FREQUENCY OF FALSE POSITIVE AND FALSE NEGATIVE ANSWERS FROM THE UP-AND-DOWN STAIRCASES OF COMPUTERIZED PERIMETRY**

Jonny Olsson, Holger Rootzén and Anders Heijl, Dept. of Mathematical Statistics and Dept. of Ophthalmology in Malmö, University of Lund, Sweden

Knowledge of the frequency of false positive and false negative answers facilitates the interpretation of computerized visual fields. These parameters are usually estimated by catch trials.

We have devised and investigated a new method where the frequencies of false answers are estimated by maximum likelihood. It utilizes all data in the up-and-down staircases of the threshold determination sequences. The results achieved with this new method have been compared with those of the conventional method, theoretically, in simulations and using data from actual normal and abnormal visual fields.

The method may be used alone or in combination with results obtained from catch trials, making it possible to save time or increase precision.

## **IPS / POSTER — 25**

### **KRAKEN: A COMPUTER SIMULATION PROGRAM FOR STATIC, KINETIC, SUPRATHRESHOLD STATIC AND HEURISTIC PERIMETRY**

Lionel R. Shapiro, Chris A. Johnson and Richard L. Kennedy  
Department of Ophthalmology, University of California, Davis

**KRAKEN** is a computer simulation model of visual field testing designed to evaluate perimetric test strategies, patient response characteristics and their interactions. In its most recent form, it has been written in Turbo Pascal for operation on an IBM PC/AT-compatible computer with an EGA color monitor. **KRAKEN** consists of a "patient" module and a "perimeter" module. The "patient" is a stochastic system that includes a high resolution visual field sensitivity surface (selected from a database of more than 1,000 normal, glaucoma, neuro-op and retina patient visual fields) and a variety of response characteristics (reaction time, fluctuation, fatigue, errors, etc.). The "perimeter" module includes a collection of device characteristics (target presentation pattern, test strategy, decision rules, etc.) that can be adjusted to emulate existing automated visual field procedures, or to provide new custom-designed devices and test strategies. The "patient" and "perimeter" modules communicate through a software interface designed to emulate the visual field testing process, and a multi-window color graphics display provides on-line information about test parameters, visual field characteristics and sequential progress of the test procedure. **KRAKEN** has been used to evaluate the accuracy, efficiency and reliability of existing test strategies, interactions among test parameters and patient response characteristics, and related topics. It is now being used for the development of heuristic test procedures and perimetry "expert systems". A hands-on demonstration will be provided at the meeting.

**RETINAL SENSITIVITY OF THE MACULA WITHIN 6 DEGREES OF CIRCLES FROM THE FOVEA IN DIABETIC RETINOPATHY**

Masaaki Tomonaga and Yasuo Ohta  
Department of Ophthalmology, Tokyo Medical College,  
Tokyo, Japan

We measured quantitative static visual fields at 25 points in the macular area and on circles delineated from the fovea at 2, 4 and 6 degrees in normal subjects and patients with diabetic retinopathy using a Fundus Photo-perimeter.

White stimuli with 6 degrees and 5 minutes and 10 asb background luminance were used in this study.

When the distribution of retinal sensitivities in the macular area and on circles delineated from the fovea at 2, 4 and 6 degrees was compared between normal subjects and patients with diabetic retinopathy, there were statistically significant differences in addition to very interesting findings.

**COMPUTERIZED VISUAL FIELD ANALYSIS**

Stürmer J., Vollrath-Junger Ch., Lauterbach K., and Gloor B.  
Eye Department, University of Zürich (Head: Prof. Dr. B. Gloor)

A decision algorithm as an aid for localisation of visual field defects is presented. This will be the basis of a computerised analysis of visual field results gained by static or even kinetic perimetry. The aim is a program leading the user to the clinical localisation of the underlying lesion by simple yes/no questions. Finally, the visual field data obtained by means of a computerised static perimeter will be directly transferred to this program permitting the localisation of the lesion within the visual pathways.

REGRESSION TECHNIQUES IN THE ANALYSIS OF VISUAL FIELD LOSS

J.M. Wild, M. Dengler - Harles. Department of Vision Sciences, Aston University, Birmingham B4 7ET, U.K. M.K. Hussey, Information Management Division, Management Centre, Aston University, Birmingham B4 7ET, U.K. S. J. Crews, Retina Department, Birmingham and Midland Eye Hospital, Birmingham B3 2NS, U.K.

Inter - and intra - subject variability between and within perimetric examinations limits the accuracy with which both early field loss and small changes in loss can be evaluated, particularly when the interpretation utilises normative age - matched values of sensitivity for comparative purposes.

Using clinical data obtained from central field examinations with the Octopus 201 and Humphrey 630 perimeters and data from computer simulations, the study investigated the suitability of two novel and distinctly different approaches to visual field analysis. Based upon regression techniques and with limited resource to normative data, both methods primarily place the emphasis on the individual patient as the control.

Time series analysis evaluates the regression of sensitivity between any two examinations of a given patient at each individual test location; with the use of outlier theory, the technique provides an indication of abnormality, especially when used in conjunction with suitable estimates of the short term fluctuation in sensitivity at each location. Snap shot regression analysis evaluates the departure of sensitivity at each location from the best fit polynomial regression equation of an individual field.

CHROMATIC FLICKER DEFICITS IN GLAUCOMA PATIENTS AND SUSPECTS

Edward Brussell, Myriam Muermans, Donna Krasowski, and \*Gordon Balazsi  
Concordia University, and \*McGill University, Montreal, Quebec.

There is a growing body of evidence that losses in the ability to detect luminance flicker are an early symptom of glaucoma. However, it is probable that data from these studies only reflected the operation of those optic nerve fibres that do not respond to pure colour changes. In order to determine whether temporal sensitivity loss in chromatic fibers is also an early symptom of glaucoma, sensitivity to pure colour flicker, as well as to luminance flicker, was assessed at 1, 2, 5, 10, and 15 Hz. Early glaucoma patients, ocular hypertensives (OHT) and age categorized controls were tested, all of whom scored within the normal range on the FM-100.

In the experimental conditions, equiluminant chromatic flicker between yellow and blue (tritanopic confusion line through D65) or red and green (deuteranopic confusion line through D65) was implemented after the use of heterochromatic flicker photometry. In the control condition, the luminance of the 2 deg diameter test field, set to the same white (D65) as the 15 X 9 deg surround, was flickered around the mean luminance level of the surround (40 td viewed through a 3 mm artificial pupil). In no condition did the data reveal differences between the patient- and OHT-groups. However, both the patient- and OHT-groups exhibited lower sensitivities than the control group at all frequencies in the yellow-blue, and luminance flicker conditions, but not in the red-green condition. These findings confirm the prevalence of yellow-blue, as opposed to red-green deficits in glaucoma, and imply that both chromatic and luminance flicker deficits are early symptoms of glaucoma.



**CLINICAL IMPORTANCE OF SPATIAL SUMMATION IN GLAUCOMA**

R Fellman, J Lynn, R Starita, Glaucoma Assoc's. of Texas, Dallas

Goldmann showed the equivalence of a ten-fold change in stimulus intensity and a sixteen-fold change in test object area during kinetic perimetry. Sloan showed the larger area has even less stimulus value as eccentricity from fixation decreases. Using static automated perimetry in eyes with advanced glaucoma, the authors have repeatedly observed an improvement of perimetric threshold which far exceeded the predicted 6 to 10 dB when test object size III was changed to size V (.43° diameter to 1.72° diameter). It appears that small spot sizes are needed to find defects and large spot sizes are needed to find residual function for clinical follow-up in otherwise blind zones.

Twenty glaucoma patients with significant field defects and ten normals were thresholded with size III and size V test objects using a background of 31.5 asb. The test was repeated later with test size III on a background of 3.2 asb. In an attempt to learn the mechanism for the large disparity between spot size thresholds, two loci which exhibited the greatest difference in the fields using 31.5 asb were thresholded with 18 size III spots corresponding to the same area occupied by the size V spot. Thus, spatial summation, background luminance, and other mechanisms were studied with regard to eccentricity from fixation and depth of defect in glaucomatous as well as normal eyes.

**THE SIGNIFICANCE OF PERIPHERAL SUPRATHRESHOLD MEASUREMENTS IN THE OCTOPUS PROGRAM G1**A.L. Haas<sup>°</sup>, R.P. leBlanc<sup>\*</sup> and U.C. Schneider<sup>°</sup>; Departments of Ophthalmology, <sup>°</sup>Berne, Switzerland / <sup>\*</sup>Halifax, Canada

The G1 program has become the most frequently used program on the Octopus. In a recent study on the peripheral visual field in early glaucoma, we found that 12% of the patients had an abnormal peripheral visual field but a normal central field. Since the G1 program measures 14 peripheral points semiquantitatively we wanted to know the significance of defects reported in these points. We compared the results of semiquantitatively measured peripheral points in the G1 program with the results of quantitatively measured points at similar locations in the Sargon program PH. We created a new index  $ND_{G1}$  based on the semiquantitative measurements of the G1 program. 77% of the subjects with an abnormal mean defect as measured in the PH program had a normal  $ND_{G1}$ . These results show that it is important to measure the peripheral visual field quantitatively in doubtful cases.

THE NASAL STEP IN GLAUCOMATOUS VISUAL FIELDS

A. Jenni, University Eye Clinic, Bern, Switzerland

The Octopus G1 examination program calculates various indices which the ophthalmologist can use in the evaluation of visual fields. In order to ascertain whether the nasal step could provide a further index for the early detection of glaucoma, the sensitivity distribution in the nasal region was evaluated in a large pool of data from normal and from pathological visual fields which had been examined with the G1 program. The questions posed were: can a nasal step be detected in the data out to an eccentricity of 26 degrees? Does this, if present, represent increased information or are the existing indices already sufficiently influenced by such steps so that an additional index is unnecessary?

In normal visual fields, a weak, normally distributed nasal step could be measured which provided a normal range for the present study. When compared with this normal value, approximately 20% of the glaucomatous visual fields exhibited a significantly increased nasal step. The amount of information gained in comparison with the existing visual field indices will be discussed.

ACUTE REDUCTION OF IOP IN OCULAR HYPERTENSIVE PATIENTS.

A.C. Farinelli, F.S. Mikelberg, S.M. Drance, G.R. Douglas, M. Schulzer, K. Wijsman. U. of British Columbia, Vancouver, Canada

We studied the effect of acute medical reduction of intraocular pressure in ocular hypertensive patients. Fifteen patients with intraocular pressure of 20 mm Hg or more, normal optic discs, and normal visual fields were studied. Each patient had an Octopus G1 field recorded, a Farnsworth Munsell 100 hue test, laser interferometry, applanation tonometry, and automated optic disc analysis. The measurements were repeated sixty minutes after the patient received oral glycerol. Regression analysis of change in intraocular pressure to the corresponding change in each of the covariates was performed for both absolute as well as proportionate change from baseline. As intraocular pressure decreased the colour score increased indicating a slight deterioration in performance with reduction of intraocular pressure,  $p=0.02976$ . As intraocular pressure decreased the mid range contrast sensitivity was reduced at 3 and 7.5 cycles per degree grating,  $p=0.0748$  and  $0.0507$  respectively. There were no statistically significant relationships noted between intraocular pressure change and visual field status or optic disc parameters. Although our study did not show any significant improvement in psychophysical or anatomical parameters in patients with elevated intraocular pressure following acute pressure reduction, it is possible that such changes may occur with chronic decrease in intraocular pressure.

**CONTRAST SENSITIVITY, VISUAL FIELD DEFECT AND RETINAL NERVE FIBER DEFECT  
IN GLAUCOMA**

KUNIYOSHI MIZOKAMI, TOSHIMICHI ASAI

School of Medicine, Kobe University, Ophthalmology, KOBE, JAPAN

We examined central contrast sensitivity in 100 eyes of 61 cases with primary open angle glaucoma. These cases were early to middle stage glaucoma and better than 20/20 visual acuity. The measurement of contrast sensitivity function was carried out by a modified TV-display system.

The value of contrast sensitivity deficiency was not correlated with the visual field defect measured by OCTOPUS automatic perimeter. Positive correlation was present between contrast sensitivity deficit and papillomacular nerve fiber atrophic appearance. These results suggest that the central visual functions are often affected by nerve fiber damage even in early glaucoma despite 20/20 vision. In detecting central visual defects in glaucoma the measurement of contrast sensitivity was more useful than quantitative perimetry.

**STRATEGIES FOR THE INTERPRETATION OF THE NASAL SUPRATHRESHOLD  
POINTS OF THE OCTOPUS G1 PROGRAM**

A. Orr, MD., M. Rubilowicz, MD., R. LeBlanc, MD., C. Seamone, MD., C. Mann, MD.

Department of Ophthalmology, Dalhousie University, Halifax, Nova Scotia, Canada

The nasal peripheral visual field of one eye each from eighty-one patients in four categories (normals; low- and high-risk ocular hypertensives; early glaucoma) was assessed using the nasal qualitative (suprathreshold) points of the Octopus G1 program and a quantitative Sargon test program PFN. Simple algorithms were developed to generate from the nasal qualitative points of the G1 two "pseudo-indices" MD-Q (mean defect - qualitative) and LV-Q (loss variance - qualitative). These are analogous to the indices MD (mean defect) and LV (loss variance), respectively, which were calculated from the PFN program data. We found that MD-Q and LV-Q are well-correlated with their quantitative counterparts, and that they can distinguish glaucomatous visual dysfunction. They may thus help to provide a more uniform method for the interpretation of the nasal suprathreshold points of the G1 program and identify patients in whom further testing with the quantitative nasal program PFN is likely to yield useful information.

THE VALUE OF INDICES IN THE CENTRAL AND PERIPHERAL VISUAL FIELD  
IN THE DETECTION OF GLAUCOMA

C. Seamone, MD., R. LeBlanc, MD., C. Mann, MD., M. Rubillowicz, MD., A. Orr, MD.  
Department of Ophthalmology, Dalhousie University, Halifax, Nova Scotia, Canada

We assessed eighty-one patients in four categories: twenty-one normals; twenty each of low-risk ocular hypertensives, high-risk ocular hypertensives and early glaucoma. All subjects were tested with the standard Octopus G1 central visual field program in addition to two quantitative Sargon programs PFN and PFT designed for this study to test the nasal and temporal periphery, respectively. Indices were calculated for each program for each subject in all groups. The behaviour of the indices across the separate visual field areas within each group was then examined, as was the effectiveness of the peripheral field tests in discovering extra subjects with visual field dysfunction not detected by central (G1) field examination alone. We found that quantitative testing of the peripheral nasal visual field provides valuable information in the detection of glaucomatous visual dysfunction *additional* to that provided by quantitative testing of the central visual field. The value of the temporal periphery was less obvious.

THE TRANSFORMED Q-STATISTIC IN GLAUCOMA AND  
OCULAR HYPERTENSION

A. Pearson, T.J. Smith, Glaucoma Service  
Department of Ophthalmology University of Kentucky  
Lexington, KY

Brechner and Whalen have suggested that the transformed Q-statistic, a calculation based on third moment calculations, may be useful in the early detection of glaucoma defects. From our early experience in the use of this statistic and based on theoretical considerations, we questioned its value in the interpretation of automated visual field data. We therefore analyzed the visual fields of 30 glaucoma suspects and 15 patients with established chronic open angle glaucoma (OAG).

All visual fields were performed on the Octopus 2000R perimeter using Program 32 and target size III. Visual fields were downloaded to an 8088-based microcomputer and the visual field indices mean defect (MD), corrected loss variance (CLV) and transformed Q were performed by Lotus 123 using the formula of Flammer, Brechner and Whalen.

Our analysis showed: 1) No correlation between transformed Q and MD ( $r = -.23$ ,  $p = 0.12$ ,  $n = 48$ ) or CLV ( $r = 0.17$ ,  $p = 0.23$ ,  $n = 48$ ). 2) In our glaucoma patients population, all of whose visual fields were abnormal, only 1 of 30 visual fields were judged as abnormal based on the transformed Q criteria of Brechner and Whalen. 3) In the glaucoma suspect population, the incidence of abnormal Q values increased as the field was judged more normal by MD and CLV criteria. Upon repeat testing, positive Q values were not found to be predictive for increasing abnormality on MD or CLV criteria, and could not predict subsequent Q abnormality.

We conclude that the transformed Q is of little or no use in the analysis of visual fields.

PERIPHERAL VS. CENTRAL CONFIRMATORY TESTING

R. Zamber and R. P. Mills, M.D.  
University of Washington  
Seattle, Washington U.S.A.

Additional visual field testing is often required to confirm defects found on central threshold testing. We tested 97 patients with a Humphrey 30-2 threshold test in both eyes, using a peripheral screening 68 point (P-68) test in one randomly assigned eye and a 24-2 threshold test in the other eye as additional tests. Criteria were assigned for 10 visual field defect types according to two levels of diagnostic confidence and each field chart was graded independently.

The 30-2 test revealed a defect in one eye consistent with the suspected clinical diagnosis in 80% which was generally confirmed by the P-68 61% of the time. In the other eye, with additional testing by the 24-2 test, the percentages were respectively 89% and 77%. All visual field defect types except focal peripheral depression, generalized nasal depression, or hemianopias were confirmed more often by repeat central threshold testing (24-2) than by the P-68 test. It is recommended that the choice of peripheral vs. central confirmatory testing should be made on an individual basis after the 30-2 test results have been obtained.

THE CORRELATION BETWEEN NEURORETINAL RIM AND VISUAL FIELD INDICES

K. Wijsman, M. Schulzer, S.M. Drance and G.R. Douglas  
U. of British Columbia, Vancouver, Canada

Previous studies have shown the correlation between the neuroretinal rim area and various psychophysical functions. The relationship however only accounted for 30-40% of the variability of the neuro-retinal rim area. In this study an attempt will be made to relate the visual field indices MD and CLV with the neuroretinal rim area but with localized change in the neuroretinal rim added as a parameter in 76 glaucomatous eyes. The correlation should be greatly improved as a result of the inclusion of the parameters of localized damage to the neuroretinal rim area. The clinical implications of the findings will be discussed.

## **IPS / POSTER — 40**

### **MULTI-FLASH CAMPIMETRY AND OPTIC NERVE STRUCTURE IN EARLY CHRONIC OPEN ANGLE GLAUCOMA**

Jocelyn Faubert\*+, A.Gordon Balazsi\*, Myriam Muermans+  
Edward M. Brussell+, and Oscar Kasner\*

+ Department of Psychology, Concordia University

\* Department of Ophthalmology, McGill University  
Montreal, Quebec, Canada

Multi-Flash Campimetry (MFC) is a perimetric technique developed in our laboratory which measures the temporal resolving power of the central field up to 20 degrees of eccentricity. As in static computerized perimetry, numerical indices measure localized and diffuse losses of temporal sensitivity (IPS 1986). MFC testing is significantly abnormal in eyes with very early chronic open angle glaucoma (COAG), and in glaucoma suspect (GS) eyes with normal Gl Octopus fields (IPS 1986). It is not known whether abnormalities of temporal vision in glaucoma reflect early optic neuropathy. We studied 30 eyes of 30 subjects in 3 age-matched groups: COAG, GS, and Controls. The neuro-retinal rim area corrected for the magnification induced by the optical components of the eye (cNRA) was also calculated (Balazsi et al, 1984). Both the MFC and cNRA were significantly different across the 3 groups. Correlation was obtained between the cNRA and the MFC. This relationship suggests that defects in temporal resolving power in early COAG reflect true structural changes of the optic nerve head as opposed to a pressure-induced dysfunction.

## **IPS / POSTER — 41**

### **PERIPHERAL DISPLACEMENT THRESHOLDS IN GLAUCOMA AND OCULAR HYPERTENSION**

FITZKE FW, POINOOSAWMY D, NAGASUBRAMANIAN S, HITCHINGS RA,  
Institute of Ophthalmology, LONDON WC1H 9QS, U.K.

A significant number of ganglion cells may be affected in glaucomatous eyes before any abnormality can be detected in conventional perimetry. We showed at the previous IPS meeting that measurements of peripheral displacement thresholds (P.D.T.) provide a sensitive measure of ganglion cell mediated function throughout the visual field which may provide an earlier indication of loss of visual function.

A prospective study was carried out to establish the effectiveness of P.D.T. measurements as a routine diagnostic procedure. We looked at changes in P.D.T. in a group of 60 patients with glaucoma or ocular hypertension who were randomly allocated to topical treatment with either Timolol or Pilocarpine and followed for at least 12 months.

The parameters were examined before and during treatment at 3 monthly intervals. In addition to P.D.T. we also checked visual acuity, intraocular pressures, Humphrey visual fields, colour vision, contrast sensitivity, pupil size, disc and nerve fiber layer appearance. The results will be presented and discussed.

**RATE OF PROGRESSION OF DISCRETE AREAS OF THE VISUAL FIELD**  
H. Dunbar Hoskins, MD, San Francisco, CA; Nancy Jensvold,  
MPH, San Francisco, CA

Recent studies have shown that analysis of discrete portions of the visual field, rather than the entire field, may be more useful in the management of glaucoma. The theory investigated in the current study was that different areas of the visual field progress at different rates.

Nineteen glaucoma patients were selected from a glaucoma referral practice in San Francisco. Each patient had at least five visual fields performed using the Humphrey Field Analyzer program 30-2 and met minimum requirements for visual acuity, pupil size, reliability indices, and fixation losses. If both eyes of a given patient met these requirements, one eye was randomly selected for analysis.

For each eye, 48 clusters of four points each were identified for analysis. Regression analysis was used to analyze the progression of these 48 areas through the five fields. The variability of the slopes of the resulting regression lines was examined using graphical means. Preliminary findings indicate that different areas of the visual field progress at different rates.

**IMPROVEMENT OF THE VISUAL FIELD FOLLOWING REATTACHMENT OF RHEGMATOGENOUS RETINAL DETACHMENT**

Isashiki, M., Nakashima, Y., Nagasako, F., and Ohba, N.

Department of Ophthalmology, Kagoshima University Faculty of Medicine, Usuki-cho 1208-1, Kagoshima-shi, Japan (890)

The visual field of patients with rhegmatogenous retinal detachment due to equatorial retinal break was studied by means of the Octopus automated perimeter in a consecutive manner before and after surgical reattachment of the retina for up to one year. A marked improvement of differential visual sensitivity occurred within the first month following anatomical recovery, the degree depending upon many factors including the duration of retinal detachment. A noticeably greater improvement was found to occur in the inferior visual field in many cases whose retinal detachment had been widespread and remained for a comparable period of time in the superior and inferior retina.

## **IPS / POSTER — 44**

### **DETERMINATION OF THE GLAUCOMA STAGE BY AUTOMATED PERIMETRY -- DETECTION OF ABNORMALITIES IN THE KEYHOLE AREAS --**

Hiroshi Kosaki, Kazuko Tsukamoto, Teruko Iida,  
Hajime Nakatani, and Hirotsugu Kiboshi (Osaka)

Purpose: The purpose of the study was to determine the stage of glaucoma by static perimetry in a limited area, and to show the value of automated perimeters in practice.

Method and results: Part I: Six hundred eyes with primary open angle glaucoma (POAG) were explored for any abnormalities in the "keyhole area" (i.e. Bjerrum's area and along the horizontal nasal meridian) and any defect on the circumference at the 40° on Goldmann's kinetic field, and classified according to Kosaki's Classification (presented in the IPS Symposium in 1976). The incidence of abnormalities at 6 sites in the keyhole area and the distribution of abnormalities at these 6 sites differed significantly between stages. The range of defects on the circumference at 40° differed significantly between stages IIIa, IIIb and IV.

Part II: Threshold values were determined in the keyhole area and on the circumference at 40° in 150 of these 600 eyes, using 3 custom programs for the Humphrey Field Analyzer 630. The results were compared with those of kinetic perimetry to evaluate the reproducibility of the static perimetry. Abnormalities at each site of the keyhole area became more and more consistent between the two methods as the stages advanced, and the mean figure for consistency was 82.8%. The corresponding figure for defects on the circumference at 40° was 81.7%, and the highest figure was at Stage IV.

Conclusion: Automated perimetry for the keyhole area and on the circumference at 40°, a part of the visual field, was shown to be useful for determining the stage of glaucoma. A new program for the Humphrey Field Analyzer 630, which was developed for this purpose, will be presented.

## **IPS / POSTER — 45**

### **ESTIMATION OF OPTIC NERVE FIBER LOSS FROM COMPUTER-ASSISTED QUANTIFICATION OF VISUAL FIELDS**

Lambrou G.W., Schalk Ph., van den Berg T.J.T.P., Langerhorst C.T., Greve E.L.  
-Eye Clinic of the University of Amsterdam, The Netherlands  
-Clinique Ophtalmologique Universitaire de Strasbourg, France

Concerning the relationship between structural and functional alterations in glaucoma, a mathematical model based on retinal receptive field topography has previously been proposed, relating visual field impairment to optic nerve fiber loss. This model has been used in the present study to estimate from their visual fields the fiber loss in 10 healthy controls, 10 ocular hypertensives and 31 glaucomatous patients subdivided into 3 groups according to IOP-level. Visual field examinations were carried on the Scoperimeter and each consisted of two independent threshold measurements at 60 points in the central 25°. To estimate long-term fluctuations five or more visual field examinations were performed on every eye in the study. The appearance of the optic disk was noted on every visit.

By means of the forementioned model, the fractions of (a) lost and (b) functionally impaired optic nerve fibers are estimated for each eye, from the defect volume and long-term fluctuation respectively. These fractions are then compared to the structural alterations of the disk.

The theoretical basis and validity of the model are finally discussed and suggestions are made for its improvement.



THE ABILITY OF SEQUENTIAL FORM RECOGNITION IN OCULAR HYPERTENSION

Yuji Miyashita, Kimio Matsuda, Ikuo Azuma (Osaka Medical College)  
Masaaki Ohkura (Korean Women's College)

Ocular hypertension is defined as intraocular pressure higher than 21 mmHg without glaucomatous changes in visual fields. However, a recent investigation proved that patients with ocular hypertension tended to reveal abnormal decrease of sensitivity in visual fields by an automatic perimeter. Moreover the decreased amplitude in pattern ERG test and the decreased contrast sensitivity in ocular hypertension suggested a dysfunction of the Y-ganglion cell system.

We tried to evaluate the function the function of Y-ganglion cell system in ocular hypertension with the following method: a computer software was developed to present forms sequentially on CRT display by exposing them in piece-meal fashion through an aperture that was smaller than the whole pattern. Using this system, we measured the time required for recognizing the form and the optimal frequency that enabled the highest correct recognition between normal controls and ocular hypertensives.

As the results we obtained strong confidence that this system was a potent method to detect the dysfunction of Y-ganglion cell system in ocular hypertension. Further study will be able to produce the software system designed for the automatic perimeter. The details of the system will be discussed.

EFFECTS OF ORAL ACETAZOLAMIDE ON GLAUCOMATOUS VISUAL FIELD CHANGES

Tetsuro OGAWA, Takahisa NONAKA, Fumio FURUNO & Harutake MATSUO  
Department of Ophthalmology Tokyo Medical College Tokyo, JAPAN

(Purpose)

It was reported that oral or intravenous injection of acetazolamide can improve glaucomatous visual field changes. We re-examined whether oral acetazolamide can improve the glaucomatous retinal function and if improved whether the effect is limited to the affected part or would cover all areas.

(Method)

Visual fields were measured twice in 12 eyes from 9 cases with established glaucoma by Octopus 31 Program. 750 mg. of acetazolamide was given orally in 3 divided doses from the previous day of the second measurement. The changes in thresholds by acetazolamide were calculated with respect to whole visual fields, the normal part of the field and the abnormal part of the field.

(Results)

A mean decrease of intraocular pressure of 6.8 mmHg occurred after administration of acetazolamide. There was no clear increase of sensitivity of the whole field. Scatter graph of the threshold changes before and after administration of acetazolamide revealed high increase of sensitivity at +3-7 dB from normal values and a decreasing tendency at other threshold levels.

**PERIMETRIC FOLLOW-UP OF SECONDARY CATARACT**

Gandolfo E, Sanfelici G, Corallo G, Zingirian M  
University Eye Clinic, Genoa (Italy)

The main complication of extracapsular cataract surgery is opacification of the posterior capsule (secondary cataract). In 25% of patients operated on with the extracapsular technique a posterior capsule discission is necessary within two years. Patient follow-up is normally based on periodic examinations of the visual acuity. In our opinion, this procedure must be supplemented by more accurate functional tests, with a precise evaluation of the central and paracentral sensitivity. A group of 78 patients was examined by automated perimetry every 6 months for a period of 3 years after surgery. We used the program 24-I of the Humphrey 630 perimeter and a static profile program with the automated Goldmann perimeter "Perikon", along the horizontal meridian. 18 subjects (23%) showed a sensitivity loss after 12 months and 28 (36%) after three years. 21 of these subjects underwent YAG-laser capsulotomy, followed by a restoration of the threshold values. Compared with the visual acuity assessment, perimetry permitted an earlier detection of the presence of a secondary cataract and a more precise identification of cases in which the visual function deterioration arose from optic nerve or retinal alterations. These results were obtained analyzing the shape of the static profiles and taking in account the behaviour of some perimetric indexes.