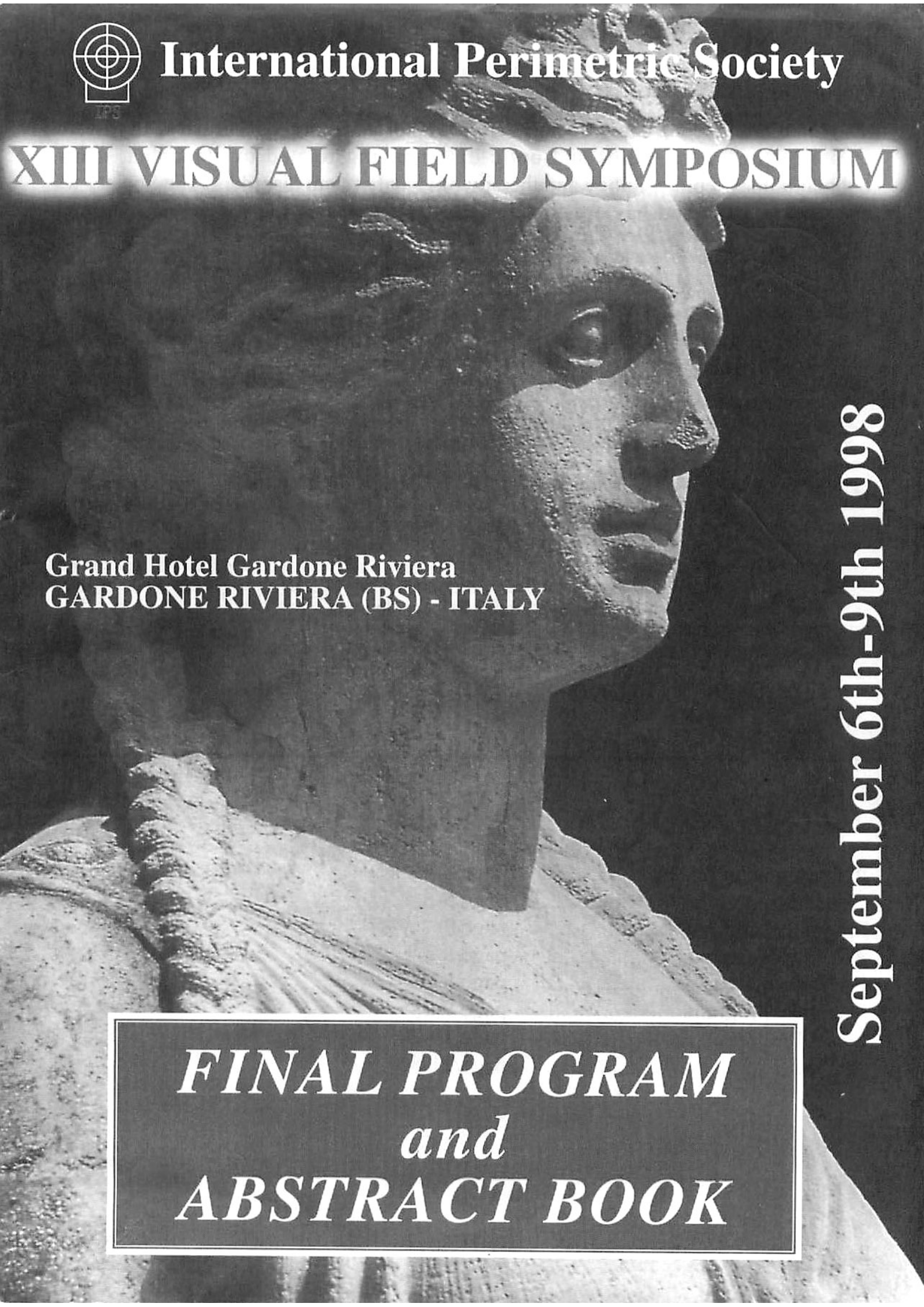

International Perimetric Society

XIII VISUAL FIELD SYMPOSIUM

Grand Hotel Gardone Riviera
GARDONE RIVIERA (BS) - ITALY

September 6th-9th 1998

FINAL PROGRAM and ABSTRACT BOOK

The VISUAL FIELD SYMPOSIA

The International Perimetric Society (IPS) is an organization concerned with research in perimetry, visual fields and optic disc imaging related to glaucoma, neuro-ophthalmology, epidemiology and therapy of visual system disorders. The Society was founded in 1974 and has organised biennal meetings in the following locations:

1974	MARSEILLES	(France)
1976	TÜBINGEN	(Germany)
1978	TOKYO	(Japan)
1980	BRISTOL	(UK)
1982	SACRAMENTO	(USA)
1984	S.MARGHERITA LIGURE	(Italy)
1986	AMSTERDAM	(The Netherlands)
1988	VANCOUVER	(Canada)
1990	MALMÖ	(Sweden)
1992	KYOTO	(Japan)
1994	WASHINGTON	(USA)
1996	WÜRZBURG	(Germany)
1998	GARDONE RIVIERA	(Italy)

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Social Program..... page 19-20
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INVITATION ADDRESS

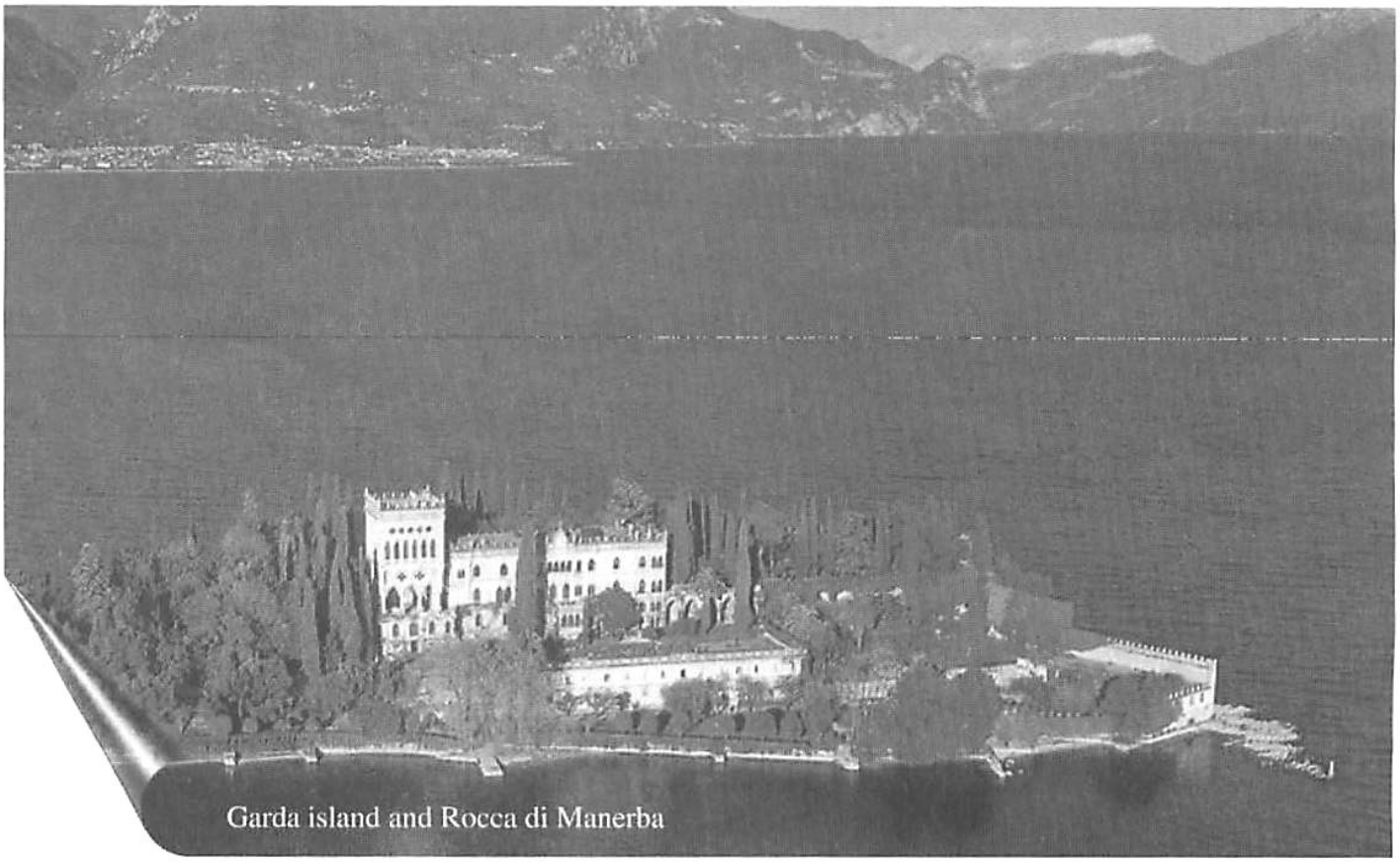
Dear Colleagues,

It is our great pleasure to invite you, on behalf of the Organising Committee, to the XIII International Perimetric Society (IPS) Meeting to be held in Gardone Riviera, Italy, from September 6th to 9th 1998. Scientific sessions are scheduled on Monday, Tuesday and Wednesday (September 7th, 8th and 9th). The social program begins on the evening of the arrival day, Sunday September 6th, 1998 and continues through the evening of Wednesday, September 9th, with the traditional IPS banquet. Thursday September 10th is the departure day; however, an optional excursion to Venice is planned. We expect the Meeting to continue the tradition of excellence established by the previous Visual Field Symposia and hope that you will be able to attend.

Yours sincerely,

Michael Wall, M.D.
IPS Secretary

John M. Wild, Ph.D.
IPS President



Garda island and Rocca di Manerba

Dear Colleagues,

As the local host of the XIII Meeting of the International Perimetric Society and on behalf of the Organising Committee, it is my great pleasure and honour to invite you to the forthcoming Symposium to be held in Gardone Riviera (Brescia - Italy) from 6th to 9th of September, 1998. Gardone Riviera offers a beautiful setting (Grand Hotel Congress Centre), situated a few steps from the shores of Lake Garda, close to places dear to the famous Italian poet Gabriele D'Annunzio and to many excellent hotels. Gardone Riviera is easily accessible by car (30 km from Brescia). The adjacent airports are Milan Malpensa and Milan Linate. From Milan it is possible to travel by train to Brescia (1 hour) and then by bus to Gardone Riviera (45 minutes) or by taxi (30 minutes). Other nearby airports are located in Verona (Villafranca) and Bergamo (Orio al Serio). Lake Garda is the largest and the most attractive lake in Italy; it is located in the north of the country and is characterised by a very mild climate. Many historical, artistic and natural sites are close by including Brescia, Verona, Venice, Milan, Turin, Genoa, Bologne, Florence, the Alps, the Dolomites, and the Northern Italian Lakes. The Closing Ceremony will be held in the Villa Alba which is steeped in an atmosphere of tranquillity, surrounded by a centuries-old park with the echoes of great celebrities and international aristocracies. The Villa is an impressive building in the Neoclassical style dating from the end of the last century, and has been recently restored to its original splendor. The scientific program and the social events will make your stay in Italy unforgettable. The Meeting offers an opportunity for an update in perimetry, glaucoma, neuro-ophthalmology and image analysis of the fundus together with an opportunity to experience the incomparable level of Italian cuisine and scenery in a friendly and warm atmosphere.

Sincerely yours,

Enrico Gandolfo M.D. - Local host
University Eye Clinic, Brescia (Iyaly)

Enrico Gandolfo

Organisation of the Meeting

Executive Committee of the International Perimetric Society

President	Prof. John M. Wild, Ph.D. UK
Vice President	Prof. Anders Heijl, M.D. Sweden Prof. Yoshiaki Kitazawa, M.D. Japan
Secretary	Prof. Michael Wall, M.D. USA
Treasurer	Prof. Fritz Dannheim, M.D. Germany

Honorary Members of the IPS

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Prof. Stephen Drance
Prof. Franz Fankhauser
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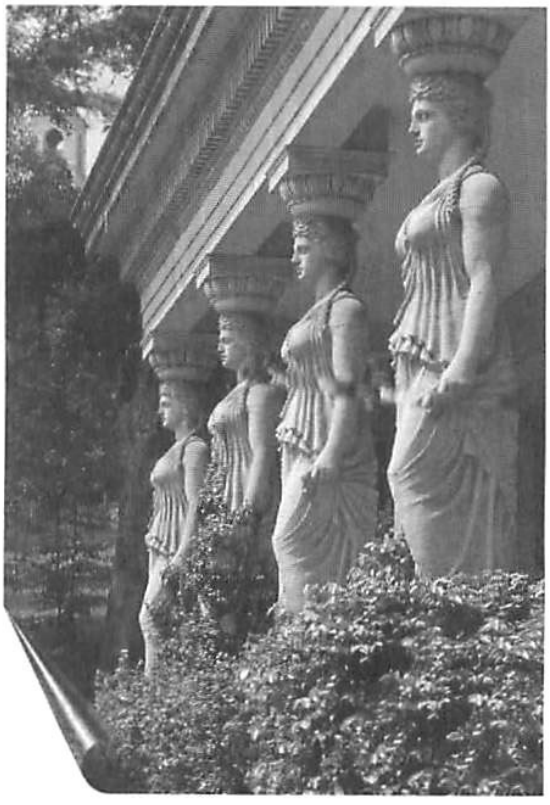
Prof. Hans Goldmann
Prof. Heinrich Harms
Prof. Haratuke Matsuo
Prof. Mario Zingirian

IPS web page

http:\\webeye.ophth.uiowa.edu/ips/



The Caryatidis of Villa Alba

ORGANIZING SECRETARIAT

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E-mail: medicina.viva@rsadvnet.it http://www.rsadvnet.it/medicinaviva

Organising Committee of the XIII IPS MEETING Gardone Riviera, Italy

Local host:
Prof. Enrico Gandolfo M.D.- Italy

Other committee members:
Prof. Mario Zingirian M.D.- Italy
Prof. John M. Wild Ph.D.- UK
Prof. Michael Wall M.D.- USA
Dr. Luciano Quaranta M.D.- Italy
Dr. Francesco Semeraro M.D.- Italy

Progam Committee of the XIII IPS MEETING Gardone Riviera, Italy

Prof. J.M. Wild Ph.D.- UK
Prof. M. Wall M.D.- USA
Prof. E. Gandolfo M.D.- Italy
Dr. P. Brusini M.D.- Italy
Prof. D.B. Henson Ph.D.- UK

The Gardone Riviera promenade

Working Group Chairperson

Standards:
Prof. E. Casson Ph.D.- Canada
Retina/Optic Disc:
Prof. R. Burk M.D.- Germany
Glaucoma:
Prof. J. Weber M.D.- Germany
Neuro-Ophthalmology:
Prof. A. Safran M.D.- Switzerland
Non-standard Perimetric Techniques:
Prof. W. Hart M.D.- USA
Data Acquisition and Analysis:
Prof. B. Chauhan Ph.D.- Canada
Visual Disability Evaluation:
Prof. M. Zulauf M.D.- Switzerland

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Prof. Y. Kitazawa M.D.- Japan
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Prof. F. Dannheim M.D.- Germany
Members at large:
Dr. P. Brusini M.D.- Italy
Prof. E. Gandolfo M.D.- Italy
Prof. A. Iwase M.D.- Japan
Prof. E. Werner M.D.- USA

SCIENTIFIC PROGRAM

SUNDAY, September 6

9:00 am to	1:00 pm	Board Meeting - Registration (Grand Hotel Gardone)
2:00 pm to	6:00 pm	Group Meetings - Registration (Grand Hotel Gardone)
8:00 pm to	10:00 pm	*Welcome Dinner (Grand Hotel Gardone)*

MONDAY, September 7

8:00 am to	1:00 pm	Registration
8:00 am to	8:30 am	Opening Ceremony
8:00 am to	10:30 am	**Scientific Session I - Fundamentals of Perimetry**
10:30 am to	11:30 am	Posters viewing- Coffee break - Technical Exhibition
11:30 am to	1:00 pm	**Scientific Session II - New Methods: Screening**
1:00 pm to	2:00 pm	Lunch
2:00 pm to	6:00 pm	Registration
2:00 pm to	3:30 pm	**Scientific Session III - Variability**
3:30 pm to	4:30 pm	Posters viewing - Coffee break - Technical Exhibition
4:30 pm to	5:30 pm	**Scientific Session IV - Psychophysics**
7:00 pm to	10:00 pm	*Lake Garda Boat Trip & Dinner*

TUESDAY, September 8

8:30 am to	1:00 pm	Registration
8:30 am to	10:00 am	**Scientific Session V - New Algorithms (SITA & TOPs)**
10:10 am to	10:30 am	Therapeutic advances: Clinical profile of highly-selective alpha-2 agonist - (C.E. Traverso)
10:30 am to	11:00 am	Posters viewing - Coffee break - Technical Exhibition
11:00 am to	1:00 pm	**Scientific Session VI - Optic Disc Imaging**
1:00 pm to	2:00 pm	Lunch
2:00 pm to	6:00 pm	Registration
2:00 pm to	3:30 pm	**Scientific Session VII-Retinal and Neurologic Disorders**
3:30 pm to	4:30 pm	Posters viewing - Coffee break - Technical Exhibition
4:30 pm to	5:45 pm	**Scientific Session VIII - Glaucoma**
6:30 pm to	11:00 pm	*Excursion Borgo Quercia, visit to wine vault & Dinner*

WEDNESDAY, September 9

8:00 am to	1:00 pm	Registration
8:30 am to	10:00 am	**Scientific Session IX - Perimetric Techniques**
10:00 am to	11:00 am	Posters viewing - Coffee break - Technical Exhibition
11:00 am to	12:45 pm	**Scientific Session X - Color Perimetry**
12:45 pm to	1:15 pm	Business Meeting
1.15 pm to	2:15 pm	Lunch
2:30 pm to	6:00 pm	*Excursion to romantic Verona*
8:00 pm to	11:00 pm	*IPS Banquet with traditional national singing (Villa Alba)*

THURSDAY, SEPTEMBER 10, DEPARTURE DAY
or ALL DAY EXCURSION TO VENICE

ACKNOWLEDGEMENTS

In support of the XIII International Perimetric Society Meetings, generous financial contributions have been made by the following corporations. The Organising Commitee is grateful for their generosity, helping to lower registration fees:

ALCON INTERNATIONAL

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We also thank the following companies to take part at the technical exhibition:

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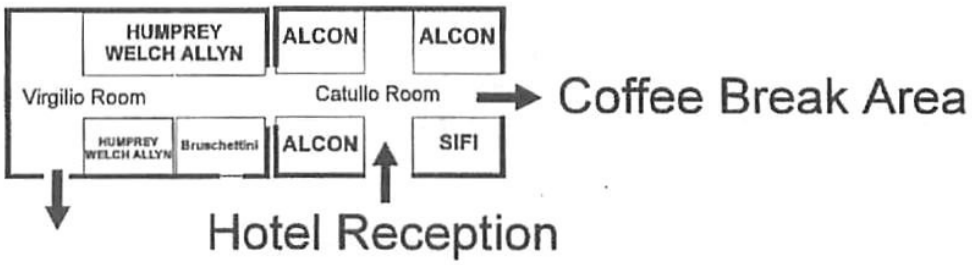
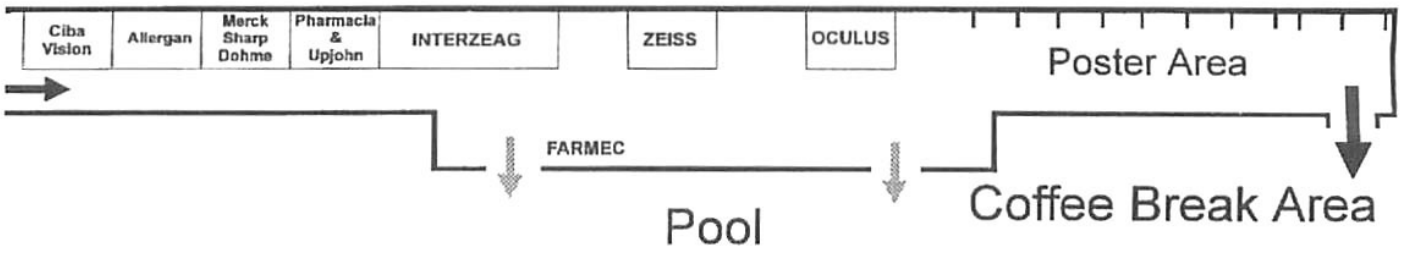
International Perimetric Society
XIII VISUAL FIELD SYMPOSIUM
Gardone Riviera (BS) Italy September 6-9, 1998

EXHIBITION AREA

GROUND FLOOR LEVEL



LAKE FLOOR LEVEL



MONDAY, September 7, 1998

8:00 am - 8:30 am **Opening Ceremony**
Michael Wall
Enrico Gandolfo

8:30 am - 10:30 am **Session I** **Fundamentals of Perimetry**
Chairperson **Dr. Lars Frisèn**
Moderator **Dr. Ronald Harwerth**

1 8:30 Age and Eccentricity Dependent Visual Field Changes in a Five-Year Prospective Study of Normals
Balwantray C. Chauhan and Terry A. McCormick

2 8:42 Age Influences Asymmetry in Retinal Sensitivity
T.J. Dietrich, N. Ata, A. Sanger, B. Selig, U. Schiefer and N. Benda

3 8:54 Age and Eccentricity Effects on Grating Detection and Grating Resolution Automated Perimetry
Shaban Demirel, Larry N. Thibos and Chris A. Johnson

4 8:58 Effect of Localized Refractive Error on Perimetric Thresholds for Different Sized Targets in Foveal and Peripheral Vision
D. R. McDowell, R.S. Anderson and F. Ennis

5 9:10 Suprathreshold Perimetry: Establishing the Test Level
David B. Henson, Paul H. Artes and Shaila J. Chaudry

6 9:22 The Effect on Perimetric Thresholds of using a Quadrant-Limited Seed Point Algorithm
Michael Wall

7 9:34 Driving Standards for Peripheral Vision: Time for a Review
E.J. Casson and L. Racette

8 9:46 Psychophysical Assessment of Visual Function in Glaucoma
C. O'Brien, P. Nelson, P. Aspinall, O. Papasouliotis and B. Worton

9 9:58 Clinical Implications of the Filling-in Phenomenon in Ophthalmological Practice
Avinoam B. Safran

11:30 am - 1:00 pm Session II New Methods: Screening

Chairperson Dr. Aiko Iwase, Dr. Peter Asman
Moderator Dr. Richard P. Mills

1 11:30 Evaluation of Two Screening Tests for Frequency Doubling Perimetry
Chris A. Johnson, George A. Cioffi and E. Michael Van Buskirk

2 11:42 Efficacy of Screening Modes of Frequency Doubling Technology and Dicon Perimeters
Rosita E. VanCoevorden, Richard P. Mills, Lan Wang and Derek C. Stanford

3 11:54 Frequency Doubling Perimetry as a Glaucoma Screener
Y. Kondo, K. Inazumi, T. Yamamoto and Y. Kitazawa

4 12:06 A Comparison of the Effects of Neutral Density and Diffusing Filters on Motion Detection Perimetry, White on White Luminance Perimetry and Frequency Doubling Perimetry
W.L. Membrey, S. Kogure and F.W. Fitzke

5 12:18 Automated Flicker Perimetry in Glaucoma and Retinal Detachment Patients
C. Matsumoto, S. Okuyama, A. Iwagaki, S. Takada and T. Otori

6 12:30 Simultaneous Pupil and Standard Perimetry
O. Bergamin, M. Zulauf, M. Schelling, A. Hagopian, A. Schotzau and Ph. Hendrickson

7 12:42 Virtual Reality and the Detection of Glaucomatous Field Loss: A Pilot Study
G. Richard Bennett, Elliot B. Werner and Lindsay Bennett

8 12:54 Polarized Light Perimetry (PLP) and Advanced Glaucoma
L. Palanza, L. Aleci, G. Magistro, B. Brogliatti, B.Boles Carenini

2:00 pm - 3:30 pm Session III Perimetric Variability

Chairperson Dr. Jörg Weber
Moderator Dr. Balwantray Chauhan

1 2:00 The Relationship Between Sensitivity and Variability in Normal and Glaucomatous Visual Fields
David B. Henson, Shaila J. Chaudry and Paul H. Artes

2 2:12 Sampling Discrete Ganglion Cell Mosaics Decreases Threshold Variability
P. Pearson, W.H. Swanson, R.L. Fellman, R.J. Starita and J. Lynn

3 2:16 Quantification of Glaucomatous Threshold Visual Field Loss Based on Neuromorphometric Correlates
Erkan Mutlukan

4 2:20 Test-Retest Reproducibility of Frequency Doubling Perimetry
S.A. Hancock, J.M. Wild and I.A. Cunliffe

5 2:24 Linear Regression Analysis in Glaucoma Visual Field Follow-up
Anders Heijl and Boel Bengtsson

6 2:36 Properties of Individual Progressing Visual Field Locations in Normal Tension Glaucoma
L. Quaranta, D.P. Crabb, F.W. Fitzke, R.A. Hitchings and E. Gandolfo

7 2:48 Detecting Gradual and Sudden Sensitivity Loss in series of Visual Fields
D.P. Crabb, F.W. Fitzke and R.A. Hitchings

7 3:00 Pointwise Linear Regression Criteria and the Detection of Change in Automated Visual Field Series
M.R. Wilkins, T. Lowe, A. Kotecha, R. Hitchings, P.T. Khaw and F. Fitzke

9 3:04 Pointwise Linear Regression of Glaucomatous Visual Fields: A New Approach
A.C. Viswanathan, F.W. Fitzke and R. A. Hitchings

10 3:08 The Rate of Visual Field Progression During Long Term of Follow up of Normal Tension Glaucoma Patients
D. Poinoosawmy, C. Bunce, W.L. Membrey and R.A. Hitchings

11 3:12 Ocular Stability During Static and Kinetic Fixation Perimetry
P. Asman, E. Rhemtulla, D. Bay, M. Eizenman, A. Hoeltje and J. Flanagan

12 3:16 The Evaluation of Fixation During Perimetry Using a New Fundus Perimeter
T. Murata, Y. Nishida, K. Yoshida, T. Iwami and K. Kani

13 3:20 Central Retinal Sensitivity with a Social Dose Alcohol Measured with Scanning Laser Ophthalmoscope
Fredrik Kallmark

4:30 pm - 5:30 pm **Session IV Psychophysics**

Chairperson Prof. Dr. Yoshiki Kitazawa
Moderator Dr. Evanne J. Casson

1 4:30 The Independence of Perimetry Thresholds
R.S. Harwerth and E.L. Smith, III

2 4:42 Detection and Resolution Thresholds in the Fovea and periphery for High-Pass Tumbling E's
R.S. Anderson, F. Ennis and D.R. McDowell

3 4:54 Tumbling E Resolution Perimetry Using Stationary and Flickering Targets: Separating M and P Cell Loss in Glaucoma
F. Ennis, R. S. Anderson and S.J.A. Rankin

4 5:06 Comparison Between Threshold Perimetry and Suprathreshold Perimetry in Pupil Perimetry
S. Okuyama, C. Matsumoto, A. Iwagaki and T. Otori

5 5:10 Binocular Summation Within the Binocular Visual Field
A. Wakayama, C. Matsumoto, A. Iwagaki and T. Otori

6 5:14 Abnormal Maximum Line Displacement Sensitivity & Frequency-of-seeing Curves for a Motion Stimulus in Glaucoma
M.C. Westcott, F.W. Fitzke and D. Poinoosawmy

7 5:26 Intensity Distribution Beneath an Artificial Vessel - Implications for Angioscotoma
C. Hofmann, U. Schieffer and E. Plies

TUESDAY, September 8, 1998

8:30 am - 10:00 am **Session V** **New Algorithms (SITA & TOPs)**
Chairperson **Prof. Mario Zingirian**
Moderator **Dr. Chris Johnson**

1 8:30 Sensitivity to Glaucomatous Visual Field Loss in Full Threshold SITA Standard, and SITA Fast Tests
Boel Bengtsson and Anders Heijl

2 8:34 The Characteristics of SITA Program on HFA
Aiko Iwase, Yuko Ohno, Reiko Shiraki, Satoko Tuji and Yoshiaki Kitazawa

3 8:46 The Swedish Interactive Thresholding Algorithm (SITA) in Patients with Prior Experience with the Full Threshold Humphrey Field Analyzer
Ivan Goldberg

4 8:58 Comparing SITA and Standard Threshold Strategies
P. Capris, G. Gatti, G. Corallo, S. Romiti, M. Zingirian and E. Gandolfo

5 9:10 Screening of Early Glaucomatous Visual Fields Using Swedish Interactive Thresholding Algorithms (SITA)
Yoshiaki Tanaka, Hidetaka Maeda and Satoshi Matsubara

6 9:14 Comparison of SITA and Dynamic Strategies with the Same Examination Grid
C.T. Langerhorst, L.L. Carenini, D. Bakker and M.A.C. de Bie-Raakman

7 9:18 Evaluation of Results of SITA and Full-Threshold Strategies in the Low Sensitive Areas
Yoko Aoki, Genichiro Takahasi, Takeshi Koike and Kenji Kitahara

8 9:22 Test Time and Efficiency of a New Static Threshold Algorithm in Glaucomatous Eyes
Hidetaka Maeda, Satohsi Matubara, Yoshiaki Tanaka and Makoto Nakamura

9 9:26 Intra-individual Inter-test Fluctuation by SITA-S and FASTPAC
Erkan Mutlukan

10 9:38 Comparative Evaluation of Four Strategies (Normal, 2 Level, Dynamic, Top) Using the Automated Perimeter Octopus 1-2-3
S. Takada, C. Matsumoto, S. Okuyama, A. Iwagaki and T. Otori

11 9:50 G1-top Program: Introduction and Comparison with G1-standard Bracketing
M. Gonzalez de la Rosa, M. Losada, M. Serrano and J. Morales

12 10:02 Reproducibility of the Top Algorithm Results Versus the Ones Obtained with the Bracketing Procedure
M. Gonzalez de la Rosa, A Martinez Pinero and M. Gonzalez Hernandez

13 10:06 Flicker-top Perimetry in Normal, Ocular Hypertensive and Early Glaucoma Patients
M.l Gonzalez de la Rosa, J. Rodriguez and M. Rodriguez

10:10 Therapeutic advances: Clinical profile of highly-selective alpha-2 agonist
C.E. Traverso

11:00 am - 1:00 pm Session VI Optic Disc Imaging

Chairperson Prof. Enrico Gandolfo
Moderator Dr. Reinhard Burk

1 11:00 Glaucomatous Optic Disc Border Depression Correlates with Visual Field CPSD in Primary Open Angle Glaucoma
R. O.W. Burk, Thomas U. Bartke, Klaus Rohrschneider and Hans Eberhard Volcker

2 11:12 Morphometric Parameters in Normal Tension and High Tension Glaucoma
M. Iester, F.S. Mikelberg, P. Courtright and S.M. Drance

3 11:24 Relationship Between Perimetric Light Sensitivity and Optic Disc Neuroretinal Rim Area
D.F. Garway-Heath, A. Viswanathan, M. Westcott, D. Kamal, F.W. Fitzke and R.A. Hitchings

4 11:36 Comparison Between Optic Nerve Head Topography and Resolution Visual Fields in Glaucoma Diagnosis
Lene Martin and Ulrika Gedda

5 11:40 May Retinal Nerve Fiber Layer be "Normal" in Primary Open Angle Glaucoma?
M. Marraffa, R. De Natale, R. Morbio, L. Tomazzoli and L. Bonomi

6 11:44 Measuring Eyes with Large Optic Discs Using Nerve Fiber Analyzer Gdx
Lan Wang, Padma Karyampudi, Philip P. Chen and Richard P. Mills

7 11:56 **Retinal Nerve Fiber Layer Thickness in Normal and Glaucoma**
H. Suzumura, K. Harasawa, A. Kobayashi, C. Matsumoto and N. Endo

8 12:08 High-Pass Resolution Neural Capacity and Retinal Nerve Fiber Layer Thickness in Glaucoma
Paolo Brusini, Patrizia Busatto and Claudia Tosoni

9 12:12 Is There a Proportion Between Visual Field Defects and Retinal Nerve Fibers Loss in Glaucoma?
M. Marraffa, G. Marchini, R. De Natale, R. Morbio, L. Tomazzoli and L. Bonomi

10 12:24 Association of Blue-on-yellow Visual Field with Optic Disc and Retinal Nerve Fiber Layer
P. Juhani Airaksinen and Pait Teesaulu

11 12:36 The Validity and Repeatability of Retinal Nerve Fibre Layer Thickness Measurements Determined by Optical Coherence Tomography
S.A. Hancock, J.M. Wild and I.A. Cunliffe

12 12:48 Correlation Between Optic Nerve Head Topographic Parameters and Visual Field Indexes: A Study in Normal and POAG Patients
C. Picardi, M. Bruschini, M. Verolino, P. Antinozzi, G. Pignalosa and C. Costagliola

13 12:52 Evaluation of a New Parameter for the Intra-papillary amount of Nerve Fiber Tissue Using Scanning Laser Tomography
Antoinette G.J.E. Niessen, Thomas J.T.P. van den Berg and Christine T. Langerhorst

2:00 pm - 3:30 pm Session VII Retinal and Neurologic Disorders

Chairperson Prof. Dr. Avinoam Safran
Moderator Dr. Steven A. Newman

1 2:00 Retinal Topography and Perimetric Examination of Patients with Epiretinal Membranes: Prognosis of Functional Results of Surgery
Marina A. Rudneva, A.V. Kiselev and E.E. Ioileva

2 2:12 Perimetric long term follow-up of diabetic cystoid macular edema after laser treatment extended to the foveal avascular zone
Morescalchi, F, Scuri E, S. Formenti, Gandolfo E.

3 2:16 Visual Field in Areolar Atrophy of the Retinal Pigment Epithelium Associated with Age--related Macular Degeneration
Alessandro Magnasco, Paolo Capris, Mario Zingirian and Enrico Gandolfo

4 2:28 Value of Octopus Automated Perimetry in Patients in Hydroxychloroquine Treatment
I. Castagna, A.D'Andrea, M. Briguglio, B. Gentile and R. Lo Gullo

5 2:32 Evaluation of Toxic and Dystrophic Retinal Diseases by Red Increment Perimetry and Multifocal ERG
Chr. Nimagern, H. Krastel, Inez Eggers, O. Schapp, A. Castro and F. Holz

6 2:36 Detection vs Resolution Perimetry Deficits in Diabetes Prior to Clinically Observable Retinopathy
B. J. Curran and R. S. Anderson

7 2:40 Scanning Laser Derived Topographic Oedema Maps: Correlation with Visual Function Assessment in Patients Undergoing Laser Photocoagulation for Clinically Significant Diabetic Macular Oedema
C. Hudson, J.G. Flanagan, G. S. Turner, H. C. Chen, L. B. Young and D. McLeod

8 2:52 Automated Perimetry in Azoor
Steven A. Newman and Antonio V. Aragon

9 3:04 Homonymous Hemianopia-Perimetric Findings and Corresponding Results of Structural and Functional Neuroimaging
J. Schiller, T.J. Dietrich, L. Lorch, M. Skalez, C. Braun and U. Schiefer

10 3:16 Central Visual Field Changes in Dysthyroid Optic Neuropathy
Y. Inoue, T. Inoue and K. Goto

11 3:20 Computerized Perimetry in Patients Affected by Multiple Sclerosis, in Interferon-beta Treatment
D. D'Andrea, A. D'Andrea, M.G. Scullica, G. Minissale and G. Ferreri

12 3:24 Role of Visual Field Examination in the Follow-up of Patients with Pituitary Microadenoma
D. D'Andrea, A. D'Andrea, S. Cannavo, M.G> Scullica, F. Palamara, G. Pettinato and G. Ferreri

13 3:28 Puzzling Visual Field Loss in Patients with Primary Empty Sella
D. Doro and Dorigo De Natale

14 3:32 Development of the Tubingen Neuro-Ophthalmological Perimetric Database
R. Burth, W. Fink, E. Holper, S. Mayer and U. Schiefer

4:30 pm - 5:45 pm **Session VIII Glaucoma**

Chairperson Dr. Paolo Brusini

Moderator Dr. Peter Asman

1 4:30 Morphometric Asymmetry of Peripapillary Atrophy is Associated with Orbital Blood Flow Asymmetry in Normal Tension Glaucoma Patients
Hideya Uchida, Tetsuya Yamamoto, Yoshiaki Niwa, Goji Tomita and Y. Kitazawa

2 4:42 What is the Minimum Threshold What is the Minimum Threshold Asymmetry, Between Fellow Eyes of Glaucomatous Patients, to Define the Side of Greater Field Loss?
L. Fontana, D. Poinoosawny and R.A. Hitchings

3 4:46 The Comparison of the Slope of the Regression Lines of RA/DA Cumulative Curves Allows the Separation of Normal Subjects from Patients with Early Glaucomatous Visual Field Damage
A. Macri, M. Rolando, M. Iester, G. Calabria and M. Zingirian

4 4:50 Simple Criteria for Detecting Glaucomatous Perimetric Defects in High Myopia
G. Corallo, P. Capris, A. Macri, C. Guidi, M. Zingirian and E. Gandolfo

5 4:54 False Negative Rates in Glaucomatous Patients Visual Fields
D. Messenio, M. Zona, B. Cavallotti and P. Montanari

6 4:58 Beaver Dam Eye Study Visual Field Follow-up (1988-95)
W.E. Sponsel, B.E.K. Klein, R. Klein, J. Mensah and Y. Trigo

5 5:10 Knowledge-Based Glaucoma Monitor Using Hybrid Neural Nets
A. Wegner, G. Zahlmann, M. Scherf and I. Ugi

6 5:22 Frequency of Normal Tension Glaucoma in Health Check Up
Hiroharu Okosi, Natsuko Kimua, Hiromi Hayashi, Hiroko Yamashiro, Hirotaka Suzumura and Masahiko Usui

7 5:34 Automatic Static Fundus Perimetry for Precise Detection of Early Glaucomatous Function Loss
K. Rhorschneider, R. Gluck, F.E. Kruse, R.O.W. Burk, T. Fendrich and H.E. Volcker

WEDNESDAY, September 9, 1998

8:30 am - 10:00 am Session IX Perimetric Techniques

Chairperson Dr. Prof. Dr. Fritz Dannheim
Moderator Dr. David B. Hensen

1 8:30 Automated Static Campimetry with Locally Enhanced Spatial Resolution
U. Schiefer, B. Selig and T.J. Dietrich

2 8:42 An Automatic Target Adding System for Visual Field Screening
Y. Takihata, K. Miyazaki and K. Kani

3 8:46 Neural Attractor-Network Classification of Visual Field Data
W. Fink, U. Schifer and E.W. Schmid

4 8:58 The Clinical Role of the Fast Threshold Strategy Programme in the Long-term Follow-up of Glaucoma
C. O'Brien and N. Bolton

5 9:10 Estimating Cataract by Means of Resolution Perimetry
Lars Frisen

6 9:22 Correlation of Relative Dispersion Analysis and the Other High Pass Resolution Perimetry Indices with Standard Threshold Perimetry
M. Altieri, M. Iester, C.E. Traverso, P. Capris and M. Zingrian

7 9:26 Use Your PC to Quickly Map Remaining Vision after Foveal Vision Loss
M. Mackeben, A. Colenbrander and A. Gofen

8 9:30 Automated Perimetry, Color Vision and Contrast Sensitivity in Ocular Hypertensives
G.C.M. Rossi, G.Milano and F. Trimarchi

9 9:34 Improved Resolution by 3 dB Grey Scale Print Outs of Visual Fields
F. Dannheim

11:00 am - 1:00 am Session X Color Perimetry

Chairperson Dr. William M. Hart Jr.
Moderator Dr. Pamela A. Sample

1 11:00 Repeatability of Abnormality and Progression in Glaucomatous Standard and SWAP Visual Fields
Pamela A. Sample, Alireza Emdadi, Yoshiki Kono and Robert N. Weinreb

2 11:12 A Longitudinal Evaluation of Short-wavelength Automated Perimetry in Glaucoma Patients
Yoshiki Kono, Pamela A. Sample, Alireza Emdadi and Robert N. Weinreb

3 11:24 STATPAC for Short Wavelength Automated Perimetry (SWAP) in Patients Affected by Perimetry Open Angle Glaucoma (POAG) with Normal White on White (W/W) Perimetry.
A. Perdicchi, A. Pece, A. D'Alberto and R. Brancato

4 11:36 First Year Experience of SWAP in Private Practice
Eva Forsman

5 11:48 Non-conventional Visual Field Testing in Patient with High-risk Ocular Hypertension
P. Brusini, P. Busatto and G. Driussi

6 11:52 Some Remarks on Blue-On-Yellow Perimetry and Colour Vision in Early Glaucoma
A. Serra, I. Zucca, A. Tanda, V. Piras and M. Fossarello

7 11:56 Frequency-Doubling Technique and Short-Wavelength Automated Perimetry in Ocular Hypertension: A Comparison
F. J. Goni, M. Guarro, J.C. Ondategui, R. Borras and E. Peris

8 12:08 Short-Wavelength Automated Static Perimetry at Baseline and Following Laser Photocoagulation in Patients with Clinically Significant Diabetic Macular Oedema (DMO)
C. Hudson, J.G. Flanagan, G. S. Turner, H. C. Chen, L. B. Young and D. McLeod

9 12:12 Blankout Phenomenon in Standard and Short Wavelength Automated Perimetry
R. Borras, J.C. Ondategui, E. Peris, X. Bofill, F.J. Goni and M. Guarro

10 12:16 The Sensitivity Distribution of Blue on Yellow Perimetry
Genichiro Takahashi, Yoko Aoki, Takeshi Koike and Kenji Kitahara

11 12:20 An Analysis of Spatial Summation Using Blue on Yellow Perimetry
Takeshi Koike, Genichiro Takahashi, Yoko Aoki and Jenji Kitahara

12 12:24 Evaluation of White-on-white Perimetry Using Size I Stimulus Compared with Blue-on-yellow Perimetry
M. Takada, M. Osako, S. Osako, H. Goto, N. Horikoshi and T. Okano

13 12:28 Blue-on-yellow Perimetry Using a Glaucoma Screening Program
Satoshi Matsubara, Hidetaka Maeda, Yoshiaki Tanaka and Misao Yamamoto

14 12:32 An Artificial Scotoma Generated by Looking at Claude Monet's Masterpiece "Impression, Rising Sun"
Avinoam B. Safran and Theodor Landis

15 12:36 Correlation of Color Campimetry & Humphrey Field Analysis in Glaucoma Patients
E.J. Dudenhoefer, L.I. Nesteruk, M.A. Ohara and W.E. Sponsel

SOCIAL PROGRAM

All delegates and accompanying persons are invited to attend the following Social Program.

WELCOME DINNER

Date: Sunday September 6 1998
Time: 8:00 pm - 10:00 pm
Place Grand Hotel Gardone Riviera
Fee Included in Registration fee and in the Accompanying Persons' fee
Welcome Dinner with special traditional Italian cuisine in the Hall of the Conference Venue, Grand Hotel, Gardone Riviera.

CRUISE ON LAGO DI GARDA

Date: Monday September 7 1998
Time: 7:00 pm - 10:00 pm
Place: Sailing on Lago di Garda
Fee: Lit. 100.000 (including dinner)
A boat tour on Lago di Garda visiting picturesque locations. Dinner will be served as the sun sets over the Alps.

EXCURSION TO BORGO QUERCIA

Date: Tuesday September 8 1998
Time: 6:30 pm - 11:00 pm
Place: Borgo della Quercia
Fee: Lit. 120.000 (including dinner)
Borgo Quercia is a typical Italian Villa where characteristic Italian hospitality can be found. The villa is situated in a natural country park. During the visit, there will be an opportunity for the tasting of Italian wine and a visit to the famous old vault. Dinner will feature special Lake Garda cuisine.

EXCURSION TO ROMANTIC VERONA

Date: Wednesday September 9 1998
Time: 2:00 pm - 6:00 pm
Place: Verona (downtown and historic centre)
Fee: Lit. 80.000
An exciting tour to the historical heart of Verona, visiting the famous Juliet and Romeo Balcony, the Roman Arena, and the Old City.

IPS BANQUET WITH TRADITIONAL NATIONAL SINGING

Date: Wednesday September 9, 1998
Time: 8:00 pm - 11:00 pm
Place: Villa Alba (Gardone Riviera)
Fee: Included in Registration fee and in the Accompanying Persons' fee
The traditional IPS Social Program will close with national folk singing in the famous Austrian Villa, surrounded by a centuries old park filled with echoes of great celebrities and international aristocrats.

VENEZIA TOUR (POST-MEETING TOUR)

Date: Thursday September 10, 1998
Time: 8:00 am - 4:00 pm
Place: Venezia
Fee: Lit. 100.000 (no lunch included)
Venezia is awaiting you, with the Basilica of San Marco, the Gondola, and the famous Churches in Gothic, Baroque, Romanic and Arabic style. Lose yourself in the "Calle" (little streets) of old Venezia.

ACCOMPANYING PERSONS' PROGRAM

TOUR TO GARDALAND

Date: Monday September 7, 1998
Time: 9:00 am - 3:00 pm
Place: Gardaland Park
Fee: Lit. 60.000 (no lunch included)
This is an exciting tour for children and the young at heart. You'll discover the Italian Recreation Park featuring many national and international attractions and amusements.

TOUR TO SIRMIONE

Date: Tuesday September 8, 1998
Time: 8.30 am - 12:30 pm
Place: Sirmione City
Fee: Lit. 60.000 (no lunch included)
A visit to this splendid typical mediaeval town including the famous "Grotte di Catullo" and the "Castello Scaligero"

ABSTRACTS

Scientific Session I: Monday, September 7 8:30-10:30 Fundamentals of Perimetry

AGE AND ECCENTRICITY DEPENDENT VISUAL FIELD CHANGES IN A FIVE-YEAR PROSPECTIVE STUDY OF NORMALS

1)

Balwantray C. Chauhan,[1,2] and Terry A. McCormick.[1] Departments of [1]Ophthalmology and [2]Physiology & Biophysics, Dalhousie University, Halifax, NS, Canada

Purpose: To determine the age- and eccentricity-related changes in visual field sensitivity in a prospective study of healthy normal subjects. **Methods:** Our sample contained 119 subjects who had a median of 11 examinations (range 5 to 14) and follow up time of 60 months (range 24 to 78 months). One eye was randomly selected as the study eye and was the only eye tested in the study with program 30-2 of the Humphrey Field Analyser at six-monthly intervals. Subjects were tested by the same technician on the same perimeter. We divided our sample into three baseline age groups: (i) $\leq$ 40 yrs (n=53); (ii) between 41 and 59 yrs (n=36) and (iii) $\geq$ 60 yrs (n=30). The visual field was divided into 3 zones based on eccentricity: (i) $< 10°$; (ii) between 10° and 20° and (iii) $> 20°$. **Results**: After a small learning effect between the first two examinations, the overall mean sensitivity declined significantly by 0.156 dB/yr., however, the two younger age groups showed no appreciable change. The central zone showed the greatest decline (0.198 dB/yr.) followed by the intermediate (0.160 dB/yr.) and peripheral (0.143 dB/yr.) zones. Again these changes were due to the oldest age group where after relatively stable sensitivities for the first half of the follow-up, there were precipitous declines in sensitivities. In those aged $\geq$ 65 yrs, the losses were 0.276, 0.328 and 0.438 dB/yr. in the three zones respectively. **Conclusions:** Over a period of 5 yrs, age- and eccentricity-related changes in visual field sensitivity in normals are minimal in those aged less than 60 yrs but become increasingly pronounced in older individuals.

2)

AGE INFLUENCES ASYMMETRY IN RETINAL SENSITIVITY

T.J. Dietrich[1], N. Ata[1], A. Sänger[1], B. Selig[1], U. Schiefer[1], N. Benda[2]

[1] University Eye Hospital Tübingen, Dept. II; [2] Dept. of Medical Biometry, Tübingen

Purpose. To evaluate the influence of age on nasal-temporal and superior-inferior asymmetries in incremental and decremental detection sensitivity. **Methods.** 72 ophthalmologically normal volunteers (aged between 10 and 70 years) were recruited. Bright and dark (26') test points were presented on a background intensity of 10 cd/m² luminance using a 4-2-1 dB strategy with 3 reversals. The maximal and minimal increments were 100 cd/m² (10 dB) and 0.10 cd/m² (40 dB), respectively.The maximal and minimal decrements were -10 cd/m² (20 dB) and -0.10 cd/m² (40 dB), respectively. 60 test points equally distributed within the central 30°-visual field were analysed (threshold estimation: maximum likelihood method). The mean sensitivity was then determined for each hemifield formed by the vertical and horizontal meridian. **Results.** A statistically significant influence of age was found for the dls (differential light sensitivity) differences. Overall retinal sensitivity decreases by ca 0.05 dB per year (bright and dark stimuli). Linear regression shows a inferior-superior difference of 0.28 dB (bright stimuli; dark stimuli: –0.07 dB) for ten year olds increasing by 0.014 per year (bright stimuli; dark stimuli: 0.015 dB per year). For nasal-temporal differences a higher sensitivity of the *temporal* hemifield is found in younger people: Ten year olds show dls_{nas}-dls_{temp} of –0.33 dB for bright stimuli and –0.40 for dark stimuli. This value increases by +0.11 dB per decade (bright stimuli; dark stimuli: +0.13 dB). Thus, in *older* people, a higher sensitivity of the *nasal* hemifield is determined relative to the temporal hemifield.
Conclusions. Altitudinal asymmetry increases with age, leaving the inferior hemifield advantage unchanged. In contrast, there is a reversal of nasal-temporal asymmetries at approximately the age of 40 benefitting the nasal hemifield. These asymmetries and their alteration with age are found for both types of stimuli. Explanations for these results could possibly be found in retinal maturation. The higher exposure of the nasal retina to light due to the anatomy of the periorbital region should also be considered. Furthermore, hemifield-related differences could also be due to an inequality in the number of neurons transducing or processing light.

3)

AGE AND ECCENTRICITY EFFECTS ON GRATING DETECION AND GRATING RESOLUTION AUTOMATED PERIMETRY

Shaban Demirel[1] Larry N. Thibos[1] and Chris A. Johnson[2]
School of Optometry, Indiana University, Bloomington, IN and [2] Devers Eye Institute, Portland, OR

No theoretical link between thresholds measured with standard automated perimetry and retinal ganglion cell (RGC) density exists. However, sampling theory indicates that the density of RGCs can be estimated via the finest grating that can be veridically resolved by the array [See Wang, et al. (1997) IOVS 38:2134]. The purpose of this study was to determine if local detection (Det) and resolution (Res) acuity could be measured perimetrically in a group of 100 normals and in a group with early glaucoma. This was accomplished using 4, 21-inch high-resolution monochrome monitors combined optically to produce seamless coverage of the central 30°. The resulting pixel density allowed us to generate sinusoidal gratings fine enough to measure detection and resolution acuity at all locations except the fovea. Stimuli were square grating patches, 4° across, arranged in a manner identical to a Humphrey 24-2 pattern. Stimulus duration was 640ms.

Results show a decline in acuity with eccentricity. Det and Res acuities were 0.34 & 0.58logMAR respectively at 3° and 0.62 & 0.73logMAR at 21°. Res acuity was poorer than Det acuity at all but 2 locations suggesting only a small effect of refractive error. At 3°, the age related fall-off in Det and Res acuities were 0.03 & 0.02logMAR / decade respectively. At 21°, these values were 0.06 & 0.03logMAR / decade. Det acuity, which is limited by the eye's optics, shows a greater aging effect than Res acuity, which is limited by the RGC density. Average normal and early glaucoma data will be presented. In conclusion, the perimetric measurement of detection and resolution acuities in normals and glaucoma patients suggest that this procedure may be a good means of estimating local parvocellular (P-cell) ganglion cell density.

4)

EFFECT OF LOCALIZED REFRACTIVE ERROR ON PERIMETRIC THRESHOLDS FOR DIFFERENT SIZED TARGETS IN FOVEAL AND PERIPHERAL VISION.

D.R. McDowell, R.S. Anderson and F. Ennis,
Vision Science Research Group, School of Biomedical Sciences, University of Ulster, Coleraine.

Several studies have measured the effect of foveal refractive error on peripheral detection thresholds. This is inappropriate since peripheral refractive error is significantly different from that of the fovea and means that correcting foveal refractive error may actually make peripheral performance worse and so reduce field sensitivity due to optical rather than neural factors. We wished to measure thresholds in the fovea and periphery for known amounts of defocus at the same location using different sized stimuli to determine the direct effect of defocus at different locations.

We measured detection thresholds for computer-generated spot stimuli in the fovea and at 30 degrees in the horizontal nasal field in three trained observers. Peripheral refractive error was first determined at each location and thresholds measured for stimuli ranging in size from 0.2 to 6.4 degrees and for refractive errors between ±4.00 diopters at each location. Cycloplegia was employed for the foveal measurements and an artificial pupil used to maintain the same pupil size as for the peripheral measurements.

In the fovea, thresholds increased with increasing refractive error particularly for smaller stimulus sizes. At 30 degrees, however, thresholds for smaller stimuli were less affected by defocus initially and then increased sharply. Larger stimuli were relatively unaffected by defocus such that when stimulus size reached 1.6 degrees there was little or no increase in threshold for refractive error between ±4.00 diopters. These data indicate that peripheral refractive error, which has largely been ignored by perimetrists, can have a significant effect on performance, particularly for smaller stimuli, and static perimetry may be better served by larger stimuli than those based on Goldmann sizes.

SUPRATHRESHOLD PERIMETRY: ESTABLISHING THE TEST LEVEL.

David B Henson, Paul H Artes, Shaila J Chaudry,
Department of Ophthalmology, University of Manchester.

5)

Purpose. To establish the precision of the Humphrey Visual Field Analyzers (HFA) technique for establishing the suprathreshold test intensity by retrospective analysis of perimetric data and simulation.
Method. Full threshold data (24-2) from 76 glaucoma patients were retrospectively analysed. Sensitivity values from the 4 seed locations (12.7 deg. from fixation along the 45, 135, 225 and 315 meridians) were processed to derive a suprathreshold test level in the manner outlined in the HFA manual. We used the 7th best point within the central 24 degrees as a 'gold standard' estimate of sensitivity, as it is unaffected by localised visual field loss[1] and resistant to false positive patient errors.
Computer simulations of patient responses were also used to derive the precision of the HFA procedure and the results compared to those from the retrospective analysis.
Results. The standard deviation of the differences between the HFA routine and the 7th best point was 1.49 dB. The simulation gave standard deviations of 1.20, 1.54, 2.16 and 2.91 dB (200 repeats) for error rates (false positive and false negative) of 0, 10, 20 and 30% respectively and a starting value 3 dB brighter than threshold.
Conclusions. Retrospective analysis of full threshold data and the computer simulation gave similar values for the precision of establishing the suprathreshold test intensity. The simulation data highlighted the importance of the error rates and how they lead to inappropriate test intensities in a significant proportion of patients.

[1] Heijl A et al (1989) Arch Ophthalmol 107:204-208.

6)

The Effect on Perimetric Thresholds of using a Quadrant-Limited Seed Point Algorithm

Michael Wall, M.D., University of Iowa, Iowa City, IA USA

To determine the effect of using a quadrant-limited seed point algorithm on perimetric thresholds, we simulated six different conditions. We used a false positive rate of 1% and false negative rate of 2% Then, using 1) a 4/2 staircase procedure, 2) varying starting values (0, 28, 40 dB) for the primary or "seed" points and 3) using the rules for passing other starting values within each quadrant, we compared these results with thresholds obtained with these same starting values for all test locations (no seed point and value passing). We assumed any variability could be attributed to the testing method rather than patient factors.

We chose visual field data from one perimetric examination from a patient with optic neuritis and a relative quadrant defect and used these results as the "true" or actual visual sensitivities used to calculate frequency of seeing curve slopes for each test location. We then simulated 30 program 30-2 visual fields for each of the six conditions.

We found the starting value had a large bias on the final threshold. With values used in conventional automated perimetry this resulted in a consistant underestimation of threshold at damaged test locations. Although the values for the quadrants (9-22 dB) and whole field (21-27 dB) varied considerably among the conditions for not using the seed point, there was only a 1-2 dB difference within the seed point conditions. However, there was substantial varibility within individual visual fields for this condition.

Using a quadrant limited seed point algorithm can have a large effect on individual perimetric thresholds.

DRIVING STANDARDS FOR PERIPHERAL VISION: TIME FOR A REVIEW

7) E. J. Casson , Ph. D. and L. Racette, M. A. , Eye Institute, Ottawa, Canada

To survey driving standards in North America, we sent questionnaires to 59 agencies responsible for regulating transportation/motor vehicles in each state, province or territory in the US and Canada. The survey asked about the current standards, how they were determined and how they are enforced. Surveys were also sent to medical advisory groups to determine the basis of recommendations made to the regulatory agencies.

Ninety-two percent of the surveys have been completed. While the results demonstrate consistency for visual acuity standards (90 percent report minimum standards of 20/40), there is a disturbing amount of variability in standards for peripheral vision. Only 60% of agencies have a standard for peripheral vision and these vary between 70° and 140° at the horizontal meridian. The method of testing is rarely specified. There is even more variability in enforcement, with hemianopic patients being allowed to drive in some jurisdictions, while individuals with narrow altitudinal defects are refused permits in others. In light of human rights legislation in these countries, the current standards, which are invariably based on subjective opinion rather than empirical research, are inadequate.

8)

Title: Psychophysical assessment of visual function in glaucoma

Authors: C O'Brien, P Nelson, P Aspinall, O Papasouliotis, B Worton. Departments of Ophthalmology and Statistics, University of Edinburgh, Scotland

Purpose: to examine the relative contribution of a variety of psychophysical tests of visual function at distinguishing between normal and glaucoma.

Methods: nineteen normal subjects (mean deviation, -0.2 dB) and 49 age and sex matched open angle glaucoma patients (mean deviation, -14.4 dB) were enrolled. Tests of visual function included contrast sensitivity, critical flicker fusion frequency, stereoacuity, Esterman perimetry, glare brightness acuity testing, dark adaptation, and D-15 colour assessment.

Results: Mann Whitney U analysis showed that all variables (except the D-15) separated normal from glaucoma ($p<0.04$). Simple logistic regression using all the variables gave an 84% classification rate, with dark adaptation as the best predictor of group classification. Glare sensitiviy ($p=0.008$), dark adaptation ($p=0.01$) and contrast sensitivity ($p=0.03$) were significantly different between the normal group and those ($n=18$) with mild glaucomatous visual field loss.

Discussion: nearly all variables seperated normal from glaucoma, with dark adaptation as the best single predictor of group classification. Glare and contrast sensitivity, and dark adaptation were capable of separating normal from early visual field loss.

9)

CLINICAL IMPLICATIONS OF THE FILLING-IN PHENOMENON IN OPHTHALMOLOGICAL PRACTICE.

Avinoam B. SAFRAN, MD, Neuro-ophthalmology and strabology Unit, Geneva University Hospitals, Geneva, Switzerland

It has recently been shown that, contrary to long-held beliefs, sensory and motor maps are not stable in the adult cerebral cortex. Cortical plasticity allows the brain to adapt to background modifications or to damage of the nervous system. Cortical changes occurring after focal visual deafferentiation modify visual perception by filling in visual field defects with information from the area surrounding the scotoma. With visual field defects, cortical plasticity also causes distortion in spatial perception.

Clinical implications of cortical reorganization following field defects were analyzed with respect to early diagnosis of blinding diseases, clinical evaluation of field defects, and coping with visual changes. The authors found that the "filling-in" phenomenon is largely ignored by clinicians, despite its major implications in ophthalmological practice.

Supported in part by the Swiss National Fund for Scientific Research, grant #3200-049594.96.

1) EVALUATION OF TWO SCREENING TESTS FOR FREQUENCY DOUBLING PERIMETRY

Chris A. Johnson, Ph.D., George A. Cioffi, M.D., E. Michael Van Buskirk, M.D.
Devers Eye Institute / Discoveries in Sight Research Laboratory, Portland Oregon

Purpose: To evaluate the clinical efficacy of two screening tests for Frequency Doubling Perimetry (FDP), using the Welch Allyn / Humphrey Instruments device.

Methods: The original FDP screening procedure tests 17 locations at the age-adjusted 1% normal probability level. If the stimulus is missed, it is repeated. If it is missed a second time, the contrast is increased to halfway between the 1% probability level and maximum contrast. If this is missed, the stimulus is presented at maximum contrast (100 %). The revised FDP screening procedure was designed to provide better detection of early losses. It tests the 17 locations at the age-adjusted 5% normal probability level. If the stimulus is missed, it retests at the 5% level, then proceeds to the 2% and 1% probability levels for successive misses, respectively. The original FDP screening procedure was evaluated in 100 normals and 169 glaucoma patients. Both the original and revised FDP screening tests were compared in 50 glaucoma patients with early and moderate visual field loss and 50 normals.

Results: The original FDP screening test demonstrated an overall sensitivity of 85% and a specificity of 96%. Sensitivity was 100% in advanced glaucoma, 90 % in moderate glaucoma and 65% in early glaucoma. The revised FDP screening procedure showed better sensitivity for detection of early glaucomatous visual field loss, but also demonstrated a modestly reduced specificity in comparison to the original screening test.

Conclusions: Both screening tests provide good sensitivity and specificity for detection of glaucomatous visual field loss, both procedures take about 45 seconds per eye to perform, and both screening tests correlate well with the results of threshold testing for FDP.

2) EFFICACY OF SCREENING MODES OF FREQUENCY DOUBLING TECHNOLOGY AND DICON PERIMETERS

Rosita E. VanCoevorden, MD; Richard P. Mills, MD; Lan Wang, MD; Derek C. Stanford, MS
University of Washington, Seattle, Washington, USA

Purpose: To assess the efficacy of the Dicon LD 400 suprathreshold 40-point screening strategy and Frequency Doubling Technology (FDT) perimetry in the screening mode in detecting glaucomatous visual field loss.

Methods: Eighty-nine patients from a clinic population (age range 27-88) with a diagnosis of glaucoma and glaucoma suspect underwent a Humphrey 24-2 full threshold test (HVF), followed by an FDT and Dicon screening test. One eye per patient was selected. Patients were excluded for Mean Defect worse than -15 dB, and best corrected visual acuity worse than 20/60. All patients were experienced with perimetric examinations. The results of the screening Dicon and FDT were compared to the gold standard HVF.

Results: Sensitivity and specificity for separating glaucoma and glaucoma suspect eyes with the Dicon were 77% and 76% respectively, and with the FDT 81% and 88% respectively. The relative hill (RH) information provided by Dicon software indicated that an RH of -4 (normal value ± 1), increased the probablity of an abnormal HVF diagnosis, therefore providing a significant improvement over the missed point analysis alone.

Conclusions: Both FDT and Dicon performed well, considering the brief test time consumed. Detection of moderate to advanced defects was excellent using either screening tehnique.

Supported by NIH Grant EY01730, and in part by a departmental award from Research to Prevent Blindness, Inc.

3) FREQUENCY DOUBLING PERIMETRY AS A GLAUCOMA SCREENER

Y. Kondo, K. Inazumi, T. Yamamoto, Y. Kitazawa- Gifu University, Gifu Japan.

Purpose. To compare the sensitivity threshold of frequency doubling perimetry (FDP) with that of white-on-white perimetry (W/W) and blue-on-yellow perimetry (B/Y) in glaucoma patients. **Methods.** Seventy-five eyes of 75 glaucoma cases of a variable severity of glaucomatous optic neuropathy who were well-experienced in W/W were studied. All subjects had a best-corrected visual acuity of 20/30 or better in the study eye. Their age ranged between 26 and 78 years. Mean deviation(M.D.) value of W/W ranged between -20.14 and 2.73dB. The 30-2 program was employed for W/W and B/Y using HFA model 750; the program N-30 for FDP using model 710. The threshold values of W/W and B/Y corresponding to each of the 19 grids of FDP were averaged to compare the thresholds in each grid.We calculated the specificity and sensitivity of FDP in 19 grids and in total area, regarding the W/W as the standard. **Results.** Both the threshold values of FDP and W/W and those of FDP and B/Y were significantly correlated. ($p<0.0001$ and $r=0.472$ for FDP and W/W, $p<0.0001$ and $r=0.563$ for FDP and B/Y; Spearman's correlation coefficient by rank). The specificity and sensitivity in total were 30.0% and 86.3%, respectively. **Conclusion.** Threshold value of FDP is significantly correlated with that of W/W and B/Y.

4) **A COMPARISON OF THE EFFECTS OF NEUTRAL DENSITY AND DIFFUSING FILTERS ON MOTION DETECTION PERIMETRY, WHITE ON WHITE LUMINANCE PERIMETRY AND FREQUENCY DOUBLING PERIMETRY.**

W L Membrey, S Kogure, F W Fitzke
Institute of Ophthalmology and Moorfields Eye Hospital, London, UK.

Background: Motion detection perimetry and Frequency doubling perimetry are methods that have been developed with the goal of detecting glaucomatous field defects earlier than conventional white on white perimetry. It is well recognised that the development of cataract and pupillary constriction can significantly influence perimetric thresholds when screening for glaucomatous field loss.

Purpose: To compare the potential effects of changes in pupil size and cataract on motion detection perimetry, frequency doubling perimetry and conventional white on white perimetry.

Methods: The right eye of 5 normal subjects 23-42 years of age underwent- 1.Standard white on white luminance perimetry on the Humphrey field analyser model 630 using the 30/2 program and size III stimulus. 2.Frequency doubling perimetry using the N30 program on the Humphrey FDT visual field instrument 3.Motion detection perimetry using a vertical line stimulus undergoing lateral displacements. For each procedure either no filter, a series of neutral density filters (0.5-2.4 log units) or a diffusing filter was mounted in random order before the eye to be tested.

Results: The mean whole field thresholds were calculated from the Humphrey field analyser results and the frequency doubling results. These values and threshold from the motion detection test were converted into standard or Z scores using the means and standard deviations calculated from the corresponding tests done without any filter. Deviations greater than 2 standard deviations from the mean were seen for both the frequency doubling results and the Humphrey field analyser results with neutral density filters above 0.7-0.9 log units and with the diffusing filter. Thresholds for the motion detection test remained within this range with neutral density filters up to 2 log units and with the diffusing filter.

Conclusions: Our model suggests that the development of cataract and changes in pupil size are likely to have less effect on motion detection perimetry than on either frequency doubling or conventional white on white perimetry.

5)

AUTOMATED FLICKER PERIMETRY IN GLAUCOMA AND RETINAL DETATCHMENT PATIENTS

C. Matsumoto, S. Okuyama, A. Iwagaki, S. Takada and T. Otori
Department of Ophthalmology, Kinki University School of Medicine, Osaka-Sayama, Japan

Purpose: To study the relationship between the critical fusion frequency (cff) and the threshold value of differential light sensitivity in glaucoma and retinal detachment patients.

Subjects and Methods: One hundred and fifty eyes of 82 glaucoma patients and 20 eyes of 20 retinal detachment patients were examined by both light-sense perimetry using Octopus 201 and flicker perimetry using Octopus 1-2-3. In glaucoma patients, we studied the correlation between light sensitivity and flicker sensitivity in the area where nerve fiber bundle defects were observed. In retinal detachment patients, we studied the area where the retina had been detached.

Results: In glaucoma patients, when the threshold values of differential light sensitivity decreased from 30 to 20 dB, the cff decreased from 40 to 5 Hz. Many test points where the values of differential light sensitivity were less than 15 dB were shown to be 0 Hz by flicker perimetry. On the other hand, in retinal detachment patients, light-sense perimetry detected more abnormal points than flicker perimetry. In abnormal points where the threshold values of differential light sensitivity were less than 15 dB the cff never decreased to 0 Hz by flicker perimetry.

Conclusion: Flicker perimetry is more sensitive and useful for the detection of visual field defects of glaucoma than that of retinal detachment.

6)

SIMULTANEOUS PUPIL AND STANDARD PERIMETRY

O.Bergamin, M.Zulauf, M.Schelling, A.Hagopian, A.Schötzau, Ph.Hendrickson;
University Eye Clinic Basel, P.O.Box, CH-4012 Basel - Switzerland

Purpose: To evaluathe hypothesis, that the pupillary light reflex (PLR) could serve as an additional reliability parameter in standard perimetry, and/or, near psychophysic threshold stimuli would reduce sleep-wave artifacts during pupil perimetry.
Methods: Twelve healthy normal volunteers (age: 31.8; 23-62 years; 6 females, 6 males) were examined with a modified Octopus 1-2-3 perimeter which measures the pupil area at 50 Hz. Background (1 cd/m2), stimulus size (0.43°) and stimulus duration (100 ms) were chosen similar to standard Octopus perimetry. Stimuli were presented at 4 different brightness levels (5.2 – 413.4 cd/m2). The PLR was evaluated by 4 experts on screen and by our algorithm which fits linear regressions and polynomials into the pupil tracings to define the onset of the PLR and the maximal constriction of the pupil.
Results: The algorithm was 20% more conservative than the experts to recognize the existence of a PLR. To elicit (and detect by the algorithm) a PLR with a chance of 50%, stimulus brightness averaged at 0°/0° 5.2 cd/m2; at 8°/8° 65.4 cd/m2, at 8°/-8° 52 cd/m2, at 20°/20° 164.3 cd/m2 and at -20°/-20° 206.8 cd/m2. The PLR decreased with age.
Conclusions: The results suggest that the evaluation of the PLR during standard Octopus automated perimetry might serve as a reliability parameter but does not permit to detect minor flaws in cooperation. Stimulus size 5 (1.7°) is preferred for simultaneous pupil and standard perimetry. Based on these results, we are currently developing algorithms which permit to perform simultaneous both perimetries by 'online' evaluation of the PLR.
Supported by grants 32-43624.95 & 32-52 982.97 of the Swiss National Fund.

7) VIRTUAL REALITY PERIMETRY AND THE DETECTION OF GLAUCOMATOUS FIELD LOSS: A PILOT STUDY.

G. Richard Bennett , M.S., O.D.
Elliot B. Werner, M.D.
Lindsay Bennett, B.A.
Pennsylvania College of Optometry/Allegheny University
Philadelphia, Pennsylvania

The authors compared results of virtual reality perimetry to the Humphrey Visual Field 24-2 SITA-standard threshold examination. Ten normal patients and forty patients with glaucomatous visual field loss were evaluated using both techniques. Virtual reality perimetry was preformed using the Kasha visual field system (KVF) consisting of virtual reality glasses, a desktop computer and printer, mouse in a windows 95 environment. The KVF system allows both full,and supra threshold testing of a 24 degree field with 6 degree spacing using 52 points. The system has a full threshold testing range of 13 to 39 dB and allows simultaneous testing of both eyes. All 10 subjects with normal visual fields with Humphrey 24-2 SITA-standard perimetry showed normal KVF fields. All 40 subjects with established glaucomatous visual field loss on the Humphrey showed corresponding visual field defects on KVF.

8)

POLARIZED LIGHT PERIMETRY (PLP) AND ADVANCED GLAUCOMA

Palanza L., Aleci C., Magistro G., Brogliatti B., Boles Carenini B.
Institute of Ophthalmology, University of Turin. Italy

INTRODUCTION: in a previous study Aleci C. and coll.(1998) has applied a particular type of computerized perimetry, using a polarized stimulus with 90° and 180° oriented axis, on a group of 20 patients with suspect or initial glaucoma and on a control group composed of normal subjects. This research has demonstrated in the pathological subjects a significant increase of the retinal sensitivity to the polarized light, compared to the controls, suggesting the possibility of a recovered polarized perception induced by the glaucomatous condition. In virtue of these results, we have decided to apply the PLP also on subjects with advanced glaucoma (IOP increased, functional and morphological changes in the papilla, typical visual field defects).

MATERIALS AND METHODS: 20 patients with advanced POAG and 10 normal subjects have been selected. All the subjects, after a complete ophthalmological screening and a standard computerized visual field (CVF) (Octopus 2000, pr.G1), were studied with two automatic perimetry examinations by Octopus 2000 before placing polarized filters with 90° and then 180° oriented axis in front of the eye. In order to get comparable data to those of conventional perimetry, also a CVF with a grey filter was done, so as to reduce stimulus luminance to the same values as those induced by the polaroid absorbance.

RESULTS: in the glaucomatous subjects we have demonstrated a significant increase in the retinal sensitivity for the polarized light with 90° and 180° oriented axis.

CONCLUSIONS: these results could confirm the Aleci's theory of *phylogenetic regression induced by barostress* supposed in his previous research. In the invertebrates the perception of the polarized light is due to a simple organization of the photoreceptors: 8 retinal cells, with microvilles oriented on different planes, converge on one second order neuron so that, in virtue of an *angular summation*, the plane of polarization of the ambient light can be perceived. On the contrary, in the mammalian retina there isn't this degree of convergency, which could explain the absence of the polarized perception. In the subjects with initial glaucoma so as the probes with advanced glaucoma, the common increased IOP could induce a "phylogenetic regression" (a simplification) in the retinal intercellular networks (through the loss of ganglion cells) which cause the loss of the finest functions, such as the colour perception, and the acquisition of an increased sensitivity in polarized conditions, less important for the human beings.

1)

THE RELATIONSHIP BETWEEN SENSITIVITY AND VARIABILITY IN NORMAL AND GLAUCOMATOUS VISUAL FIELDS

David B Henson, Shaila J Chaudry, Paul H Artes,
Department of Ophthalmology, University of Manchester.

Purpose. To establish the relationship between sensitivity and variability in normal and glaucomatous visual fields.
Method. Frequency of seeing (FOS) data were collected from 4 visual field locations of 35 subjects (15 normals and 20 glaucoma patients), using a constant stimulus method on a Henson 4000 perimeter. Twenty presentations were made at 6 or more intensities, above and below threshold. In glaucoma patients, at least one location was chosen to lie in an area of normal sensitivity. The FOS data were fitted with a cumulative Normal distribution, the standard deviation (SD) of which was used as an estimate of variability.
Results. Variability was found to increase more rapidly with decreased sensitivity. The relationship was best described (R^2=0.85) by the negative exponential function SD=a*exp[b*sensitivity (dB)], where the constants a and b were 85 and -0.11, respectively.
Conclusions. Previously presented linear models of the relationship between sensitivity and variability fail to accurately predict variability of high and low perimetric sensitivities, suggesting negative variability at high sensitivities and underestimating variability at low dB values. Our model attempts to correct these shortcomings. It can be used in computer simulations of perimetry to establish optimum test parameters.

2)

SAMPLING DISCRETE GANGLION CELL MOSAICS DECREASES THRESHOLD VARIABILITY.

P. Pearson[1], W.H. Swanson[1], R.L. Fellman[2], R.J. Starita[2] & J. Lynn. ([1]Retina Foundation of the Southwest, Dallas, Tx; [2]Glaucoma Associates of Texas, Dallas, Tx.)

We have designed a new psychophysical technique which samples discrete ganglion cell classes by measuring thresholds in scotomas. To evaluate the sensitivity of this technique for measuring visual change, we evaluated the long-term (between sessions) and short-term (within sessions) variability of both patients and age-matched normals.

A 3-channel direct-view system with an array of eccentric fixation points was used to measure thresholds for critical flicker frequency and three increment thresholds (blue (470 nm), red (620 nm) & white) on white backgrounds for a 4° eccentric test object with maximum luminance of 6000 asb. An Iscan RK-426 eyetracker ensured that only trials on which the subject was correctly fixating were included in the threshold calculations. A two-alternative forced-choice staircase procedure was used to obtain the thresholds for six glaucoma patients (63 ± 9 yrs) and six age-matched normals (63 ± 9 yrs). Each subject completed all tests twice in sessions one week apart. The threshold and short term fluctuation (slope of the psychometric function) were estimated using a maximum likelihood method.

An average of 62±10 trials was required to obtain each of the four thresholds. For these data, differences in the short-term fluctuation between normals and patients were not evident ($F(1,10)= 0.342$, $p=0.5$). The thresholds obtained in the first and second sessions were not significantly different ($x_{diff} < 1.1 \pm 0.08$ dB; $F(1,10)=0.36$, $p=0.5$) nor was the long-term fluctuation greater for patients than for normals ($F(1,10)=0.017$, $p=0.9$).

The high short and long-term fluctuation typically found in perimetric studies of glaucoma make detection of defects less than 9 dB difficult. This new procedure yields low short and long-term fluctuation which permit the detection of threshold elevations of less than 3.5 dB.

QUANTIFICATION OF GLAUCOMATOUS THRESHOLD VISUAL FIELD LOSS BASED ON NEUROMORPHOMETRIC CORRELATES

3)

Erkan Mutlukan MD PhD, Henry Ford Hospital, Detroit

ARTS scoring algorithm has been designed to put the emphasis on neuronal representation and implied quantity of receptive field density / axonal damage in the central field. To study the usefulness of the method, Forty C30-2 threshold field results (18 right, 22 left) of 40 glaucoma patients (age 19-82 yrs, mean 62 yrs) were assigned ARTS (e.g. 0-100% scale), AGIS (e.g. Stage 1-20) and HPA (e.g. early=1, moderate=2 & severe=3) scores. Spearman's rho test was used for statistical assessment. Mean scores were $A_{11\%}R_{22\%}T_{34\%}$ (i.e. Absolute=11%, range 0-86%; Relative=22%, range 2-72%; Total=34%, range 2-100%), AGIS=6.5 (range 0-20) and HPA=2.1 (range 1-3). "Total" percentage scores correlated significantly with AGIS, HPA and global field indices of MD ($p<0.001$) and PSD ($p<0.02$). ARTS measured significant defects when other global field indices were within normal range and AGIS scores were zero. ARTS also indicated increasing severity of visual field loss after HPA scores reached to their maximum approximately at 30% "Total" score. To establish the reproducibility of the method, an independent group of ten patients (mean age 64 yrs, range 43 – 82 yr.) with glaucomatous optic neuropathy were tested twice. The "Total" Scotoma component of ARTS algorithm fluctuated for 6.2±4.3% with the use of FASTPAC and, for 4.0±3.8% with SITA-S ($p=0.008$). ARTS scoring provided equal or better scotoma measurement and retest reproducibility compared to other numeric results. ARTS model provides a continuous scale for the measurement of threshold field damage when the usefulness of other methods is limited.

4)

TEST-RETEST REPRODUCIBILITY OF FREQUENCY DOUBLING PERIMETRY

S.A. Hancock, J.M.Wild, I.A.Cunliffe
Aston University, Birmingham, UK; Heartlands Hospital, Birmingham, UK

Purpose: to compare the reproducibility of Frequency Doubling Perimetry compared to White-on-White Automated Perimetry (W-W), and Short Wavelength Automated perimetry (SWAP) in high risk ocular hypertensives (OHT) and in primary open-angle glaucoma (POAG).

Method: One eye, from each of 19 high risk OHT patients (mean age 65.1 years, SD 11.6) and from each of 19 stable POAG patients (mean age 65.3 years, SD 9.5) underwent the Frequency doubling perimetry with the Humphrey FDT Visual Field Instrument C-20 Threshold Program (Software Revisions 1.2 and 620), W-W and SWAP with Humphrey Field Analyzer Program 24-2 using the Full Threshold algorithm. All patients were naïve to FDP but experienced in W-W and SWAP. The examinations were each separated by an interval of 15 min. The protocol was repeated after an interval of approximately 14 days. The order of perimetry within-and between-visits was randomized between patients but held constant within each patient for each visit. The test-retest MD data for each type of perimetry were expressed in terms of the coefficient of repeatability (COR) (i.e. the 95% confidence limits for the difference between test and retest measures).

	OHT*	POAG*
FDT	2.52(-0.14)	2.46(-4.36)
WW	2.63(+0.21)	3.23(-2.66)
SWAP	4.01(-0.72)	2.67(-3.53)

*Coefficient of repeatability (Median of distribution of mean of the two visits)

Conclusions. The results indicate that FDT yields good repeatability in observers who, although experienced in conventional perimetry were hitherto naïve to FDT.

None

5) LINEAR REGRESSION ANALYSIS IN GLAUCOMA VISUAL FIELD FOLLOW-UP

Anders Heijl and Boel Bengtsson
Department of Ophthalmology
Malmö University Hospital, Malmö, Sweden

Linear regression analysis has been used to judge progression of glaucomatous visual fields for more than a decade. Global indices and pointwise threshold values have been subjected to such analysis. Linear regression analysis has clear advantages, e.g., that all available data are used, and that the patient's own test-retest variability will decide whether significant progression has occurred. There are also disadvantages, however, e.g., that several or many observations are needed before analysis become meaningful, that false positive or false negative results are very disturbing when results are based on few tests, and that increasing media opacities are likely to disturb the results. This presentation will discuss the advantages and disadvantages of linear regression analysis in glaucomatous visual field follow-up based on prospective and retrospective data. The results can form a basis for recommendations on the usage of such analyses for visual field follow-up of glaucoma patients.

6)

PROPERTIES OF INDIVIDUAL PROGRESSING VISUAL FIELD LOCATIONS IN NORMAL TENSION GLAUCOMA

L. Quaranta, DP Crabb, FW Fitzke, RA Hitchings,*E. Gandolfo
Institute of Ophthalmology and Moorfields Eye Hospital London, *University Eye Clinic of Brescia

Background. Linear regression of individual sensitivity values against time of follow-up has been shown to be a useful way of quantifying visual field progression. Several factors may influence the incidence of a progressing point including the site of the location and the initial sensitivity at the time that the follow up commences.

Purpose. To investigate characteristics of individual progressing locations in series of visual fields from patients with normal tension glaucoma (NTG).

Method. One hundred and six series of Humphrey visual fields of 106 patients were selected from a cohort of untreated NTG patients. The follow up for all the studied NTG patients was ≥ 5 years (range from 5 to 13 years). Pointwise linear regression of sensitivity on time (PROGRESSOR software) was used to identify progressing locations. A statistically significant slope of faster than -1dB per year (-2dB for outer locations) was used as the pointwise criterion for progression[1]. The site of the progressing location, the initial sensitivity and the rate of loss was recorded.

Results. A total of 628 progressing field locations were identified. A statistically significant higher proportion of the progressing locations were detected in the infer-temporal quadrant (P=0.04) compared to the other quadrants. A greater number of progressing locations were found to have a high initial sensitivity compared to a low initial sensitivity. However, there was no clear linear association (Spearmans Rank correlation; P=0.30) between the actual rate of loss and initial sensitivity for each progressing series of sensitivity values.

Conclusion There is evidence of a preferential spatial location of deteriorating points in progressive NTG. Further consideration may reveal a relationship between the rate of loss, the chance of detecting a progressive point and the initial field loss at the time follow up commences.

1. McNaught, A.I., Crabb, D.P., Fitzke, F.W. and Hitchings, R.A. (1996). Visual field progression: comparison of Humphrey Statpac2 and pointwise linear regression. *Graefe's Arch Clin Exp Ophthalmol* **234**: 411-418.

7) **DETECTING GRADUAL AND SUDDEN SENSITIVITY LOSS IN SERIES OF VISUAL FIELDS**

DP Crabb, FW Fitzke, RA Hitchings.
Institute of Ophthalmology and Moorfields Eye Hospital, London, UK.

Background. Linear regression of sensitivity against time of follow-up at individual test locations has been shown to be a useful method for determining visual field progression. However, the linear model may not be sensitive to cases where progression is sudden or episodic in nature.
Purpose. To examine the performance of pointwise linear regression in detecting gradual and sudden sensitivity deterioration.

Methods. A computer simulation (*FieldSIM*) generates series of sensitivity values typical of longitudinal visual field data. The model has controllable parameters for length of follow-up, frequency of observations, initial sensitivity, level of perimetric between test variability and magnitude of deterioration. The mode of loss in a given series can also be specified as stable, gradual (linear) or randomly episodic (sudden deterioration). Pointwise linear regression (PLR) was applied to each simulated series. A statistically significant slope of faster than -1dB per year was used as the criteria for progression[1]. The sensitivity of PLR was defined as the proportion of correctly classified series.

Results. The sensitivity in detecting progression was similar whether progression was gradual or episodic. For example: when *FieldSIM* (1000 series) specified a total 7.5dB loss over a 3 year follow-up (2 fields per year), PLR successfully identified 60% of gradual progression series and 58% of episodic progression series. When *FieldSIM* (1000 series) specified a total 7.5dB loss over a 5 year follow-up (2 fields per year), PLR successfully identified 71% of gradual and 74% of episodic progression series.
Conclusions. Pointwise linear regression is sensitive to detecting both gradual and episodic sensitivity changes. There is no 'gold-standard' for visual field progression in glaucoma: the *FieldSIM* model is, therefore, a useful technique for comparing methods and developing new criteria for detecting serial visual field changes.

1. McNaught, A.I., Crabb, D.P., Fitzke, F.W. and Hitchings, R.A. (1996). Visual field progression: comparison of Humphrey Statpac2 and pointwise linear regression. *Graefe's Arch Clin Exp Ophthalmol* **234**: 411-418. *(Supported by the RNIB, IGA and MRC.)*

8) Pointwise Linear Regression Criteria and the Detection of Change in Automated Visual Field Series

M.R.Wilkins, T.Lowe, A.Kotecha, R.Hitchings, P.T.Khaw, F.Fitzke
Wound Healing Research Unit, Department of Pathology, Institute of Ophthalmology; Glaucoma Unit, Moorfields Eye Hospital, London, United Kingdom

Sixty two patients undergoing trabeculectomy had at least 2 preoperative Humphrey 24-2 fields followed by 4 postoperative fields at 3 month intervals. Pointwise linear regression was used to analyse the field series; with the first field omitted from the analysis. Points were classified as deteriorating, or improving according to the magnitude and statistical significance of their slope. Either criterion was changed in small increments while the other was held constant. With the statistical significance held at $P<0.05$ and a critical slope of 0.01 dB/yr the numbers of patients with a single deteriorating, improving point or both were 34, 35, and 18 respectively. These figures fell to 21, 25, and 8 when the critical slope was increased to 5.0 dB/yr. With the critical slope held at 1.0 dB/yr and a statistical significance of $P<0.001$ the numbers of patients with a single deteriorating, improving point or both were 1, 0, and 0 respectively. These figures rose to 34, 35 and 18 when the statistical significance was set to $P<0.05$. Altering the critical slope within the range used is poor at separating field series showing deterioration from those showing improvement. Changing the statistical significance values within the range used offers better opportunities for separating deteriorating series from improving ones.

Supported by:MRC grant G9330070, IGA. Commercial Interest: None

9)

POINTWISE LINEAR REGRESSION OF GLAUCOMATOUS VISUAL FIELDS: A NEW APPROACH

AC Viswanathan, FW Fitzke, RA Hitchings.
Institute of Ophthalmology and Moorfields Eye Hospital, London, UK.

Background: Pointwise linear regression is an effective technique for the reliable early detection of glaucomatous visual field progression. However, if the regression is always begun from the first field in a series, it is possible that a decline in sensitivity will be detected relatively late if it occurs after a period of stability. Thus a new algorithm in which each field in a series was analysed with those following it (rather than those preceding it) was developed. **Purpose**: To compare the ability of the new algorithm to detect progression with conventional pointwise linear regression. **Methods**: All the patient records which satisfied the following selection criteria were drawn from the Moorfields Eye Hospital visual field database (64,949 visual fields): more than 19 fields for either eye, age > 40yr., false +ves and-ves < 33%, fixation losses < 20%, macular threshold ≥ 30 dB. If both eyes of a patient satisfied the criteria, one was chosen at random. Thus 27 field series were studied. The first 3 fields in each series were ignored to obviate learning effects: the following 16 were studied. Both the conventional and new algorithms were applied to each field series. The time taken from the start of each series until progression criteria (slope worse than -1 dB for inner points, -2 dB for edge points, $p < 0.001$) were satisfied by at least one retinal location was calculated for each algorithm. **Results**: The algorithms agreed that 20 series showed progression and 2 were stable. 5 series were detected as progressing by the new algorithm but not by the conventional one. No series were detected as progressing by the conventional algorithm but not by the new one. In the 20 series which both algorithms detected as progressing the new one detected progression by a mean of 0.85 years earlier ($p<0.01$, Wilcoxon Signed Rank test). **Conclusions**: The new pointwise linear regression algorithm appears superior to the conventional one.

The rate of visual field progression during long term of follow up of Normal Tension Glaucoma patients

10)

D Poinoosawmy, C Bunce,W L Membrey and RA Hitchings
Moorfields Eye Hospital, London, UK.

Purpose: To quantify visual progression over a period of 5 years in Normal Tension Glaucoma patients.

Methods: 178 patients with normal tension glaucoma were followed up for at least 5 years at Moorfields Eye Hospital with a maximum follow up of 15 years.Thirtytwo(18%) patients were on medical treatment, 72 (40%) patient had glaucoma surgery and 74(42%) were not on any treatment. Visual field progression was measured by linear regression using the Progressor program noting the number of progressing locations and mean slopes per year significant at 0.01 level. The Mean deviation(MD), corrected pattern standard deviation (CPSD) from the third and the last visual field were used to measure the rate progression. The mean diurnal IOP was taken as the baseline and the mean of the last three IOP were used to measure change in IOP.

Results: The cohort consisted of 64 (36%) men and 114(64%) women. Mean age 72 years(65,77) . The mean no of fields was 16(12,22). There were 120 (62%) of right and 117 (60%) of left eyes progressing at 5 (2-11) locations in right and 4 (2-9) locations with a mean rate of 2db per year in left eyes. The median change in mean deviation per year was –0.24 (-0.02 to –0.6) for right eyes and –0.35 (-0.03 to –0.7) in left eyes. Mean baseline diurnal IOP was 16.37 for right and 16.58 for left eyes that were progressing. Mean baseline diurnal IOP was 16.12 for right and 16.58 for left eyes that were not progressing. The mean of the last 3 IOP measurements was 11 for the right and left eyes in those patients who had surgery. The mean of the last 3 IOP measurements was 16 for the right and left eyes in those patients who had no treatment and those on medical treatment.

Conclusion: This study shows that approximately 60% of both right and left eyes show visual field progression over 5 years in normal tension glaucoma patients at 4-5 locations with a mean rate of 2dB per year. There was no difference in the baseline IOP between the progressing and non-progressing groups in either eye. The mean of the last 3 IOPs was significantly lower in those patients who had drainage surgery. There was no significant difference in these last IOPs between those on medical treatment and untreated patients.

OCULAR STABILITY DURING STATIC AND KINETIC FIXATION PERIMETRY.

11) P.Asman[1], E.Rhemtulla[2], D.Bay[2], M.Eizenman[2], A.Hoeltje[2], J.Flanagan[2,3]
[1]University of Lund, [2]University of Toronto, [3]University of Waterloo

Purpose: To quantify the stability of the fixating eye during static (central) fixation perimetry (SFP) and kinetic fixation perimetry (KFP) by monitoring real-time eye movements using a video based eye-tracking system.

Methods: The right eyes of 10 normal subjects (mean age 60 years) and 10 patients with glaucoma (mean age 70 years) were examined on two separate occasions using a Humphrey Field Analyser, Fastpac program 30-2, and a DICON tks4000 kinetic fixation, 76 point threshold test. The test sequence was assigned in a pseudorandom fashion and maintained at each session. Eye movements were recorded throughout visual field testing using a high resolution video-based eye-tracker (Series 2000; EL-MAR Inc). Data was recorded onto videotape and analysed using fixation analysis software (FAST™; EL-MAR Inc.). The standard deviation of the radial eye position (SDEP) was recorded during a 200msec time window following the onset of each stimulus presentation and was used as an index of the subject's fixation stability. The SDEP for each stimulus presentation was then averaged over the entire visual field examination.

Results: For the normal subjects the group mean SDEP for eye position was significantly greater ($p=0.002$) for KFP (0.37°) than SFP (0.19°), with all subjects demonstrating a greater mean SDEP for KFP. The glaucoma subjects showed a similar trend with 7 of the 10 glaucoma subjects demonstrating increased SDEP during stimulus presentation using KFP, although there was no significant difference in the group mean SDEPs (KFP 0.45°; SFP 0.41°).

Conclusion: In the 200msec during target presentation the SD of eye position was greater for KFP than SFP. This indicates that both normal and glaucomatous subjects find it more difficult to maintain steady fixation using the kinetic fixation technique.

12)

THE EVALUATION OF FIXATION DURING PERIMETRY USING A NEW FUNDUS PERIMETER

T. Murata, Y. Nishida, K. Yoshida, T. Iwami, K. Kani, Department of Ophthalmology, Shiga University of Medical Science, Otsu 520-2192, JAPAN

Fixation instability during perimetry decreases accuracy. It is very difficult for a small scotoma to be detected, when eye movements occur. In order to evaluate a fixation during perimetry, we measured it using a new fundus perimeter. The new fundus perimeter consists of an infrared fundus camera, a target device and a persuit device. The fundus of the subject was monitored by an infrared fundus camera, and shifts of the fundus due to eye movements were detected and calculated by a persuit device. The subjects were asked to gaze at a fixed target with a diameter of 30' on a color liquid crystal monitor for 5 minutes. The data were stored directly in the computer. In this experiment, 10 normal subjects were used. Although the deviations which were larger than 20' from the target were less than 10 % at the beginning, they gradually increased and exceeded 30 % after 5 minutes. It is very difficult even for normal subjects to stably gaze at the same point for a long duration. We will present data from various subjects in the presentation.

13) CENTRAL RETINAL SENSITIVITY WITH A SOCIAL DOSE ALCOHOL MEASURED WITH SCANNING LASER OPHTALMOSCOPE.

Fredrik Källmark
Dept.of Clinical Science. S:t Eriks Eye Hospital. Vitreo-Retinal Section.

Purpose: The purpose of this study was to investigate whether a social dose of alcohol significantly affected the fixation behaviour and central retina sensitivity, and also look for differences in visual acuity and contrast sensitivity.

Subjects and methods: Eighteen subjects 9 men and 9 women with a median age of 24.1 years(range22-28) were investigated with SLO (Scanning Laser Ophtalmoscope). During the test the computer registered the location of the actually fixation for each stimulus presented. The subjects were given red vine, which was calculated 40cl/70kg bodymass.
The vine was consumed during 30min. Measurement of the alcohol level was done with a Lion detector.
The fixation test was done before and 70min after the intake of alcohol.
Each registered fixation co-ordinate was calculated compared with the fixation object.

Results: A clear significant difference in fixation stability was shown (α=0.05), after alcohol intake. Mean difference were 1.11mm. SD=1.36mm. No significance in alcohol-levels between men or women could be proved, neither in visual acuity, contrast and central retinal sensitivity.

Conclusion: This study demonstrates that a social dose of alcohol not significantly affect the central retinal sensitivity, contrast sensitivity ore the visual acuity, but that the stability of fixation decrease significantly.
This indicates that not only decreased outer visual field and worsened reaction-time are factors that decrease the ability to handle a vehicle, but maybe could clearly reduced fixation-stability also be considered as an importuned factor.
Further investigations will be needed to tell whether the early instability in the fixation would decrease the ability to handle a vehicle.

1)

THE INDEPENDENCE OF PERIMETRY THRESHOLDS

R.S. Harwerth and E.L. Smith, III
University of Houston, Houston, Texas

Purpose. Reductions in perimetry thresholds caused by glaucoma should be proportional to retinal ganglion cell losses. However, there is considerable variability in neural deficits underlying visual defects, especially for defects of less than 15 dB and for those near the fovea. A potential source of the functional-neural variability is a lack of independence of perimetry thresholds between affected and non-affected retinal areas. Thus, we have studied the independence of perimetry thresholds via a noise-masking paradigm which produced regional variations in detection thresholds. **Methods**. Behavioral contrast sensitivity perimetry with rhesus monkeys was used to determine the effects of broadband dynamic visual noise on detection thresholds for Gabor patch stimuli. Specifically, the visual field effects of noise density levels that were systematically different in the superior-nasal and inferior-temporal quadrants were investigated. **Results**. Threshold elevations at any retinal location were directly dependent on the local density and contrast of the masking visual noise, and independent of the characteristics of more remote noise. **Conclusions**. The variance in ganglion cell losses for mild glaucomatous field defects are not explained by cognitive or neural interactive effects that are caused by either elevated thresholds or increased intrinsic noise of adjacent, more highly affected, areas of the visual field.

Supported by Alcon Laboratories, Inc. and NEI Core Grant EY 07751.

2)

DETECTION AND RESOLUTION THRESHOLDS IN THE FOVEA AND PERIPHERY FOR HIGH-PASS TUMBLING E'S

R.S.Anderson, F. Ennis and D.R.McDowell, Vision Science Research Group, School of Biomedical Sciences, University of Ulster, Coleraine.

In foveal vision, resolution is limited by the optics of the eye so that spatial frequencies higher than the Nyquist frequency of the retina do not get through. In peripheral vision, however, the limiting factor for resolution of gratings has been shown to be the sampling density of the retinal ganglion cells; specifically, the minimum angle of resolution (MAR) = spacing of retinal ganglion cells. Evidence for the sampling-limited nature of peripheral grating resolution comes from the observations of aliasing and the fact that detection acuity is higher than resolution acuity for a grating with the same mean luminance as the surround. We wished to determine if peripheral resolution for a high-pass Tumbling E stimulus is sampling-limited by separately measuring detection and resolution thresholds to determine if they are the same or different.

We generated 'high-pass' Tumbling E stimuli of different orientations with the same luminance profile as the rings used in high-pass resolution perimetry. Detection and resolution performance were separately measured using 2AFC temporal and 2AFC spatial (Right vs Up) strategies respectively, in both the fovea and at 30 degrees in the right nasal field of three trained observers.

'n the fovea, detection and resolution thresholds yielded identical values indicating that acuity is optically limited for this stimulus. In the periphery, however, detection thresholds were significantly higher than resolution thresholds for all subjects indicating that resolution is sampling limited for this stimulus. This means that we can use the stimulus as a perimetric target to independently measure detection and resolution thresholds in patients with glaucoma and so better separate optical and neural losses of vision.

3)

TUMBLING E RESOLUTION PERIMETRY USING STATIONARY AND FLICKERING TARGETS: SEPARATING M AND P CELL LOSS IN GLAUCOMA.

F. Ennis[1], R.S.Anderson[1], and S.J.A. Rankin[2],
[1]Vision Science Research Group, School of Biomedical Sciences, University of Ulster, Coleraine.
[2]Department of Ophthalmology, Queens University, Belfast.

Grating resolution has been shown to be sampling limited in the periphery, in particular by the density of retinal ganglion cells. Laboratory based experiments indicate that peripheral resolution is also sampling limited for a Tumbling E stimulus, meaning that this target can be used as a perimetric stimulus to measure localised ganglion cell density at different retinal locations.

We have designed a Tumbling E perimeter which measures peripheral resolution at 16 visual field locations using targets of four different orientations that are either stationary or phase-reverse at 30Hz. This allows us to separately measure the localised density of a sampling array that is predominantly composed of either P cells or M cells. The test has advantages over previous prototypes which employed gratings, in that it is more easily understood by the patient and allows a faster 4AFC psychophysical strategy.

Resolution measurements in normal observers show good qualitative and quantitative agreement with predicted resolution values based on anatomical counts of localised ganglion cell density. Preliminary measurements in glaucoma patients indicate patterns of visual field loss closely similar to those measured by Humphrey visual fields. However, early glaucoma patients display a greater reduction in resolution for the flickering E's indicating a selective loss of M ganglion cell density.

4)

COMPARISON BETWEEN THRESHOLD PERIMETRY AND SUPRATHRESHOLD PERIMETRY IN PUPIL PERIMETRY

S. Okuyama, C. Matsumoto, A. Iwagaki, S. Takada and T. Otori
Department of Ophthalmology, Kinki University School of Medicine, Osaka-Sayama, Japan

Purpose: Pupil perimetry has been performed with two methods. One of them is suprathreshold perimetry and the amplitude or ratio of pupil constriction is determined and evaluated. Another one is threshold perimetry in which the threshold of pupil reaction is determined. We compared the examined values obtained with these two methods using the modified Octopus 1-2-3.

Subjects and Methods: Pupil perimetry was performed in ten normal subjects in the upper nasal field on the 135° meridian within the central 30° visual field using the background luminance of 3asb, the stimulus size of 5 and the stimulus duration of 200msec. In suprathreshold perimetry, the ratio of pupil constriction was measured using the stimulus intensity of 6dB(1030asb). In threshold perimetry, the lowest stimulus intensity that caused pupil reaction was determined when the stimulus intensity gradually increased by the step of 1dB.

Results: The ratio of pupil constriction and the threshold value of pupil reaction were well correlated (Spearman's rank correlation coefficient=0.67, n=80, $P<0.001$). Interindividual and intraindividual variations in suprathreshold perimetry were larger than those in threshold perimetry. The examination time of suprathreshold perimetry was much shorter than that of threshold perimetry.

Conclusion: Suprathreshold pupil perimetry was more convenient for clinical use than threshold pupil perimetry.

5) BINOCULAR SUMMATION WITHIN THE BINOCULAR VISUAL FIELD

A. Wakayama, C. Matsumoto, A. Iwagaki and T. Otori
Department of Ophthalmology, Kinki University School of Medicine, Osaka-Sayama, Japan

Purpose: To study the influence of binocular stimulation on the central visual field under the monocular and binocular conditions, we modified Octopus 201 by the combined use of the space synoptophore.

Subjects and Methods: The subjects were 10 normal subjects between 20 and 30 years of age. A space synoptophore was built in the cupola of Octopus 201 in order to measure monocular and binocular sensitivity in the central visual field. Sensitivity of the visual field was measured by the use of fusional patterns displayed by the space synoptophore. Forty seven points in the central 6° visual field were tested with the SARGON program and the stimulus size 3.

Results: The mean sensitivity in the central 6° visual field were 30.5 dB in the right eye, 30.6dB in the left eye and 32.4 dB in both eyes. The difference in foveal sensitivity was 4.0 dB between the monocular and binocular conditions.

Conclusion: This type of set-up by the combined use of Octopus 201 and the space synoptophore was useful for the assessment of binocular summation.

6) ABNORMAL MAXIMUM LINE DISPLACEMENT SENSITIVITY & FREQUENCY-OF-SEEING CURVES FOR A MOTION STIMULUS IN GLAUCOMA

((M.C.Westcott[1], F.W. Fitzke[1], D. Poinoosawmy[2]))
Institute of Ophthalmology, London, UK[1]; Moorfields Eye Hospital, London, UK[2].

Purpose: To investigate frequency-of-seeing (FOS) curves and maximum line displacement (LDmax) sensitivity differences between glaucoma eyes and normals.
Method: 28 normal eyes, 28 glaucoma suspect and 29 POAG eyes underwent motion sensitivity testing in the superotemporal field. FOS curves were generated for a line stimulus undergoing displacements 0-18 min. arc. Motion thresholds and slopes of the FOS curve were obtained by probit analysis. Responses to greater magnitudes of displacement were analysed to determine sensitivities to maximum line displacement (LDmax).
Results: Similar to previous findings, minimum motion thresholds were abnormal in 6/28 suspect and 22/29 glaucoma eyes and the slopes of the FOS curves were abnormally shallow in 14/28 of the suspect and 21/29 glaucoma eyes at the test location. In 28/29 of the normal controls the response rate showed no drop-off at the maximum displacements. However, 8/28 suspect and 14/29 of the glaucoma eyes had abnormally reduced responses to the maximum displacement (18 min. arc). Overall LDmax. was significantly lower in the suspect and glaucoma groups compared to controls, with 8/28 (29%) suspect eyes and 14/29 (48%) glaucoma eyes having LDmax. less than 18 min. arc compared with 1/29 (3%) controls ($P < 0.0005$, ranked test). This drop-off contributed to the shallowing of the probit slope.
Conclusion: Differences exist in the motion FOS response between glaucoma eyes and normals, which may not be evident on analysis of the threshold alone. Abnormal shallowing of the slope of the FOS curve may be associated with LDmax. abnormalities in glaucomatous eyes for line displacement motion. Responses are decreased for larger amplitudes of displacement as well as for the minimum thresholds for displacement.
Supported by the Friends of Moorfields and the International Glaucoma Association, London, UK.

7)

INTENSITY DISTRIBUTION BENEATH AN ARTIFICIAL VESSEL – IMPLICATIONS FOR ANGIOSCOTOMA

C.HOFMANN[1], U.SCHIEFER[2], E.PLIES[1]

[1] Institute of Applied Physics, University of Tübingen, Auf der Morgenstelle 10, D–72076 Tübingen, Germany

[2] University Eye Hospital, Dept. II, Schleichstr. 12–16, D–72076 Tübingen, Germany

High resolution perimetry is capable of detecting angioscotomata. The fundamental physically based intensity distribution beneath a vessel is, however, not measurable by perimetry.

A computer based physical simulation of artificial vessels (i.e., thin glass cannulas filled with dye) using a ray tracing model has been developed. Thereby, refraction and absorption are taken into account. The simulations show a strong dependency on refraction phenomena, which result in a lens-like focussing effect and a dependency on the distance between the vessel and the plane beneath the vessel, where the lateral intensity distribution is calculated.

Experimental measurements on glass cannulas filled with dye as well as on the retinal vascular system of cow retinas confirm these calculations. The experimental setup consists of a Zeiss–microscope Ultraphot II with a mounted CCD–camera, 756 x 580 pixel, 8 bit resolution. The intensity distribution in any focus plane is obtained by a software–generated line–scan across the vessel.

In conclusion, angioscotomata influence the light mainly by refraction and absorption, less by scattering (reduced scattering length of human blood $\approx$ 1 mm). The intensity distribution of the influenced photoreceptor area can be predicted by computer simulation. This can be helpful for interpreting high resolution perimetric results of angioscotomata and implementing a more precise threshold prediction.

1) SENSITIVITY TO GLAUCOMATOUS VISUAL FIELD LOSS IN FULL THRESHOLD, SITA STANDARD, AND SITA FAST TESTS

Boel Bengtsson and Anders Heijl
Department of Ophthalmology
Malmö University Hospital, Malmö, Sweden

When viewing grayscale representation of measured threshold values, SITA Fast test results often appear more normal than those obtained with the Full Threshold strategy from the same eye. The reason is probably reduced visual fatigue in the new short test. A similar tendency may appear with the semi-fast SITA Standard strategy. Data collected to establish normal limits and probability maps for the SITA strategies show that inter-individual variability is smaller with both SITA strategies than with the Full threshold resulting in narrower normal limits and more sensitive probability maps. We compared threshold values and number of significantly depressed points in tests obtained with the three strategies in one eye of each of 44 glaucoma patients. SITA Fast showed highest light sensitivities and Full Threshold lowest. Average number of significantly depressed points was higher with both SITA Fast and SITA Standard than with Full Threshold, however. Thus, defects were more prominent in Full Threshold tests when comparing grayscale printouts of threshold values, while both SITA versions yielded at least as extensive significant defects as those obtained with Full Threshold.

2) THE CHARACTERISTICS OF SITA PROGRAM ON HFA

Aiko Iwase M.D*,**., Yuko Ohno M.D+,Reiko ShirakiM.D*,**.,Satoko Tuji Ph.D+. and Yoshiaki KitazawaM.D,PhD**

Dept. of Ophthalmol. Tajimi Municipal Hospital*,Dept.HC.Epi AHS Faculty of Med. Osaka Univ+.and Dept. of Ophthalmol. Gifu Univ Medicine **,Japan

SITA (Swedish Interactive Thresholding Algorithm) on the Humphrey Visual field Analyzer can shorten the test time ,but the sensitivity value with SITA was significantly better than that with the Full Threshold in general. We studied in the difference in the sensitivity value of the each test point with three methods (Full Threshold(FT),SITA Standard(SS),SITA Fast(SF)) in 60 glaucom eyes and demonstrate the characteristics of SITA .The difference could be classified in to three patterns.1)the SITA sensitivity > Full Threshold sensitivity :in the vast majority of points the variability of the sensitivty value with SITA was smaller than that of FT ,this was more distinct with SITA Standard. 2) the SITA sensitivity = FT sensitivity ;the variability was the largest ,this was commonly associated with a lower sensitivity 3) the SITA sensitivity < that with FT;the variability with SITA was tended to be larger than that with FT.This caharacteristics indicate the need for the specific evaluation method of SITA Standard.

3) The Swedish Interactive Thresholding Algorithm (SITA) in Patients with Prior Experience with the Full Threshold Humphrey Field Analyser.

Automated perimetry has revolutionised the assessment of glaucoma patients in general ophthalmological practice. Worldwide, the Humphrey Field Analyser has dominated, particularly with the development of Statpac II and the gradual improvements in the software algorithm associated with full threshold strategies.

SITA is the latest and most radical development of this algorithm. Application of Statpac II methodologies to SITA testing awaits ongoing data collection - both normative and glaucomatous - and application.

Perimetrically - experienced patients were tested by means of SITA. Preliminary analysis of data revealed that testing time was reduced on average by 40%, reliability increased by 25%, average sensitivity increased by 3dB and scotoma size was decreased in 50% of patients. Some early scotomas may be missed. Universally, patients preferred the SITA programs compared with the full threshold strategy.

4) **COMPARING SITA AND STANDARD THRESHOLD STRATEGIES**

Paolo Capris, Giuseppe Gatti, Guido Corallo, Silvia Romiti, Mario Zingirian, *Enrico Gandolfo
University Eye Clinic of Genoa, *University Eye Clinic of Brescia

PURPOSE: the new software SITA (Swedish Interactive Thresholding Algorithm) for the HFA 750 II (Carl Zeiss Group) is presently available. This algorithm is a self correcting, self directing visual field operating system that allows a consistent examination time reduction and accuracy improvement.
The aim of this study is the comparison of this new algorithm with the standard full threshold strategy in a group of 32 subjects (63 eyes) with normal and damaged visual field (stages 0-3 localized and mixed of Brusini's Glaucoma Staging System).

METHODS: Every subject underwent visual field examination with SITA and standard strategy in a randomized order (program central 30-2) with a mean time interval of 115± 15 minutes. In a group of 10 patients the two examinations were repeated in a second session 7 days after.

RESULTS: The mean sensitivity measured with SITA software was 0.444 dB better then standard strategy. This difference was not homogeneous in the different locations of the pattern. The reliability indices were not significantly different with the two algorithms. The examination time was significantly shorter for SITA (363.13 ± 86 sec.) than standard strategy (737.98 ± 15.7 sec).
The global and point per point long term fluctuation with the two algorithms, evaluated in the twice tested group which was significantly correlated with light sensitivity.

5) **SCREENING OF EARLY GLAUCOMATOUS VISUAL FIELDS USING SWEDISH INTERACTIVE THRESHOLDING ALGORITHMS(SITA)**

Yoshiaki Tanaka, Hidetaka Maeda and Satoshi Matsubara, Rokko Island Hospital /Kobe University, Kobe,JAPAN

Purpose: SITA is a new perimetric algorithm desigend to shorten the test procedure for thresholding sensitivity with accuracy. The purpose of this study is to evaluate the performance of SITA as a glaucoma screening program. Subject & Methods: Twenty eyes with ocular hypertension and 22 with primary open-angle glaucoma were subjected. We compared the result of Armary central screening program and Central 30-2 Thershold Program with SITA-Fast Algorithm obtained in Humphrey Field Analyzer Model 750. Result: Average test time was shorter in SITA(227.0sec) than that in Armary screening (255.4sec). The difference was larger in glaucoma group. Screening performance was 90.1% in Armary screening and 81.8% in SITA group. Conclusion: SITA reduced the screening time of glaucoma up to 15%, but in some case underestimate the defect, and this may lead to errors in early detection of visual field defect in ocular hypertension.

6) COMPARISON OF SITA AND DYNAMIC STRATEGIES WITH THE SAME EXAMINATION GRID

C.T. Langerhorst, L.L. Carenini, D. Bakker and M.A.C. de Bie-Raakman

Department of Ophthalmology, Glaucoma Unit, Academic Medical Center of the University of Amsterdam, Amsterdam, The Netherlands

In modern automated perimetry, several programs have been developed which allow for shorter examination time without loss of information. We compared the SITA-standard strategy of the Humphrey Field Analyzer 750 with the dynamic strategy of the Octopus 101.

Patients examined: 100 well- documented glaucoma patients with stable glaucomatous field defects in varying stages of severity, and 20 neuro-ophthalmological patients. Also 20 normal control subjects.

Programs used: HFA 30-2 and Octopus 32 in all patients, 10 degree programs in some.

Results: comparison will be illustrated with printouts of typical examples, and with numerical comparison of indices and significance of defects.

Purpose: to provide a practical basis for choosing the optimal strategies in daily practise.

7) EVALUATION OF RESULTS OF SITA AND FULL-THERESHOLD STRATEGIES IN THE LAW SENSITIVE AREAS

Yoko Aoki, Genichiro Takahashi, Takeshi Koike, Kenji Kitahara
Department of Ophthalmology, Jikei University School of Medicine,
Tokyo, Japan

We compared the depth and width in the law-sensitive areas with SITA and full-threshold strategies. The subjects were 20 patients (20 eyes) with primary open-angle glaucoma, 2 patients (2 eyes) with retinal disease, 2 patients (2 eyes) intracranial disease. SITA-standard and full-threshold static perimetry was performed with program 30-2 using the Humphrey Field Analyzer. The deficits were more shallow and the law-sensitive areas were smaller with SITA than with full-threshold strategies in almost all patients. When results with SITA and the traditional full-threshold strategies are evaluated, differences in the depth and width of the law-sensitive areas should be considered.

8) TEST TIME AND EFFICIENCY OF A NEW STATIC THRESHOLD ALGORITHM IN GLAUCOMATOUS EYES

Hidetaka Maeda, Satohsi Matubara, Yoshiaki Tanaka, Makoto Nakamura
Department of ophthalmology, Kobe university, Kobe, Japan

Purpose: To investigate the time-wise reliability and efficiency of a new perimetric test algorithms, two computerized static threshold perimetry strategies namely, dynamic strategy (DS) and tendency oriented perimetry (TOP) were compared. **Method:** We examined 32 eyes of 32 glaucoma patients with the Normal strategy (4-to-2 dB), the DS and the TOP using a modified Octopus 1-2-3 perimeter. We analyzed the test time and the global indices ,short-term fluctuation(SF), mean defect (MD) and corrected loss variance(CLV). Test grid pattern used was program 32X. **Results:** The mean test time was reduced by 52% with the DS and by 68% with the TOP. Three early glaucoma cases were not detected by TOP., while glaucomatous visual field defects could be detected by normal and DS. For global indices, we recognized a tendency toward depression of mean retinal sensitivity in DS compared with normal strategy. **Conclusion:** The DS was considerably more efficient than the TOP for detection of the early glaucomatous defects, whereas TOP was found to be beneficial since it required less testing time.

9) INTRA-INDIVIDUAL INTER-TEST FLUCTUTATION BY SITA-S and FASTPAC

Erkan Mutlukan MD PhD, Henry Ford Hospital, Detroit

The pointwise intra-individual inter-test variability of Swedish Interactive Threshold Algorithm-Standard (SITA-S) was studied and compared against FASTPAC strategy. A group of ten eyes (6 right and 4 left) of ten experienced patients with glaucomatous optic neuropathy were tested twice with each of the FASTPAC and SITA-S strategies using C24-2 grid, standard parameters and default fixation monitoring. Non-parametric 2-tailed sign and Friedman Test were used for comparisons. At normal test locations (n=177), FASTPAC repeat tests produced mean+/-standard deviation results of 27.38 $\pm$ 2.82 dB (range 19-32 dB) and 27.24 $\pm$ 2.90 dB (range 16-34 dB) (p=0.202) indicating no fatigue effect. SITA-S re-test results at the identical areas were 28.03$\pm$3.3 dB (range 13-34 dB) and 27.63$\pm$4.0 dB (range 5-33 dB) (p=0.061) without fatigue. SITA-S overestimated the decibel thresholds for an average of 0.38 dB compared to FASTPAC (p<0.001). FASTPAC inter-test variability was 1.7$\pm$1.4 dB and, SITA-S inter-test variability was 1.8$\pm$2.1 dB (p=0.733). At abnormal test locations (n=343), FASTPAC pointwise results were 19.86 $\pm$ 6.9 dB (range 0-32 dB). SITA-S results at the identical areas were 21.04$\pm$6.7 dB (range 0-32 dB) (p<0.001) with an average of 1.1 dB underestimation of scotomas. Inter-test fluctuation was 4.4 $\pm$ 4.3 dB (range 0 - 23 dB) for FASTPAC and, 3.5$\pm$3.9 dB (range 0 - 29 dB) for SITA-S (p=0.004). The average test durations were 418$\pm$89 seconds (range 333-569 seconds) for 20 FASTPAC tests and, 403$\pm$80 (range 329 - 545 seconds) for 20 SITA-S tests. The average time saving with the use of SITA-S was 15 seconds (3.7%) and that was insignificant (p=0.109). In conclusion, SITA-S provided significantly less inter-test intra-individual fluctuation and 1.1 dB underestimation of scotomas when compared to FASTPAC and without significant time saving when full fixation monitoring is employed.

10) **COMPARATIVE EVALUATION OF FOUR STRATEGIES (NORMAL, 2LEVEL, DYNAMIC, TOP) USING THE AUTOMATED PERIMETER OCTOPUS 1-2-3**

S. Takada, C. Matsumoto, S. Okuyama, A. Iwagaki and T. Otori
Department of Ophthalmology, Kinki University School of Medicine, Osaka-Sayama, Japan

Purpose: Dynamic strategy and tendency oriented perimetry (TOP) are new programs for reducing the test duration of perimetry. We compared these new strategies with normal and 2 level strategies in normal subjects and glaucoma patients.

Subjects and Methods: The subjects were 25 eyes of 25 normal (23-61 years old) and 40 eyes of 24 glaucoma patients (28-73 years old). We measured the visual field using four strategies (normal, 2 level, dynamic and TOP) and compared their test duration, number of questions, sensitivity and specificity. We also studied the correlation of MD and LV between normal strategy, dynamic strategy and TOP.

Results: Dynamic strategy showed about 30 % decrease in the test duration than normal strategy. TOP showed that the test duration was only about three minutes in all examinations. In early glaucoma patients, sensitivity of dynamic strategy and TOP was equal to that of normal strategy. In patients of stage 1 by Aulhorn classification, sensitivities of dynamic strategy and TOP were 94.1%. However, specificity of TOP was low (78.6%). The correlation of MD between normal strategy, dynamic strategy and TOP was excellent. The coefficients of correlation between normal strategy and dynamic strategy were 0.98 (MD), 0.96(LV), and those of correlation between normal strategy and TOP were 0.97(MD), 0.92 (LV).

Conclusion: Dynamic strategy and TOP are useful programs for the purpose of reducing the test duration of perimetry.

Scientific Session V: Tuesday September 8 8:30-10:00 New Algorithms (SITA & TOPs)

11) G1-TOP PROGRAM: INTRODUCTION AND COMPARISON WITH G1-STANDARD BRACKETING

González de la Rosa M.[1], Losada M.[1], Serrano M.[1], Morales J.[2]
1: Univ. La Laguna-Spain, and 2: Texas Tech University, HSC, Lubbock, Texas

Purpose: The G1-TOP program sub-divides the G1 grid of 59 points into four sub-grids which are tested sequentially, and adds 10 extra points. Each point is tested only once. Each patient's response is utilized to modify that particular point and the surrounding points from the remaining sub-matrixes, taking into account their distance. Methods: This study consisted of 106 eyes (78 patients) with a mean age of 54.9±17.2 years. The sample consisted of 15 normal eyes, 47 with early glaucoma (MD<7dB), 21 with advanced glaucoma, 12 eyes with visual fields originating from neurological disorders and 11 with abnormal fields from chorioretinal lesions. All subjects were examined consecutively with the G1-standard and G1-TOP programs using the Octopus 1-2-3 perimeter. Results: The results of the G1 version of the TOP algorithm were similar to the ones obtained previously with the 32 version. Excellent correlation was found between the indices in the two examinations and with respect to point by point analysis. G1-TOP produces on average a mean sensitivity which is 0.45dB thresholds higher than G1-standard. Mean duration of the test for G1-TOP was 2:19±0:36 min., while G1-standard took 11:15±1:17 min. (relation G1TOP/G1standard: 1/4.9, or a net reduction of 79.4%). Normal individuals had the same MD (TOP Vs Bracket. 0.2±1.0 and 0.2±1.5dB) (p>0.05) and the LV value was significantly smaller with TOP (TOP Vs Bracket. 4.3±4.1and 11.0±13.0dB) (p<0.05) .Conclusions: G1-TOP program produces very similar results to G1-standard in a small fraction of the time utilized by the traditional bracketing strategy.

r: correl. coeffic.
s.e.: st.error YX (dB)

	Total MD		MD (SN)		MD (IN)		MD (ST)		MD (IT)		sLV		Thresh.	
	r	s.e.	r	s.e.	r	s.e.	r	s.e.	r	s.e.	r	s.e.	r	s.e.
TOP Vs BRACKETING	0.97	1.52	0.96	2.15	0.95	2.08	0.95	1.95	0.96	1.88	0.90	1.17	0.85	4.18

12) REPRODUCIBILITY OF THE TOP ALGORITHM RESULTS VERSUS THE ONES OBTAINED WITH THE BRACKETING PROCEDURE

González de la Rosa M., Martinez Piñero A., González Hernandez M.; Univ. La Laguna-Spain

Purpose: To compare the reproducibility and agreement between different global indices obtained with TOP strategy versus the standard bracketing procedure (BP). Methods: 54 patients (54 eyes) with age 55.2±15.4 years: 14 normal subjects, 14 with ocular hypertension and early glaucoma (MD<7dB), 11 with advanced glaucoma, 12 with neurological pathology and 3 with chorioretinal lesions. All were examined with standard 32 program twice and with TOP program twice utilizing the Octopus 1-2-3 including re-testing of point where the patient did not respond at the beginning of the test. Results: Test duration: 2:57±0:15 min.(TOP) and 13:56±1:40 min.(BP).Excellent correlation was found between the indices in the four examinations. Point by point differences were slightly smaller when each strategy was compared with itself than when the comparison was made with the other strategy, but in all cases there was minimal dispersion. TOP produces, on average, 1.57 dB higher thresholds. In TOP, threshold fluctuation was less (1.54±2.14 dB) than with the BP (1.95±2.42 dB) (P<0.01) and the reproducibility of the MD value was higher (r=0.997, MD Fluct.: 0.35±0.31dB) than with the BP (r=0.977, MD Fluct: 0.94±0.92 dB) (p<0.01). Conclusions: The TOP algorithm seems to result in better reproducibility, decreasing MD fluctuation 63%, and duration of the test 78.8% when compared with the standard strategy. The differences between TOP and BP are similar in magnitude to those observed between two exams performed at different times with the traditional bracketing strategy.

r. correl. coeffic.
s.e. st.error YX (dB)

	Total MD		MD (SN)	MD (IN)	MD (ST)	MD (IT)	sLV		Thresh.	MD Dif.	MD Fluct.
	r	s.e.	s.e.	s.e.	s.e.	s.e.	r	s.e.	s.e.		
TOPa Vs TOPb	0.997	0.66	1.73	1.66	1.26	1.42	0.98	0.67	3.66	0.09	0.35
32a Vs 32b	0.977	1.89	2.12	2.65	1.9	2.2	0.95	0.85	4.28	0.22	0.94
TOPa Vs 32a	0.983	1.58	2.27	2.46	2.12	2.07	0.85	1.68	4.73	1.64	
TOPb Vs 32b	0.979	1.74	2.29	2.48	2.4	2.02	0.9	1.42	4.74	1.49	

13) FLICKER-TOP PERIMETRY IN NORMAL, OCULAR HYPERTENSIVE AND EARLY GLAUCOMA PATIENTS

González de la Rosa M., Rodriguez J., Rodriguez M. Univ. La Laguna (Spain)

Purpose: To evaluate sensitivity, specificity and early glaucoma diagnostic capabilities of the TOP algorithm utilizing Flicker Perimetry. **Methods:** A regular TOP program for Octopus 1-2-3 was modified using the examination protocol proposed by Matsumoto et al(1) as follows: Grid type "32", background 31.5asb, size Goldmann III, constant intensity of 4.000asb, sampling time of 1 second and variable frequency. Taking into account the normal values described by this author and those regularly used by the perimeter, stimuli were generated using a value denominated "dB-Flicke equivalent". Each dB is equivalent to 1.25Hz, but no other modifications are made to the TOP strategy. 45 eyes of 45 normal patients were examined (17 with previous perimetric experience and 28 without it), 30 with ocular hypertension (normal TOP-standard visual field and optical papila) and 23 patients with early glaucoma (MD<7dB). **Results**: Mean duration of the flicker test was 4:01±0:22 min. The results for Flicker-MD were: Normal -0.94 ±1.67dB. Ocular hypertension 6.58±6.04dB Early glaucoma 9.37±6.66dB. The majority of the normal patients had normal results for TOP-Flicker (93.3% for MD<2dB). Some normal patients without perimetric experience had hypernormal results (36% for MD<-2dB). 21 (70%) eyes with ocular hypertension had pathological TOP-Flicker perimetry (MD>2dB). Flicker perimetry was abnormal in all of the early glaucoma patients and more abnormal than standard perimetry in 19 (82.6%) patients. The correlation between both types of perimetry was low (r=0.39 for MD and r=0.20 for LV) although better in the Bjerrum area (r=0.50). Point by point correlation is also very low (r=0.25). **Conclusions:** TOP-Flicker perimetry demonstrated a specificity of 93.3% and sensitivity of 100% for patients with early glaucoma. It considered pathological 70% of eyes with ocular hypertension. Flicker perimetry might prove a good screening system for the initial phases of glaucomatous damage.

1) **Matsumoto el al.** *Automated flicker perimetry using theOctopus 1-2-3.* Perimetry Update 1992/1993, Amsterdam Kugler Publ. 1993 ; 435-440.

1)

GLAUCOMATOUS OPTIC DISC BORDER DEPRESSION CORRELATES WITH VISUAL FIELD CPSD IN PRIMARY OPEN ANGLE GLAUCOMA

Reinhard O.W. Burk, Thomas U. Bartke, Klaus Rohrschneider, Hans Eberhard Völcker
Department of Ophthalmology, University of Heidelberg; INF 400, D-69120 Heidelberg, Germany

Purpose: The diagnosis of manifest primary chronic open angle glaucoma (POAG) is based on structural changes of the optic disc and retinal nerve fiber layer in association with glaucomatous visual field defects. We evaluated the correlations between corrected pattern standard deviation of static perimetry (CPSD) and optic disc border topography in eyes with glaucomatous visual field defects (GVFD) in different locations.

Patients and Methods: We measured the contour-line modulation (CLM; segment height differences between the temporal superior (TSO-TQ) and temporal inferior octant (TIO-TQ) to the temporal quadrant along the optic disc border) in 111 eyes of 111 persons. All control subjects (N; n=33) had normal visual fields. The glaucoma patients were divided according to GVFD into four groups: localized GVFD in the upper nasal quadrant (A; n=26), lower nasal quadrant (B; n=20), upper hemifield (C; n=17) and lower hemifield (D; n=15). Topometry (10°, triple measurements) was performed with the Heidelberg Retina Tomograph HRT, perimetry was done with the Octopus 500 (Interzeag AG).

Results: The CPSD values [dB; MW±SEM] were 1.2±0.16 (N), 5.9±0.41 (A), 5.6±0.55 (C), 7.0±0.39 (D) and 7.6±0.86 (D). CLM-values [µm] (TSO and TIO) of normals were significantly ($p<0.01$) higher as compared to all other glaucoma groups: N TSO 207±12; A 135±17; B 90±12; C 95±16; D 75±13. N TIO 211±12; A 75±13; B 95±17; C 55±15; D 90±14. For all eyes, Spearman Correlation was -0.464 ($p<0.001$) for TSO and -0.551 ($p<0.001$) for TIO, respectively.

Discussion: The results demonstrate, that disc border CLM values are useful topometric variables which might be used to indicate functional damage based on structural parameters.

Supported by DFG Vö 437/1-2

2)

MORPHOPMETRIC PARAMETERS IN NORMAL TENSION AND HIGH TENSION GLAUCOMA.

Iester M[1,2], Mikelberg FS[1], Courtright P[1], Drance SM[1]- [1]) Department of Ophthalmology, University of British Columbia, Vancouver, Canada; [2]) Department of Ophthalmology, University of Genoa, Genoa, Italy

Purpose: To determine the morphometric parameters in high tension and normal tension glaucoma with scanning laser ophthalmoscopy.

Methods: One hundred and 71 glaucomatous patients were recruited for this study. For each patient only one eye was randomly chosen. Normal and high tension glaucomatous patients were classified by considering intraocular pressure (IOP): normal tension glaucoma group had IOP = < 21 during a diurnal tension curve, while high tension glaucoma patients had IOP > 21 mm Hg in at least three measurements. All the patients were examined with Humphrey perimeter, program 30-2, and Heidelberg Retina Tomograph (HRT). Finding were assessed by Student't test, Pearson's correlation coefficient and multiple linear regression.

Results: 124 high tension glaucoma eyes and 47 normal pressure glaucoma eyes were assessed. No significant differences were found between high tension and normal tension glaucoma eyes for any of the morphometric parameters.

Conclusion: No differences were apparent between the morphometric parameters as measured by scanning laser ophthalmoscopy in patients with high tension and normal tension glaucoma.

RELATIONSHIP BETWEEN PERIMETRIC LIGHT SENSITIVITY AND OPTIC DISC NEURORETINAL RIM AREA

3) D.F. Garway-Heath, A. Viswanathan, M. Westcott, D. Kamal, F.W. Fitzke, R.A. Hitchings
Glaucoma Unit, Moorfields Eye Hospital, and Institute of Ophthalmology, London, U.K.

Aims: to explore the relationship between perimetric light sensitivity (LS) and neuroretinal rim area (NRR) in regions of the visual field and corresponding sectors of the optic nerve head.

Methods: 69 normal subjects (mean age 57.7 years, s.d. 12.0) and 33 with early glaucomatous field defects (mean age 66.5 years, s.d. 8.7) underwent Humphrey 24-2 field testing and imaging with the Heidelberg Retina Tomograph. NRR was expressed as a percentage (%) of the area expected for age of subject and optic disc size, for the whole disc (global) and 6 predefined segments. The field was divided into corresponding areas. Mean stimulus intensity (global and segmental) was converted from decibels to apostilbs. LS was calculated as the reciprocal of intensity, and expressed as the % expected for the age of subject. Linear regression was performed between % NRR and % LS.

Results: the relation between % NRR and % LS was linear in all segments and significant ($R^2 > 0.10$, $p < 0.01$) for global ($R^2 = 0.26$), temporal inferior (TI) ($R^2 = 0.31$), temporal superior (TS) ($R^2 = 0.23$), and nasal inferior (NI) ($R^2 = 0.16$) segments. For a 3dB loss (LS 52% expected), the % expected NRR was: global 52%, TI 38%, TS 41% and NI 55%.

Conclusions: the relation between LS and NRR is strongest in the TI and TS segments. A global 3dB loss equates with a 48% loss of NRR.

COMPARISON BETWEEN OPTIC NERVE HEAD TOPOGRAPHY AND RESOLUTION VISUAL FIELDS IN GLAUCOMA DIAGNOSIS

4) **Lene Martin & Ulrika Gedda, Dept. of Clinical Science,
Karolinska Institute, Stockholm, Sweden**

Purpose: To evaluate the concordance between results, obtained with the Heidelberg Retina Tomograph (HRT) and the high-pass resolution perimeter (HRP), in patients with glaucoma and ocular hypertension, and to evaluate the repeatability of the HRT technique.

Subjects and Methods: Fifty patients were examined because of glaucoma, suspected glaucoma or ocular hypertension. Concordance between the automatic classifications performed by the software included in these instruments was evaluated. In addition, the repeatability of the HRT classifications was estimated by erasing and redrawing the contour lines. The original drawings were made by different examiners, and the re-drawings by one well-trained technician.

Results: In 72% (32/42) of the right eyes and in 70% (26/37) of the left eyes the HRT and HRP software agreed on the classification. Both tests conformed in both eyes in 18 of the 28 patients (64%), in whom both eyes were examined. In seven patients (25%) concordance was observed in one eye. When redrawing the original contour lines the HRT classification changed in five eyes; from normal to glaucoma in two eyes, and from glaucoma to normal in three eyes.

Conclusion: A good agreement was observed between optic nerve topography changes, analyzed with the Heidelberg Retina Tomograph, and resolution perimetry abnormalities. The repeatability of HRT findings appeared adequate. A larger study is currently performed in order to clarify if differing results from these two examinations have any clinical significance.

5)

MAY RETINAL NERVE FIBER LAYER BE "NORMAL " IN PRIMARY OPEN ANGLE GLAUCOMA ?

M. Marraffa, R. De Natale, R. Morbio, L. Tomazzoli, L. Bonomi, University Eye Clinic of Verona, Italy

Most recent literature has stated the outcome of retinal nerve fiber layer loss to be earlier than visual field defects in POAG. Neverthless we would like to investigate if the anatomical lesion of the nerve fibers preceed anytime the onset of visual field defects.

A group of 54 eyes affected by POAG were studied. Visual field was examined with the Humphrey Field Analyzer (Zeiss) by using program 30-2. The Nerve fiber Analyzer (Laser Diagnostic Technologies) was used to study the retinal nerve fiber layer of these patients.

Mean deviation of visual field was ranging from 6 db to 31 db in all the examined eyes. The average thickness of retinal nerve fiber layer was ranging from 20 to 90 microns. According to our previous experiences 75 microns was fixed as an arbitrary value to be considered as border point between normal and pathological value of NFL thickness. We could isolate 5 eyes with a NFL thickness over 75 microns and a visual field with a mean deviation over 6 db.

9 % of the studied eyes showed to have a visual field defect with no changes in NFL, according to our selection criteria.

We explain our results considering that not all subjects have the same NF endowment and therefore is possible to underestimate the NF changes. Our study remarks anyway how the concept of normal and altered has to be considered as a relative one for all the aspects caractherizing the glaucomatous disease.

6)

MEASURING EYES WITH LARGE OPTIC DISCS USING NERVE FIBER ANALYZER GDx

Lan Wang, MD; Padma Karyampudi, MD; Philip P Chen, MD; Richard P Mills, MD
University of Washington, Seattle, Washington, USA

PURPOSE: To determine if "large" optic discs need a separate normative database when undergoing scanning laser polarimetry of the nerve fiber layer.

METHOD: Scanning laser polarimetry (GDx, Laser Diagnostic Technologies, San Diego, CA) was used to image 96 "large" optic discs, chosen when a centered optic disc displayed "not enough pixels" with the default measurement band of 1.75 disc diameters (DD). Other measurement bands (1.4–1.6 DD) were tested to determine the optimal measurement band for "large" discs, which proved to be 1.4 DD. Using a different group of "normal sized" optic discs (N=95; 46 normal, 49 glaucoma), we compared results at 1.75 DD to determine the parameters that could differentiate between normal and glaucomatous eyes. Then, using the 95 "normal sized" eyes, polarimetry was compared, and the effect of peripapillary atrophy assessed, to determine if data obtained at 1.4 DD were comparable to the normative database obtained at 1.75 DD.

RESULTS: Only at 1.4 DD could all "large" optic discs be measured with the GDx. Of 56 GDx parameters, 26 were helpful in "normal sized" optic discs to differentiate between normal and glaucomatous eyes at 1.75 DD. However, results with the same group of "normal sized" optic discs at 1.4 DD compared to 1.75 DD were significantly different in 16 of the 26 parameters. Exclusion of eyes with peripapillary atrophy touching the 1.4 DD measurement band still resulted in significant difference in 11 of the 26 parameters.

CONCLUSION: All "large" optic discs could be measured only when the measurement band was reduced to 1.4 DD. Data obtained at 1.4 DD are not comparable to the current normative database obtained at 1.75 DD. Peripapillary atrophy may contribute to this difference and must be considered when compiling a normative database for "large discs" at 1.4 DD.

Supported by an unrestricted departmental award from Research to Prevent Blindness, Inc., and with assistance from the Glaucoma Research Foundation.

7) RETINAL NERVE FIBER LAYER THICKNESS IN NORMAL AND GLAUCOMA

H.Suzumura, K.Harasawa , A.Kobayashi, C. Matsumoto, N.Endo

Department of Ophthalmology, Tokyo Medical College, Tokyo

We evaluated the utility of the Nerve Fiber Analyzer (NFA) for glaucoma.
Subjects: Twenty-eight eyes of 25 patients with glaucoma and 28 eyes of 14 normal controls were examined with the NFA. The patients with glaucoma had defects in only the hemi-visual field with both of the Goldmann perimeter and Humphrey Field Analyzer central 24-2. The ones with the defects in the inferior visual field were converted in to the superior. **Method:** The relation of the parameters in the NFA and visual field defects was evaluated. **Result:** The datas of "Symmetry" for glaucomas were mostly in the normal range. The "Inferior averages (I. ave.)" were distributed from the lower bound to outside of normal range, whereas the "Superior averages (S.ave.)" were in the normal range on the half number of glaucomas. The glaucoma eyes with 30 or more of "Glaucoma Number (GN)" showed that both S. ave. and I. ave. were less than the normal range. There was no one that GN showed 30 or more on the normal eyes. **Conclusion:** There was no significant difference in the thickness of the retinal nerve fiber layer in normals between the superior and the inferior retina. There might be possibility that the disturbances of the retinal nerve fiber layer can be detected by comparing of S. ave. and I. ave.. It was considered that the eye with 30 or more of GN might have high risk for the retinal nerve fiber layer defects.

8) **HIGH-PASS RESOLUTION NEURAL CAPACITY AND RETINAL NERVE FIBER LAYER THICKNESS IN GLAUCOMA**

Paolo Brusini, Patrizia Busatto and * Claudia Tosoni
Dept. of Ophthalmology - Hospital of San Donà di Piave, Venice, Italy
*** Dept. of Ophthalmology - Hospital of Udine, Italy**

High-pass resolution perimetry (HRP) is at present the only perimetric technique which allows the user to estimate the anatomical damage in glaucoma and in neurological disease. This is possibly thanks to the direct proportionality between spatial separation of functional ganglion cells and resolution thresholds. The HRP Neural Capacity indicates the number of functional retinocortical neural channels relative to average age-corrected normal values. The proof for this exciting feature is based on few studies, and a clear in vivo demonstration is still lacking due to the difficulties in determining the anatomical damage.

In the last few years, new techniques have been proposed to study the retinal nerve fiber layer in glaucoma. The reliability and the reproducibility of such a measure seems now to be good and allows the user to find a reduction in the thickness of retinal nerve fiber layer not only in established glaucoma cases, but also in most patients with ocular hypertension and no visual field defects.

In this study we compared HRP Neural Capacity with the results obtained using the GDx Nerve fiber Analyzer in patients with both ocular hypertension and chronic glaucoma at various levels of severity (Stage 0 to Stage 5 of the Glaucoma Staging System). The relationship between the Total Polar Average (thickness average along the ellipse surrounding the optic nerve), the Total Polar Integral (volume of the nerve fiber layer), and the GDx "Number" (calculated from 215 parameters resulting from GDx scan) were studied. All considered GDx indices (in particular the Number) showed a statistically significant correlation with NC values.

Our results support the hypothesis that the HRP Neural Capacity reflects glaucomatous anatomical damage.

9)

IS THERE A PROPORTION BETWEEN VISUAL FIELD DEFECTS AND RETINAL NERVE FIBERS LOSS IN GLAUCOMA ?

M. Marraffa, G Marchini, R. De Natale, R. Morbio, L. Tomazzoli, L. Bonomi, University Eye Clinic of Verona, Italy

Elevated I.O.P., visual field defects and optic disc changes caractherize primary open angle glaucoma. Much has been told about what is to be considered the first sign but we do not know if, once a glaucomatous optic neuropathy is started, there is a direct and proportional correlation between visual field loss and nerve fibers changes. For this reason in the present study we are comparing V.F. defects and R.N.F. loss in a group of glaucomatous patients.

70 eyes affected by POAG were enrolled. The visual field was examined with the Humphrey Field Analyzer (Zeiss) using program 30-2. The retinal nerve fiber layer was studied with the Nerve Fiber Analyzer (Laser Diagnostic Technologies). For each visual field was calculated the loss of db expressed in percentage as well as for the retinal nerve fibers, where thining in microns was also expressed in percentage.

In all the studied eyes retinal nerve fibers showed a higher percentage of compromission as compared to visual field. This result seems to indicate retinal nerve fibers to be more sensitive to a glaucomatous damage than what we can obtain through the visual field. No direct proportional correlation seems to be present therefore in these two considered parameters.

10)

ASSOCIATION OF BLUE-ON-YELLOW VISUAL FIELD WITH OPTIC DISC AND RETINAL NERVE FIBER LAYER

P. Juhani Airaksinen, MD and PaitTeesalu, MD
Department of Ophthalmology, University of Oulu, Oulu, Finland
and
Department of Ophthalmology, University of Tartu, Tartu, Estonia

Purpose of this study was to test the relationship between quantitative optic nerve head (ONH), semi-quantitative retinal nerve fiber layer (RNFL) and B/Y visual field test results in normals and patients with glaucoma.
Methods. We evaluated 1 randomly chosen eye of 40 normal subjects and 37 patients with ocular hypertension and different stages of glaucoma. The B/Y and W/W visual fields were adjusted for the patients' age and for the yellow coloration of the lens expressed as measure of the lens autofluorescence. The hemifield mean deviation (MD) of visual field was calculated as the difference between the measured and expected mean sensitivity values, predicted by the regression model fitted in normal subjects. The optic discs were measured using the Heidelberg Retina Tomograph. Monochromatic RNFL photographs were assessed in a masked fashion.
Results. With forward stepwise logistic regression analysis using B/Y hemifield data 38% of the glaucoma patient's "normal" (MD> -2 dB) W/W hemifields were classified abnormal. With the cup shape measure alone in the model 52% of the cases were classified abnormal. The B/Y hemifield data obtained from "normal" W/W hemifields of early glaucoma patients were well correlated with respective RNFL loss scores found to be abnormal in 84% of hemispheres.
Conclusions. The results of B/Y visual field, ONH and RNFL evaluation are well correlated. In patients with glaucoma these parameters may reveal glaucomatous abnormalities in a hemifield found to be normal on W/W perimetry.

THE VALIDITY AND REPEATABILITY OF RETINAL NERVE FIBRE LAYER THICKNESS MEASUREMENTS DETERMINED BY OPTICAL COHERENCE TOMOGRAPHY

11) S.A.Hancock, J M Wild, I.A Cunliffe. Department of Vision Sciences, Aston University; Department of Ophthalmology, Birmingham Heartlands Hospital, Birmingham, U.K.

Purpose: to determine the within- and between-visit variability associated with the measurement of the peripapillary retinal nerve fibre layer thickness in glaucoma using Optical Coherence Tomography.

Methods: The sample comprised 25 eyes from 25 patients with primary open angle glaucoma and 25 eyes from 25 patients with high risk ocular hypertension. Tomographic images concentric with the optic nerve head were obtained using Software Revision A4 of the Humphrey Systems Optical Coherence Tomograph at each of two visits separated by 14 days. Three pre-defined scan patterns were used: 1.5 and 2.0 times the disc size as defined by the operator from observation of the disc in real time on the video screen; and a fixed 1.73 mm radius. Each scan was repeated seven times at each visit. On two additional occasions, within the same time period, conventional automated perimetry was undertaken using the Full Threshold algorithm of the Humphrey Field Analyzer 750 and Program 24-2.

Results: The within-visit variability decreased with increase in the number of scans. It increased with increase in scan distance from the disc margin and with decrease in nerve fibre layer thickness. These factors also influenced the magnitude of the between-visit variability. The nerve fibre layer characteristics, in general, correlated favourably with the visual field appearance.

Conclusions: Optical Coherence Tomography can provide a measure of the reflectance associated with the retinal nerve fibre layer thickness, and with progressive reduction in thickness, in cases where a substantial thickness remains.

None.

12)

CORRELATION BETWEEN OPTIC NERVE HEAD TOPOGRAPHIC PARAMETERS AND VISUAL FIELD INDEXES: A STUDY IN NORMAL SUBJECTS AND POAG PATIENTS

Picardi C.[1], Bruschini M.[1], Verolino M.[1], Antinozzi P.[2], Pignalosa G.[2] and Costagliola C.[1]
[1]Eye Clinic, II University of Naples and [2]Eye Clinic, Federico II University, Naples, ITALY

The authors estimated the optic nerve head (ONH) topographic parameters in patients with primary open angle glaucoma (POAG) and in age-matched healthy subjects to verify their correlation with visual field indexes.

Parameters of optic nerve head topography were evaluated in 49 eyes of 25 healthy subjects and 47 eyes of 25 age-matched healthy POAG patients using the Disc Data Software applied on photographic measurements (50-degree color optic disc slides taken by fundus camera). Visual field was analyzed using the G1 program of the Octopus system.

For ONH study, patients and subjects were analyzed three times by three different performers and ANOVA test was used to ascertain the reproducibility of the test. For visual field analysis, patients and subjects underwent to three visual field examinations, in three different days; to minimize the mistakes related to the learning effect, only the last examination was included into the statistical evaluations (ANOVA test and linear and multiple correlation).

In POAG patients the ONH parameters were significantly different as compared to those recorded in normal subjects. Of the various ONH measures, cup/disc area ratio was the parameter presenting the highest degree of reproducibility, and thus, which showing the stongest correlation with visual field indexes.

13)

EVALUATION OF A NEW PARAMETER FOR THE INTRA-PAPILLARY AMOUNT OF NERVE FIBER TISSUE USING SCANNING LASER TOMOGRAPHY

Antoinette G.J.E. Niessen[1], Thomas J.T.P van den Berg[2,3] and Christine T. Langerhorst[1]

[1]Glaucoma Center, Department of Ophthalmology, [2]Department of Medical Physics and Informatics, and [3]The Netherlands Ophthalmic Research Institute, Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands

On the basis of scanning laser tomography, a new parameter for the amount of nerve fiber tissue in the disk ('average rim area') was designed and studied in patients with ocular hypertension or glaucoma and normals. This parameter was compared to other approaches for quantitative assessment of nerve fiber tissue. The peripapillary amount of nerve fiber tissue was assessed by scanning laser polarimetry and retinal nerve fiber layer photography using the reference set based grading system. Comparison of the average rim area with polarimetry and photography showed correlation coefficients of $r = 0.56$ and 0.42 respectively. The best estimate for glaucomatous visual field damage was obtained with the average rim area using tomography ($r = -0.79$).

1) RETINAL TOPOGRAPHY AND PERIMETRIC EXAMINATION OF PATIENTS WITH EPIRETINAL MEMBRANES : PROGNOSYS OF FUNCTIONAL RESULTS OF SURGERY

M.A. RUDNEVA, A.V. KISELEV, E.E. IOILEVA

IRTC "EYE MICROSURGERY", MOSCOW, RUSSIA

26 patients with fibrous epiretinal membranes in central retinal area were examined before surgical removal of the membranes. The examination included investigation of central retinal topography using the Rodenstock "Optic Nerve Head Analyzer" and perimetric examination of the central visual field with the central 30-2 threshold programme using the Humphrey Field Analyser 640.

Analyzing the results, we revealed significant reverse correlation between the level of light sensitivity in central visual field and the the thickness of the membrane in 82 % of cases.

After surgical removal of the fibrous epiretinal membranes we estimated the prognostic value of both indices in respect of functional results (visual acuity) of the treatement. We found out that light sensitivity more than 26 dB and membrane thickness less than 0.2 mm are favourable prognostic signes; in these cases visual acuity after treatement in most cases exceeds 0.4.

2) PERIMETRIC LONG TERM FOLLOW-UP OF DIABETIC CYSTOID MACULAR EDEMA AFTER LASER TREATMENT EXTENDED TO THE FOVEAL AVASCULAR ZONE

Francesco Morescalchi, Emanuele Scuri, Stefano Formenti, Enrico Gandolfo
University Eye Clinic of Brescia - Italy

PURPOSE: the study was performed in order to detect the usefulness of automated perimetry in monitoring the functional evolution of diabetic cystoid macular edema (CME) after laser treatment.
METHODS: two groups each of 30 eyes with mild CME (VA > 0.3) underwent laser traditional grid treatment or a modified laser therapy with a grid extended up to the edge of the foveal avascular zone (FAZ). All patients were followed for at least three years by the assessment of visual acuity (VA), fluorangiographic examination (FAG) and perimetry (Octopus M1 program). Statistical analysis was based on t test and Wilcoxon test .
RESULTS: in the first group (traditional grid), VA improved in 20%, was unchanged in 33% and worsened in 47%. In the second group (grid extended to FAZ), VA increased in 33%, was unchanged in 50% and worsened in 27%. In both groups perimetric and FAG results were related with VA. The comparison between the two groups showed significant difference in relationship with VA ($p < 0.05$) and the value of foveal perimetric thresholds ($p < 0.05$). The global perimetric indices did not show significant difference. In both groups the best values of foveal threshold were more related with the capacity of near reading than with VA for distance.
CONCLUSIONS: the perimetric assessment of the visual function was more useful than the other utilized methods (VA and FAG) in detecting the evolution of the CME after the laser therapy and the effects on the quality of vision.

VISUAL FIELD IN AREOLAR ATROPHY OF THE RETINAL PIGMENT EPITHELIUM ASSOCIATED WITH AGE-RELATED MACULAR DEGENERATION.

3)

Alessandro Magnasco, Paolo Capris, Mario Zingirian, *Enrico Gandolfo
University Eye Clinic of Genoa, *University Eye Clinic of Brescia

Areolar atrophy of the retinal pigment epithelium (RPE) is an important stage of age-related macular degeneration (AMD). The areolar atrophy of the RPE is the progression of tiny areas of reticulated hypo- and hyperpigmentation in the central macula and these atrophic areas are more likely to cause visual field disturbances than drusen, which do not typically cause visual field dysfunction. The aim of this study is to compare the visual field defects with the angiographic findings in the areolar atrophy of the RPE associated with AMD. Twenty-four eyes of 14 patients with AMD, aged from 52 to 83 years, were tested with the Central 10-2 and Macula Program of the Humphrey Visual Field Analyzer. Fluorescein and indocyanine green videoangiography by Topcon IMAGEnet H1024 Digital Imaging System (Paramus, NJ) were performed in all patients. The Macula Program resulted able to point out the macular RPE atrophy areas with a diameter more or equal to 750 micron with a significant specificity. The Central 10-2 Program revealed a reduction of the macular sensitivity, but was not able to point out the small RPE atrophy areas. The study showed a good correspondence of the macular RPE atrophy areas with the visual field defects.

VALUE OF OCTOPUS AUTOMATED PERIMETRY IN PATIENTS IN HYDROXYCHLOROQUINE TREATMENT

4)

CASTAGNA I.*, D'ANDREA A.*, D'ANDREA D.*, BRIGUGLIO M.*,
GENTILE B.*, LO GULLO R.°

UNIVERSITY OF MESSINA
*Intitute of Ophthalmology
°Department of Internal Medicine. Research of Rheumatology

ABSTRACT

Hydroxychlorqqine retinopathy in a well-known toxic manifestation of a commonly used systemic medication. The aim of the study is to evalue the role of automated perimetry in order to detect early retinal involvement related to hydrxychloroquine therap·

The study group was composed by 25 patients (21 female and 4 male , average age 34,5 years) affected by rheumatologic diseases in treatment with hydroxychloroquine.

All patients were submitted to an ophthalmologic examination and computerized perimetry (Octopus 2000 R), using a static full treshold program (31 program), before and after 12 and 18 months from treatment begining. For visual field evaluation we considered perimetric indices (MD: mean defect) and the presence of scotomas, in relation to their depth and extension .

Authors discuss perimetric defect variations in relation to dose of used drug and duration of therapy. Obtained results confirm the sensitivity of Octopus perimetry in evidencig first signs of hydroxychloroquine retinal toxicity and its important role in the follow-up of patients in treatment with this drug.

Scientific Session VII: Tuesday September 8 2:00-3:30 Retinal and Neurologic Disorders

EVALUATION OF DYSTROPHIC AND TOXIC RETINAL DISEASES BY RED INCREMENT PERIMETRY AND MULTIFOCAL ERG

5) Chr. Nimagern, H. Krastel, Inez Eggers, O. Shapp, A. Castro, F. Holz
(Univ-Eye Hospital, Im Neuenheimer Feld 400, D-69120 Heidelberg, Germany)

Background: Colour vision in dystrophic and toxic retinal diseases is, besides a tritan defect, often coined by a red-green defect (Verriest). The latter tends to progress from pseudo-protanomaly towards scotopization, accompanied by an increasing loss in luminosity of red (Grützner, Jaeger, Marré & Marré). By using red targets, perimetry may take advantage of this spectral region of reduced sensitivity in early diagnosing dystrophic and toxic retinopathies. Multifocal ERG is a high spatial resolution technique evaluating the central and paracentral retinal areas, originally introduced by Sutter.

Methods & patients: Red increment perimetry is performed on the Aulhorn Tübingen automatic perimeter. No colour discrimination judgement is required; the patient's task simply consists in detection of red targets on a white background. Stimuli are presented according to a two niveau technique, supplemented by a threshold evaluation in locations of pathology. Red increment perimetry, therfore, displays a psychophysical threshold profile. Multifocal ERG is carried out by the RetiScan (Roland), presenting a pattern of 19, 37 or 71 hexagonal stimuli to the central and paracentral retina. This method displays a response profile at retinal level. Patients examined comprise 4 with toxic retinopathies (Chloroquine, thioridazine) and 5 with hereditary dystrophies (M. Stargardt, cone dystrophy, cone-rod-dystrophy).

Results: In all cases examined, red increment perimetry shows more pronounced defects than standard white perimetry (in otherwise identical conditions). Multifocal ERG may show pathology in cases who escape the perimetric evaluation.

Conclusion: Red increment perimetry is superior to standard white perimetry in detecting central scotomas due to dystrophic and toxic maculopathies. Wether, concerning this task, multifocal ERG is superior to psychophysical threshold perimetry, cannot be deduced from the present data with significance, however, it provides an indication of the retinal origin of the scotoma.

6)

DETECTION VS RESOLUTION PERIMETRY DEFICITS IN DIABETES PRIOR TO CLINICALLY OBSERVABLE RETINOPATHY

B.J. Curran and R.S. Anderson,
Vision Science Research Group, School of Biomedical Sciences, University of Ulster, Coleraine.

Previous studies report various functional visual deficits in diabetes before the onset of clinically detectable retinopathy. However, it is not always clear whether these functional losses result from optical filtering or neural sampling deficits, or a combination of both. This study aims to better discriminate between optical and neural losses of visual function in diabetes by separately measuring peripheral grating detection acuity (which is optically limited) and resolution acuity (which is sampling limited) and comparing them with normal values.

Detection acuity and resolution acuity were measured separately using sinusoidal gratings at four 20 degree locations in the peripheral field of twenty non-insulin-dependent diabetic patients with no detectable retinopathy, and twenty age-matched normal subjects. Stimulus contrast was 30% for the detection part and 90% for the resolution part.

Detection acuity was significantly lower in the diabetic group compared to the normal group ($p=0.01$). Resolution performance showed no significant difference between groups. Detection acuity decreased with age, more so for the normal group. Resolution performance decreased less markedly with age with a similar decline in diabetics and normals.

The loss of detection acuity but not resolution acuity in early diabetic retinopathy points towards an optical/filtering rather than neural sampling cause of visual loss. Further work on more advanced stages of diabetic retinopathy and/or different types of diabetes may indicate different patterns of visual loss.

Scientific Session VII: Tuesday September 8 2:00-3:30 Retinal and Neurologic Disorders

SCANNING LASER DERIVED TOPOGRAPHIC OEDEMA MAPS: CORRELATION WITH VISUAL FUNCTION ASSESSMENT IN PATIENTS UNDERGOING LASER PHOTOCOAGULATION FOR CLINICALLY SIGNIFICANT DIABETIC MACULAR OEDEMA

Chris Hudson [1,2], John G Flanagan [1,3], George S Turner [1], Hean C Chen [1], Lorna B Young [1] and David McLeod [1].

7) [1]Univ. Dept. of Ophthalmology, Manchester, UK; [2]School of Biomedical Sciences, Univ. of Ulster, Northern Ireland; [3]Dept. of Ophthalmology, Univ. of Toronto, Canada.

Purpose. To compare the results of oedema map analysis with visual function assessment in a cohort of patients with clinically significant diabetic macular oedema (DMO).

Methods. The sample comprised 24 patients with clinically significant DMO (range 45-75yrs). One eye of each patient was selected. At each visit, patients underwent logMAR visual acuity, conventional and short-wavelength (SWAP) automated perimetry and scanning laser tomography (SLT); 7 SLT images were acquired for both the 10° and 20° scan fields. Patients were assessed twice prior to treatment and within 1 week of, and at 1, 2, 4 and 12 weeks after, treatment. Empirical observation of the Z-profile (i.e. plot of reflectance intensity as a function of scan depth) of the SLT in patients with clinically significant DMO demonstrated a localised increase of Z-profile signal width, SW, and also a localised reduction of maximum reflectance intensity, I_{max}. We have developed a reference plane independent index of retinal oedema; topographic oedema maps were generated by dividing the SW by I_{max} at each pixel (i). The oedema map index was calculated after normalisation of reflectance intensity. The SW was measured at 50% of I_{max} following fitting of the Z-profile with a 16th order polynomial. Volumetric oedema map values (arbitrary units) were derived and the probability of significant change in the extent and magnitude of DMO was established for each diabetic patient using mean oedema map values of two baseline assessments (i.e. mean oedema map values represented 4 x 4 pixel sets x 7 images).

Results. At baseline, the site of focal oedema corresponded with the area of localised visual field loss in 7 patients using conventional perimetry and in 23 patients using SWAP. Immediately post-treatment, the magnitude of retinal oedema significantly increased relative to baseline in 18 of the 24 patients; the increase in retinal oedema peaked between 1 and 2 weeks post-treatment. At 12 weeks post-treatment, the magnitude of retinal oedema decreased relative to baseline in 20 patients. Group mean oedema correlated over the course of the study with the corrected pattern standard deviation index of conventional perimetry and with cluster area of SWAP; the magnitude of the oedema correlated with the severity of visual field loss.

Conclusions. This study describes the time course of change in the magnitude of retinal oedema following laser photocoagulation for clinically significant DMO as assessed by objective, non-invasive oedema map analysis of SLT images. The correlation with the assessment of visual function provides further evidence to validate the oedema map analysis of SLT images.

8)

AUTOMATED PERIMETRY IN AZOOR

Steven A. Newman, Antonio V. Aragon
University of Virginia, Charlottesville, VA

Abstract purpose: The term AZOOR has been used to include a variety of clinical syndromes of unknown pathophysiology presumably affecting the outer retinal element producing acute visual disturbance. Because of the peripheral nature of many of these field defects, kinetic full field perimetry has been widely utilized. We undertook a retrospective evaluation of central automated static perimetry and the assessment of patients with AZOOR.

Material and Methods: 8 patients coded for Azoor seen through the University of Virginia, Neuro-ophthalmology Unit were analyzed. Automated static perimetry included central 10, 24 and 30 degree visual field testing.

Results: Patterns of visual field defects included cecal scotomas, paracentral defects and arcuate visual field defects. The use of I, III, and V size test objects indicated lack of absolute density with variable size defects seen on perimetric testing. 30-2 programs often demonstrated the peripheral involvement than the 24-2 program, although defects could be seen on all central visual fields.

Conclusions: The pathophysiologic process in AZOOR presumably causing damage to the retinal receptors poses incomplete loss of function that manifests by better response to larger test objects. Although better outlined on 30-2 program than the 24-2 program, central visual field testing reproducibly outlines areas of defects in patients with AZOOR.

9) Homonymous hemianopia – perimetric findings and corresponding results of structural and functional neuroimaging

J. Schiller[1], T.J. Dietrich[1], L. Lorch[1], M. Skalej[2], C. Braun[3], U. Schiefer[1]

[1] University Eye Hospital, Dept. II, Schleichstr. 12-16, D-72076 Tübingen, Germany

[2] Dept. of Neuroradiology, University Tübingen, Hoppe-Seyler-Str. 3, D-72076 Tübingen, Germany

[3] Institute of Medical Psychology and Behavioural Neurobiology, Otfried-Müller-Str. 47, D-72076 Tübingen, Germany

Interesting neuro-ophthalmological cases demonstrate the diagnostic capabilities of adequate perimetric techniques: High resolution automated grid perimetry revealed bilateral "RNFL defects" as minute homonymous visual field defects. – Subtotal bilateral superior altitudinal scotomata without any corresponding ophthalmoscopical pathologies in another "pseudo-RNFL-patient", were attributable to a bilateral inferior infarction in the posterior cerebral arteries circuit. – Two cases with infarctions situated in the superior region of one cerebral hemisphere and involving the inferior parts of the other leading to checkerboard defects, demonstrate another type of bilateral pathology. – Structural and functional MRI demonstrated that macular *sparing* in the lower visual hemifield and macular splitting in the upper visual hemifield could be correlated with sparing of the inferior contralateral occipital pole, and involvement of the superior contralateral occipital pole, respectively. – Similar neuroimaging techniques revealed combined infarctions within the region of the geniculate body and of the very rostral part of the visual cortex to be the cause of a *unilateral* hemianopic scotoma, considerably exceeding the temporal crescent.

In conclusion, adequate application and interpretation of perimetric techniques in patients with presumed lesions of the postchiasmal visual pathways are an essential neuro-ophthalmological diagnostic tool, as confirmed by corresponding structural and functional neuroimaging results.

Supported by the "Deutsche Forschungsgemeinschaft" (DFG BR 1689/2-1)

10) CENTRAL VISUAL FIELD CHANGES IN DYSTHYROID OPTIC NEUROPATHY

Y. INOUE, T. INOUE, K. GOTO

Olympia Eye Hospital Tokyo, Japan.

One hundred cases (42 men and 58 women, 23 to 76 years old) with dysthyroid optic neuropathy were subjected to a visual field examination using Octopus 201 and Goldmann Perimeter.

178 eyes were observed as having visual field changes out of 200 eyes. Improved visual field was seen in 168 of 178 eyes (94.4%) after a combined therapy of local and systemical steroid administration within a short period of time. The evidence suggests that central visual field defects can be improved with conservative treatment and that attention should be given to lower quadrant visual field changes when following up this disease.

Scientific Session VII: Tuesday September 8 2:00-3:30 Retinal and Neurologic Disorders

11)

COMPUTERIZED PERIMETRY IN PATIENTS AFFECTED BY MULTIPLE SCLEROSIS, IN INTERFERON-BETA TREATMENT

D. D'Andrea, A. D'Andrea, M.G. Scullica, G. Minissale, G. Ferreri

UNIVERSITY OF MESSINA
Institute of Ophthalmology

ABSTRACT

Multiple sclerosis in a neurological disease characterized by focal demielinating damage to SNC, with a frequent clinical or subclinica involvment of visual pathways. The study aims to value visual field and chromatic sense defects in clinically definite multiple sclerosis patients, and their possible variation in a short-term follow-up, after interferon beta-1b treatment. A group of 35 patients was examined. Twenty of these were treated with interferon beta-1b, and fifteen formed control group.

All subjects were submitted to visual field examination, tested by Octopus 2000R automated perimetry, and chromatic sense evaluation, tested by Farnsworth-Munsell 100 hue test, before and after one year from treatment begining. Tests defects were evidenced both in patients with a pregress optic neuritis and in patients without a history of visual disturbance.

The short-term follow-up results showed no significative perimetric variation in treated patients, in comparison with control group. Instead, a slightly improvement of chromatic sense was showed in treated group. It would be more suitable to examine these patients for a longer treatment period, to value the real drug effect on reduction of clinical and subclinical relapses frequency.

12)

ROLE OF VISUAL FIELD EXAMINATION IN THE FOLLOW-UP OF PATIENTS WITH PITUITARY MICROADENOMA

D. D'Andrea*, A. D'Andrea*, S.Cannavò°, M.G. Scullica*, F. Palamara*, G. Pettinato *, G. Ferreri *

UNIVERSITY OF MESSINA
*** Institute of Ophthalmology**
° Institute of Endocrinology and Metabolic diseases

ABSTRACT

The present study was conducted to evalue visual field defects and their possible evolution in patients affected by pituitary microadenoma, treated with a pharmacological terapy, in a one year follow-up.

The study population was composed by 35 patients (28 female and 7 male, average age 38,2 years) with neuroradiological diagnosis of pituitary microadenomas. All patients were subjected to a neuroradological evaluation (Nuclear Magnetic Resonance) and a computerized visual field examination (Octopus 2000R), using a static full-threshold program (32 programm), before and after one year from treatment begining.

The analisys of findings from all examined patients (70 eyes) revealed a reduction of microadenomas size in 73,3% of the patients; instead, a significative improvement of visual field was showed only in 26,6% of examined eyes. Once the damage from compression is completed, we don't obtain a funcional improvement, even if the cause is removed. Therefore,the resuts confirm the computerize visual field exam role as an important ring of conjunction between ophthalmologist and endocrinologist in the follow-up of this disease.

13) **PUZZLING VISUAL FIELD LOSS IN PATIENTS WITH PRIMARY EMPTY SELLA**

Doro D., M.D.; Dorigo De Natale M.T., M.D.

Several patterns of visual field loss including bitemporal or binasal defects have been sporadically reported in primary empty sella syndrome (EES).
We present the automated and Goldmann perimetry findings in three female patients (age range 57-64yrs) - followed-up for six years with EES, normal intraocular pressure, good visual acuity and nonglaucomatous cupping of the optic disc. Severe irregular bilateral peripheral constriction and decreased central sensitivity with normal apprearance of the optic disc were found in the first patient. Another patient showed moderately pale disc with inferonasal defect in her right eye, and pale disc with just islands of temporal visual field left in her left eye; progression of perimetric defects was found in the follow-up. The third patient had generalized irregular constriction of visual field and pale disc in her right eye, and normal field in her left eye; both discs were slightly elevated.
Understanding the cause of visual defects similar to those found in our patients may be challenging and should prompt adequate neuroimaging focusing a possible EES.

14) DEVELOPMENT OF THE TÜBINGEN NEURO-OPHTHALMOLOGICAL PERIMETRIC DATABASE

R. Burth [1], W.Fink [2], E.Hölper[1], S.Mayer[1], U.Schiefer[1]
[1]University Eye Hospital of Tübingen, Dept. II, Schleichstraße 12, D-72076 Tübingen, Germany,
[2]California Institute of Technology, Pasadena, California 91125

This project is aimed at the development of a computer based primary neuro-ophthalmological perimetric database for research, education and patient care. This project is divided into three phases:

In the first phase, the perimetric examination protocol was analyzed and optimized through computer support. Each perimetric finding is classified according to the type of visual field defect (e.g. homonymous defects, retinal nerve fiber defects, etc), and its reliability rating. Results of this phase have reduced the administrative effort, created a paperless digital archive and allowed faster access for scientific evaluation.

In the second phase, perimetric results obtained before the development of the new protocols are introduced into the electronic database by scanning, digitizing and classifying the perimetric printouts (as mentioned above). By these procedures, automated perimetric results of more than 10,000 patients with primary neuro-ophthalmological pathologies will be implemented into the database.

In the last phase, the manual classification will be replaced by an expert system. This system is based on a neural network, building up it's knowledge from the available digital results. This is especially promising since the comparatively high density of test point locations allows exact description of scotoma extent, form and position. The purpose of the database is to support the ophthalmologist in the interpretation and differential diagnosis of perimetric findings.

1) MORPHOMETRIC ASYMMETRY OF PERIPAPILLARY ATROPHY IS ASSOCIATED WITH ORBITAL BLOOD FLOW ASYMMETRY IN NORMAL TENSION GLAUCOMA PATIENTS

Hideya Uchida, Tetsuya Yamamoto, Yoshiaki Niwa, Goji Tomita, Yoshiaki Kitazawa.

Department of Ophthalmology, Gifu University School of Medicine, Gifu, Japan.

Purpose: To determine the relationship between peripapillary atrophy (PPA) and orbital blood flow in normal tension glaucoma (NTG). **Methods:** Twenty-six of NTG patients who had asymmetrical PPA between the two eyes (difference in PPA area exceeds 10% by planimetry) were studied. Refractive error and visual field mean deviation were matched in both eyes. Color Doppler imaging was used to assess the hemodynamics in orbital blood flow including peak systolic flow velocity (PSV), end diastolic flow velocity (EDV) and resistance index (RI) for ophthalmic artery (OA), central retinal artery (CRA), and nasal and temporal short posterior ciliary arteries (NPCA & TPCA). **Results:** Eyes with larger PPA had significantly lower CRA PSV, CRA EDV and a higher CRA RI than eyes with smaller PPA. The ratio of PPA area of larger PPA to smaller PPA showed significant correlation with the ratio of TPCA PSV of larger PPA to small and TPCA EDV of larger PPA to smaller PPA. **Conclusion:** The results suggest that the size of PPA may be related to the blood flow in CRA and PCA in NTG eyes.

2) What is the minimum threshold asymmetry, between fellow eyes of glaucomatous patients, to define the side of greater field loss?

L. Fontana[1], D. Poinoosawmy[2], R.A. Hitchings[2].

[1]Istituto di Oftalmologia, Universita' Cattolica del Sacro Cuore, Rome, Italy.

[2]Glaucoma Unit, Moorfields Eye Hospital, London, UK.

Purpose. Studies investigating clinical features associated with asymmetric glaucomatous field loss relay on the determination of the side of greater field damage. This is generally done by comparing the field indices of fellow eyes. In a test-retest study, we propose to determine the minimum interocular sensitivity difference to define the side of greater field loss.

Methods. 105 consecutive patients with primary open angle glaucoma underwent static threshold visual field testing (Humphrey Field Analyser 24-2) of both eyes in reverse order. Right before left eyes were tested at the first visit and left before right eyes were tested after an interval of 3-4 months. All patients had previous experience with field testing.

Results. The median (Inter Quartile) Mean Defect (MD) for the right eyes tested first was -7.54 (-14.04; -2.98) and -7.97 (-14.19; -2.72) when the testing order was inverted. The median (IQ) MD for the left eyes tested second was -8.85 (-15.21; -2.63) and -8.4 (-15.57; -2.64) at the second test. The difference in MD between tests was not significant ($p > 0.05$). In 12 (11%) patients the side of higher MD was inverted at the second test. Ten of them presented a difference in MD $\leq$ 2 dB between fellow eyes at the first test.

Conclusions. Comparison of average sensitivity between fellow eyes is influenced by test variability and by the sequence of field testing. The present study suggests that a difference in MD > 2 dB between fellow eyes may be sufficient to define the side of greater field loss on a single field test.

3) **THE COMPARISON OF THE SLOPE OF THE REGRESSION LINES OF RA/DA CUMULATIVE CURVES ALLOWS THE SEPARATION OF NORMAL SUBJECTS FROM PATIENTS WITH EARLY GLAUCOMATOUS VISUAL FIELD DAMAGE**

A. Macrì - M. Rolando - M. Iester - G. Calabria – M. Zingirian
University Eye Clinic – Genoa - Italy

Purpose: to test the ability of cumulative Rim/Disc area (RA/DA) curves to separate glaucoma damaged from normal optic discs.

Methods: The cumulative distribution of the RA/DA area of 36 equally spaced sectors of the optic disc obtained by means of the Imagenet X Rev.3/51.b (Topcon) morphometric evaluation of simultaneous videographic pictures from 71 normal and 83 glaucomatous eyes was studied.
The significance (Mann-Withney test) of the difference between the medians of the 36 RA/DA sectors of glaucomatous and normal eyes was calculated.
To increase the sensitivity of this analysis in early glaucoma and in normal eyes, these cumulative curves were subsequently divided into two equal segments and the slopes of their respective regression lines compared.

Results: The difference between the medians of the 36 RA/DA sectors of glaucomatous and normal eyes was statistically significant ($p < 0.0001$) nevertheless the range 1-95 percentile of cumulative curves distribution of normal and early damaged glaucomatous eyes overlapped. When the cumulative curve was divided in two equal segments, the comparison of the slopes of the regression lines of the two segments showed a significant difference ($p < 0.05$) in 100% of early glaucomatous eyes, such a difference was not present in 93% of normal eyes.

Conclusion: The use of cumulative RA/DA curves can separate glaucomatous from normal discs, but this is not always true in early glaucomatous damage, where the comparison the regression line slopes is more significant.

4) **SIMPLE CRITERIA FOR DETECTING GLAUCOMATOUS PERIMETRIC DEFECTS IN HIGH MYOPIA**

Guido Corallo, Paolo Capris, Angelo Macrì, Cristina Guidi, Mario Zingirian, *Enrico Gandolfo
University Eye Clinic of Genoa, *University Eye Clinic of Brescia

AIM OF THE STUDY: to define practical, simple criteria, easy to use for separating glaucomatous perimetric defects from those due to retinal degenerative lesions.

METHODS: we retrospectively analysed the perimetric findings of 92 patients affected by both glaucoma and high myopia. They all underwent the same perimetric program ("central 30-2", Humphrey 640 VFA). According to the inclusion criteria, only 36 patients (64 eyes) were enrolled into the study. Then, 25 high myopia subjects (42 eyes) without glaucoma were selected and underwent the same perimetric program. All perimetric findings were analysed by two skilled perimetrists. They were unaware of the characteristics of the patients and took into consideration the following parameters: 1) the perimetric indices MD, PSD,SF;2) the results of the Glaucoma Hemifield Test (GHT); 3) the presence of pericoecal alterations; 4) the presence of nerve fiber bundle defects (NFBDs); the presence of a nasal step; 6) the presence of artefacts by trial lens. When considering the last three parameters, some pre-determined criteria were adopted. Mann-Whitney "U" test was utilised to compare the two groups. Spearman test was utilised to evaluate the correlation between myopia degree and the other parameters.

RESULTS: the evaluations by the two perimeters showed a good concordance. Significant correlation were found between MD and refractive error ($P<0.0001$) and between pericoecal visual field alterations and refractive error ($P<0,0001$). GHT, as well as the criteria for detecting NFBDs or nasal steps, showed a good sensitivity, but a poor specificity.

CONCLUSIONS: the adopted criteria proved to be a useful help to detect glaucomatous visual field defects in high myopia. In particular, GHT abnormalities and the adopted criteria for identification of NFBDs and nasal steps presence represent a useful tool to detect glaucomatous visual field defects in high myopia in a clinical routine examination.

FALSE NEGATIVE RATES IN GLAUCOMATOUS PATIENTS VISUAL FIELDS

5)

D. Messenio, M. Zona, B. Cavallotti, P. Montanari
Ospedale Maggiore di Milano IRCCS
Eye Clinic of the University of Milan - Italy
Chair of Ophthalmology (Dir.: R. Ratiglia)

Purpose: authors estimated the trend of false negative rates in the visual fields of patients with POAG at different degree of perimetric defect.

Material and Methods: in a retrospective study Authors valued 165 visual fields of 65 glaucomatous patients (36 males, 29 females, aged from 44 to 81) performed with Octopus 2000 R perimeter (program G1) over an three-year period (1995-1997). Inclusion criteria included the following: corrected visual acuity of 7/10 or better, refractive error between +/- 3 diopters; absence or minimal opacities of the media; no history of ophthalmic or systemic diseases; pupillary diameter =/> 3 mm; IOP<21 mmHg with medical therapy; no therapy with miotic agents; automatic static perimetry experience with at least one previous visual field (excluded from this study); presence of at least one false negative and no more than one false positive in each visual field.
The visual fields were arbitrarily subdivided in seven groups according to an increasing Mean Defect (MD) Index. For each group the regression analysis and the correlation coefficient between MD and false negative rates was determined.

Results: in the first six groups there is not a statistically significant correlation between MD and false negative responses, whereas in the seventh group (MD>21 dB) the correlation between MD and false negative rates is significant (P=0.017), with a correlation coefficient (r) of 0.414

Conclusions: in glaucomatous visual fields with high values of MD (more than 21 dB) there is a significative progression of false negative responses. In these visual field the reliability factor could be reconsidered, also introducing a corrective coefficient

BEAVER DAM EYE STUDY VISUAL FIELD FOLLOW-UP (1988-95); The Preponderance of Normal Intraocular Pressures Among Eyes with Optic Disc Cupping and Visual Field Loss

6)

W.E. Sponsel*, B.E.K. Klein, R. Klein, J. Mensah*, Y. Trigo*
Depts of Ophthalmology, Univ. Wisconsin-Madison & *Univ. Tx Health Sci Ctr, San Antonio

Purpose: To evaluate the relationship between recurring perimetric nerve-fiber layer type visual field(VF) defects, optic nerve status, intraocular pressure (IOP), and prior diagnosis of disease among the adult population of Beaver Dam. **Methods:** Over 83% of the population between the ages of 43 and 86 years in a community of 5924 participated in an extensive assessment of ocular and systemic risk factors. Visual fields were obtained by Henson CFS 2000 perimetry, and among those failing the Henson screening subroutine, full 24 degree fields were performed. Identical protocols were followed in Phase I (baseline: 1988-90) and Phase II (follow up: 1993-95). Fields were scored by a method designed to emulate the Hodapp/Parrish/Anderson criteria for glaucomatous VF loss, and categorized as normal, early, moderate, or severe. **Results:** 119 subjects had manifest VF damage in one or both eyes at baseline and follow up of these, 86 were severe or progressed, while 33 remained the same or improved. The proportion of these 119 individuals at each visit attaining optic disc cupping status:

C/D >0.8 or asymmetry >0.2: baseline 14 (12%), followup 25 (21%);
C/D >0.6 or asymmetry >0.15: baseline 34 (29%), followup 46 (39%);
C/D >0.5 or asymmetry >0.1: baseline 76 (64%), followup 78 (66%).

Of these 119 subjects with recurring VF loss, in both phases and in all 3 disc cupping categories, only 12 to 20% had either received treatment for glaucoma or had IOP >21 mmHg. **Conclusions:** Both perimetric and optic disc cupping progression were clearly manifest among individuals showing VF damage during both phases of the Beaver Dam Eye Study, but the vast majority (>80%), regardless of disc pathology, had normal IOPs and remained undiagnosed.

7)

KNOWLEDGE -BASED GLAUCOMA MONITOR USING HYBRID NEURAL NETS

A. Wegner[1], G. Zahlmann[2], M. Scherf [2], I. Ugi[1]. [1] Department of Ophthalmology, Munich University of Technology, Munich, Germany. [2] Institute for Medical Informatics and Systems Research, GSF-National Research Center for Environment and Health, Munich, Germany.

Purpose: To design a knowledge-based glaucoma monitor using visual field, intraocular pressure (IOP) and morphological aspects of the disc.

Methods: Hierarchical neural nets (radial basis function-RBF- nets) are used to classify visual fields into the main classes 'normal', 'glaucomatous' and 'pathological' (others). Training, testing and evaluating the neural nets is based on 5692 perimetric data sets (program G1 - Octopus), preclassified by a medical expert. The final decision is calculated in a multi-layered fuzzy rule set using visual field classification, IOP and morphological aspects of the disc. The final situation assessment outcome describes situation classes 'normal', 'suspect glaucomatous', 'glaucomatous' and 'pathological'. 168 complete data sets were used to test and fine tune the system. Additional 200 data sets are the basis for verification.

Results: The final decision based on the neural nets and fuzzy rules was given with a sensitivity of 92% and a specificity of 100%.

Conclusion: We are able to give a good differential diagnostic support tool under primary care conditions without any further financial investment.

8)

Frequency Of Normal Tension Glaucoma In Health Check Up

Hiroharu Okosi 、Natsuko Kimura、Hiromi Hayashi、Hiroko. Yamashiro
Hirotaka Suzumura、and Masahiko Usui
Derartment of Ophthalmology、Tokyo Medical College Hospital
TOKYO、JAPAN

Purpose:Frequency of NormalTension Glaucoma(NTG) has become the topic of our conversation. This time we report that we made an investigation into frequency of NTG in a mass examination. Subjects: 10490 persons who had visited our health care center for health check up during a year from the November of 1996 to the October of 1997. Methods:We observed films of the fundus using with microfirm reader and cecked the following point which visual field changes will be predicted and advised to consult our department. Check point of the fundus was 1)Notching, 2)Bayoneting, 3)Conus, 4)Splinter henorrhage, around the optic disc and Retinal Nerve Layer Defect(NFLD). In our department, the three zone (120 Point) of Humphrey perimeter field analyzer(HFA) were tested and still more the visual field using with Goldman perimeter and HFA. Results: 226 persons more than fourty years of age were advised to consult 126 persons amonge them visited our department. Patients of NTG who had visual field changes were 90 eyes of 62 and were 0.7% in advised persons of health care cen- If the residual 112cases of obscurity had visual field changes in the same percentage, they were 1.4% in advised persons of health care center. In box plot clasification* they were classified as follows, No visual field change 63 63 eyes of 45 patients, Stage I : 8 eyes of 7 patients, Stage II:34 eyes of 38 patients, Stage III:26 eyes of 21 patients, Stage IV 18 eyes of15 patients, StageV 4eyes of 4 paients and all of them had no subjective symptons as visual field change. Conclusions: The former these check points of fundus were valid. The frequency of NTG in health care center was 1.4% and by this results we considered that three zone of HFA for detecting NTG was necessary in the check up. *Shin, YS, perimetry update 1990 /1991:295-243 .

9)

AUTOMATIC STATIC FUNDUS PERIMETRY FOR PRECISE DETECTION OF EARLY GLAUCOMATOUS FUNCTION LOSS

K Rohrschneider, R Glück, FE Kruse, ROW Burk, T Fendrich, HE Völcker;
Department of Ophthalmology, University of Heidelberg, 69120 Heidelberg, Germany

Purpose. To establish a short *routine* method of fundus perimetry which allows to detect beginning visual field defects due to glaucomatous nerve fiber bundle damage.

Methods. 65 eyes of 44 patients (45±21 years) either suspicious for having glaucoma due to increased cupping and/or beginning visual field defect (MD <2dB, Octopus 500), with gleucomatous field defects or controls were examined using our automatic static threshold fundus perimetry with the Scanning Laser Ophthalmoscope (SLO) using two different test grids (30 and 80 points) as well as argon blue nerve fiber layer imaging. We compared the results with visible nerve fiber layer defects and visual field defects in conventional cupola perimetry.

Results. The automatic threshold fundus perimetry allowed documentation of all visual field defects observed during conventional perimetry in short examination times while all controls remained normal. In addition we were able to delineate sharply demarcated beginning field defects (5-14 dB loss to normal values) due to nerve fiber layer bundle damage which were not observed during conventional perimetry. For this purpose we used a peripapillary test grid with 30 points and 4.5±0.6 minutes examination time.

Conclusions. Fundus perimetry using the SLO allows detection even of beginning visual field defects especially by the help of age-related sensitivity values. Our software with automated threshold perimetry allows for a detection of visual field defects in short examination times (less than 6 minutes) and allows to document visible nerve fiber damage using argon blue light. Exact projection of the stimuli on specific retinal locations may allow exact function testing above retinal nerve fiber layer defects.

1) **Automated static campimetry with locally enhanced spatial resolution**

U. Schiefer, B. Selig, T.J. Dietrich

University Eye Hospital, Dept. II, Schleichstr. 12-16, D-72076 Tübingen, Germany

Local condensation of a perimetric grid can render a higher spatial resolution in the corresponding retinal area thus enhancing efficiency of the method. Regions of interest are defined on individual, digitized fundus images, which are used as landmarks for tailoring localized high resolution campimetry (fundus-oriented perimetry = FOP). Alternatively, the individual grid can be constructed on the basis of the results of previous perimetric examinations.

When we applied the FOP technique under theses conditons, even minimal visual field defects such as *angioscotomata* were immediately visible in 9 out of 13 normal individuals. Neither detection rates nor signal-to-noise ratios differed noticeably under different stimulus conditions (dark vs. bright and small [12´] vs. large [32´]).

Examinations of patients with circumscribed morphological changes of the retina (chorioretinal scars) or optic disk (glaucoma, drusen) illustrate the clinical applicability of FOP. The method detected scotomata in patients who were rated as normal with conventional "30-2 perimetry".

In exemplary cases with deficient ophthalmoscopical manifestation (e.g., Purtscher´s traumatic angiopathy and minute lesions of posterior visual pathways), grids with locally condensed stimuli based on previous perimetric results markedly enhanced the capabilities of visual field testing for exact description and follow-up of circumscribed defects.

In conclusion, individually tailored local stimulus condensation, based on morphological changes or previous psychophysical results is a promising procedure for enhancing perimetric efficiency.

2) **AN AUTOMATIC TARGET ADDING SYSTEM FOR VISUAL FIELD SCREENING.**

Y. Takihata[1], K. Miyazaki & K. Kani[2]

[1]Shiga Medical Center for Children, Moriyama,

[2]Dept. of Ophthalmology, Shiga University of Medical Science, Otsu, JAPAN

For screening the visual field, better results may be obtained if the examination time is short and a smaller number of test points are used. Usually, we examine the patients using a suprathreshold 76 points quick screening program. Sometimes, we find some areas of the field where visual disturbances are suspected, but the tested points are too scattered to diagnose the type of the disturbances. In such a case, we add test points manually in and around the area and test them. This procedure is complicated. We have developed a system which automatically add test points. We applied this system in 50 clinical cases and compared the results using the neural network diagnosis system[1]. The number of added points were from one to 23 points (average 10.6 points). The output value became better in 31 cases, unchanged in 16 cases and worse in 3 cases.

1. Nagata S, Kani K, Sugiyama A: A computer-assisted visual field diagnosis system using a neural network. Perimetry Update 1990/91, 291-295, 1991

Scientific Session IX: Wednesday September 9 8:30-10:00 Perimetric Techniques

3) NEURAL ATTRACTOR–NETWORK CLASSIFICATION OF VISUAL FIELD DATA

W. Fink, Kellogg #4, California Institute of Technology, Pasadena, California 91125
U. Schiefer, University Eye Hospital, Dpt. II, D–72076 Tübingen, Germany
E. W. Schmid, Institute for Theoretical Physics, University of Tübingen, Germany

Since many diseases and lesions, even subtle ones, may be recognized from perimetric examinations, the appropriate classification of visual field data is essential for diagnosis.

However, adequate classification and interpretation of perimetric examination results is a non–trivial task and requires well–trained personnel along with long–term experience.

Therefore, a computer–based classification system for visual field data is introduced, which may act as a counselor to the diagnosing physician.

The classification system consists of a neural attractor–network, which obtains its input data from perimetric examination results. Due to an iterated relaxation process, which determines the states of the neurons dynamically, even "noisy" perimetric output, e. g., early stages of a disease, may be classified correctly according to the predefined attractors (diseases) of the network.

4) Title: The clinical role of the Fast Threshold Strategy programme in the longterm follow-up of glaucoma

Authors: C O'Brien, N Bolton. Department of Ophthalmology, University of Edinburgh.

Background: Having obtained a reliable baseline visual field, the main goal of follow-up perimetry is to detect evidence of progression. Prolonged perimetric examination time is a considerable drawback to the interpretation of field results as a result of artefact, fatigue and fluctuation. The fast threshold strategy (FTS) on the Humphrey perimeter tests the field at 2 dB brighter than the stored values of a patients baseline threshold test result. Only those points that are missed are fully thresholded, consequently reducing test time.

Methods: We present our findings for 30 ocular hypertensive patients (OHT, minimum follow-up of 3 years with an average 2.3 FTS fields) and 30 open angle glaucoma patients (OAG, minimum follow-up 3 years with an average 3.5 FTS fields).

Results: In OHT, the mean duration of (a) the baseline 24-2 threshold fields was 11 mins 30 secs, and (b) the FTS fields was 3 mins 27 secs. In OAG, the mean duration of (a) the baseline 24-2 threshold fields was 12 mins 48 secs, and (b) FTS fields was 4 mins 4 secs.

Discussion: Using FTS, there was a reduction in test duration of approximately 70%. This will improve the quality of the patients performance, the throughput of patients in the clinic and will help to identify progressive field loss. Examples of stable fields and progressive field loss will be presented. The Fast Threshold Strategy has a valuable clinical role to play in the longterm management of glaucoma.

5) ESTIMATING CATARACT BY MEANS OF RESOLUTION PERIMETRY

Lars Frisén
Dept Ophthalmology, University of Göteborg, Sweden

In high-pass resolution perimetry, cataracts and other optical faults raise thresholds in inverse relation to their native levels. This property allows application of regression techniques to calculate a blur index that summarizes effects of optical faults over a large solid angle. It is also possible to estimate peripheral vision "behind blur". Both techniques are applicable in eyes with concurrent focal visual field defects from non-optical causes. Major provisions are spatial uniformity of optical faults and sparing of subsets of test locations from non-optical influences.

The proposed blur index appeared to provide a useful summary indicator of optical faults in deliberately blurred normals and in patients tested before and after cataract surgery. Predictions of neuroretinal function were good for artificial blur but only modest for cataracts, presumably because of frequent deviations from spatial uniformity. Another dilemma is that severe blur obscures detail in fields containing focal defects and such detail cannot be restored analytically.

6)

CORRELATION OF RELATIVE DISPERSION ANALYSIS AND THE OTHER HIGH PASS RESOLUTION PERIMETRY INDICES WITH STANDARD THRESHOLD PERIMETRY.

Altieri M, Iester M, Traverso CE, Capris P, Zingirian M
Department of Ophthalmology, University of Genoa, Genoa, Italy

Purpose: Relative Dispersion Analysis, a new High Pass Resolution Perimetry (HRP) index, appears to capture a novel aspect of visual field abnormality. The aim of this study was to evaluate the correlation of relative dispersion analysis and other HRP indices with the Humphrey perimeter parameters.

Methods: Forty-four eyes were randomly recruited from the patients of our clinic. 22 eyes were classified as having glaucoma (high intraocular pressure, abnormal visual field and/or optic disc) and 22 as glaucoma suspect (high intraocular pressure, normal visual field, not evident optic disc defect). All the subjects were examined with Humphrey Perimeter, program 30-2, and HRP. The HRP data were also analyzed by relative dispersion analysis program. Findings were assessed by Pearson's correlation.

Results: A significant correlation was found between the dispersion index and mean deviation ($r = -0.46$, $p < 0.01$), corrected pattern standard deviation ($r = 0.6$, $p < 0.001$), pattern standard deviation ($r = 0.6$, $p < 0.001$) and short-term fluctuation ($r = 0.35$, $p < 0.05$). Other significant ($0.01 < p < 0.001$) correlations were found between Humphrey indices and global deviation ($-0.8 < r < 0.67$), local deviation ($-0.4 < r < 0.45$) and neural capacity ($-0.63 < r < 0.72$).

7) USE YOUR PC TO QUICKLY MAP REMAINING VISION AFTER FOVEAL VISION LOSS

M. Mackeben, Ph.D., A. Colenbrander, M.D. & A. Gofen - (mm@skivs.ski.org)
The Smith-Kettlewell Eye Research Institute, San Francisco

People with maculopathies can learn to use intact retinal areas by adopting a new viewing strategy. Size and location of usable areas must be assessed for low vision rehabilitation but vary between individuals. Our Macular Mapping Test (MMTest) does this quickly and with sufficient accuracy. The results are instructive for patient and counselor. MMTest runs on the IBM PC and compatibles under Windows without special hardware. It stabilizes gaze by an 8-spoke "wagon wheel" pattern, which is sufficient to yield good test-retest reliability in >95% of people with maculopathies. Single letters or words are displayed tachistoscopically (250 ms) and unpredictably in 33 locations on a field of typically 8 deg radius. Letter size depends on eccentricity and a selectable size offset. Details can be explored by choosing additional test locations automatically or by mouse. MMTest yields relevant information in 3-4 min and stores it in a data base. The procedure and short duration keep patient alertness high. We have used MMTest on >100 patients.

8)

AUTOMATED PERIMETRY, COLOR VISION AND CONTRAST SENSITIVITY IN OCULAR HYPERTENSIVES.

(G.C.M. Rossi, G. Milano, F.Trimarchi) Clinica Oculistica dell'Università, IRCCS Policlinico San Matteo, Pavia, Italy.

Purpose. Ocular Hypertensives (OH) have elevated intra-ocular pressure (IOP) without evidence of glaucomatous opticopathy. The early glaucomatous damage consists in loss of large ganglion cells, probably M cells (mediating contrast sensitivity) and larger P cells (mediating blue sensitivity). The psychophysical assesment of visual functions subserved by these types of cells could reveal early signs of glaucomatous damage. Methods. Twenty eyes of 20 OH were selected and submitted to white on white and blue on yellow automated perimetry, Farnsworth FM-100 and Sinusoidal Gratings contrast sensitivity presented on a PC screen. A normal control group of 20 subjects was submitted to the same examinations. Results. No sign of damage was observed in all the normal subjects. Perimetric tests pointed out an increase of the light threshold to blue stimulus in OH with normal standard perimetry. OH showed impairment in color perception (mainly in blue) in 12 eyes (60%) and in contrast sensitivity (mainly in mid and high spatial frequencies) in 10 eyes (50%). Seven out of nine patients (35%) with decrease of sensitivity to mid (>6cpd) and high (>10cpd) spatial frequencies had also alterations with FM-100 test. Conclusions. These findings pointed out an abnormality in visual functions subserved by M and larger P cells more vulnerable to glaucomatous damage. This could reveal a size-selective damage, at least functional, at a very early stage. All these data have to be further verified. The work is still in progress.

9) IMPROVED RESOLUTION BY 3 dB GREY SCALEPRINT OUTS OF VISUAL FIELDS

F. Dannheim, Dept. of Ophthalmology, General Hospital Hamburg-Harburg

The Dicon LD 400 automated perimeter offers a resolution in print outs of differential light sensitivity with grey scales separating 17 steps of 3 dB each. This higher resolution allows a more distinct recognition of patterns of localised defects as opposed to a 10 steps / 5 dB grey scale print out of the Humphrey Field Analyser.

Examples of visual fields given in both types of print out together with superimposed numerical values of sensitivity may illustrate the usefulness of this feature for the interpretation of defects.

1)

REPEATABILITY OF ABNORMALITY AND PROGRESSION IN GLAUCOMATOUS STANDARD AND SWAP VISUAL FIELDS

Pamela A. Sample, Alireza Emdadi, Yoshiki Kono, Robert N. Weinreb
Glaucoma Center and Visual Function Laboratory
University of California, San Diego, La Jolla, CA, USA

Purpose: To evaluate the repeatability of the designations "abnormal" and "progressed" on standard and short-wavelength (SWAP) visual fields. **Methods:** From our longitudinal database of patients with standard and SWAP, 68 patients were identified with primary open angle glaucoma or suspected glaucoma and multiple field tests (mean number of fields ± s.d., 6.72 ± 2.51) with at least one abnormal standard visual field. Abnormal fields were defined as those outside the normal limits on the glaucoma hemifield test or with a CPSD ≤ 5% of normal. Progression was based on a new scotoma with 2 adjacent previously normal points now at the 0.01 level, or 2 points adjacent to or in an existing scotoma depressed by 10 dB or more. **Results:** First time "converts" (normal fields followed by two abnormals) remained converted in 44% for SWAP and 28% for standards. Abnormality (at least two in a row, including eyes abnormal on first visit) was repeatable for SWAP in 65%, and for standard in 57%. A percentage of eyes with two abnormals in sequence returned to normal, but rarely did this occur after 3 abnormal designations. Some eyes showed several flips between normal and abnormal before remaining repeatedly abnormal. Progression was identified in 50% on standard and 40% on SWAP. It was repeatable in 71% on SWAPs and 67% on standard fields. **Discussion:** Variation in the field designations from normal to abnormal may be due to early physiological variation due to glaucoma, to the inherent variability in psychophysical testing, or to the use of less than optimum criteria for designating abnormality and progression. These are important issues for future research in glaucoma. **Conclusion:** Abnormality by SWAP may be more repeatable over time (see also Demirel and Johnson, 1997 NAPS meeting abstract), and identification of abnormality and progression improves with repeated testing. Supported by NEI EY08208

2)

A LONGITUDINAL EVALUATION OF SHORT-WAVELENGTH AUTOMATED PERIMETRY IN GLAUCOMA PATIENTS

Yoshiki Kono, Pamela A. Sample, Alireza Emdadi, Robert N. Weinreb
Glaucoma Center and Visual Function Laboratory
University of California, San Diego, La Jolla, CA, USA

Purpose: To conduct a longitudinal evaluation of short-wavelength automated perimetry (SWAP) results in glaucoma patients using Bebie curve-type analysis. **Methods:** Fifty-three glaucoma patients with abnormal optic discs and at least one abnormal standard field were recruited. All patients had three or more SWAP examinations that were at least nine months apart. Average follow-up period was 43.7 months (range: 23.0 - 73.0 months). Based on the evaluations of Bebie curves (first two SWAP examinations for each patient used as their baseline), four different groups were defined: 1. No progression; 2. Local progression (decreased threshold of more than 8 dB in at least 3 points of the curve); 3. Diffuse progression (decreased threshold of more than 3 dB in at least 60 % of the values of the entire curve); and 4. Local and diffuse progression. **Results:** Sixteen patients (30%) showed progression. Of these, 8 patients (50%) showed diffuse progression , 3 patients (19%) showed local progression, 3 patients (19%) showed diffuse and local progression. Two patients (12%) showed a mixed pattern of progression. **Conclusion:** Using Bebie curves, one third of glaucoma patients showed progression of their visual field examinations. Diffuse pattern of progression was more common than other patterns.

Scientific Session X: Wednesday September 9 11:30-1:00 Color Perimetry

3) **STATPAC for Short Wavelength Automated Perimetry (SWAP) in patients affected by primary open angle Glaucoma (POAG) with normal white on white (W/W) perimetry**

Perdicchi A, Pece A, D'Alberto A, Brancato R. Istituto San Raffaele Roma Italy

Purpose STATPAC software analysis for Humphrey Short Wavelength Automated Perimetry (SWAP) has recently been introduced into clinical practice. The purpose of our study is to assess its significance in a group of patients affected by primary open angle glaucoma (POAG) who have perimetric indices of traditional white on white (W/W) perimetry in normal range. **Methods** 20 POAG patients (39 eyes) with normal W/W perimetry, under therapy with beta-blockers, best corrected visual acuity 20/20, were submitted at Humphrey SWAP perimetry (Prog. 30-2). The resulting data was analyzed by STATPAC for SWAP perimetry, compared with a control group, matched for sex and age, and processed using Macintosh computer Staview II program. **Results** 1) At least one of SWAP perimetric indices was abnormal in 28% of the eyes examined 2) SWAP perimetric indices are statistically higher than W/W perimetric indices (t Test) both in POAG patients or in the control group 3) There was no significant difference of W/W perimetric indices between POAG patients and the control group (t Test). 4) SWAP Pattern Standard Deviation (PSD) index and Corrected Pattern Standard Deviation (CPSD) index of the POAG patients were statistically higher than in the control group (t Test). **Conclusions** SWAP perimetric indices seem to be more sensitive than W/W perimetric indices in POAG patients. The lack of a significant difference between W/W perimetric indices of POAG and the control group and, on the opposite, the significant differences of SWAP PSD and, moreover, SWAP CPSD, may suggest that SWAP perimetry is more accurate than W/W perimetry for detecting initial defects in POAG patients, confirming that the localized defect is the first sign of damage of the visual field

4) **First year expierience of SWAP in private practice**

Eva Forsman, MD
Ekenäs Öga, Ekenäs, Finland

Purpose: To evaluate the usefullness of a new method SWAP (Short Wave Automated Perimetry) compared with RNFL (Retinal Nerve Fiber Layer) photography detecting early glaucoma in patients in open care.

Methods: During the first year, when SWAP has been available after changing the Humphrey perimeter to a newer model (Humphrey Field Analyzer 745), 20 patients were chosen into this pilot study. The inclusion criteria were: 1) normal visual fields in conventional Humphrey-perimetry 2) the follow-up time before this study more than 3 years (range 3 –18) 3) under 60 years of age (range 46 –59) to exclude the yellowish effect of the lens. 16 patients fullfilled the criteria: ocular hypertension (OH) with (4) or without (10) medication and two (2) glaucoma suspects. During a single visit SWAP was first performed and after pupil dilation RNFL-pictures were taken .14 patients had also the usual HFA-24-2 before SWAP as control.

Results: In one eye of all 32 was a wedge defect in RNFL and SWAP was outside normal.Four other eyes had wedge defect in RNFL, but SWAP were normal in two and borderline in two.In three eyes were diffuse defect in RNFL, but normal SWAP.In seven eyes SWAP was recorded with low reliability

Conclusions: The test results showed a slight superiority to RNFL photography compared with SWAP that was a time consuming and demanding test for the patient.

NON-CONVENTIONAL VISUAL FIELD TESTING IN PATIENT WITH HIGH-RISK OCULAR HYPERTENSION

5)

P.Brusini, P.Busatto and G.Driussi
Dept. of Ophthalmology - Hospital of San Donà di Piave, Venice, Italy

In the last few years a number of non-conventional visual field testing techniques have been proposed. Some selectively assess the magnicellular mechanism, others analyze the parvicellular pathway. No method, however, has been able to supplant the traditional computerized automated perimetry (CAP), even though there is some evidence that some techniques, such as the short wavelength automated perimetry (SWAP), may identify glaucomatous visual field defects years before CAP. Unfortunately, failing long-term longitudinal research on this topic (such as the few studies on SWAP), it is very difficult to judge the real sensitivity of any method in short-term studies, due to the lack of a reliable damage gold standard in suspect glaucoma cases.

In this study we used three non-conventional techniques, which analyze selectively different neural subpopulations: a) SWAP; b) Frequency Doubling Perimetry (FDP); and c) High-pass Resolution Perimetry (HRP). Only very selected cases of high-risk ocular hypertension where a damage was very likely were taken into consideration. The admission criteria were the following: a) normal CAP (Humphrey 30-2 threshold test); b) ocular hypertension (more than 25 mmHg in several occasions or more than 22 mmHg associated with other risk factors, such as family history of glaucoma); or c) clinical evidence of monolateral damage (for example, asymmetrical IOP or cup/disk ratio with correspondent asymmetry in MD); or d) ocular hypertension in one eye and severe glaucomatous damage in the other; or e) significant reduction in nerve fiber layer thickness. The nerve fiber layer was studied with the GDx Nerve Fiber Analyzer (LDT inc.).

No technique was clearly superior to any other in our patient group. We found little agreement among the three methods, particularly looking at the location of defects. Moreover, the reproducibility of small defects was generally poor. The nerve fiber layer analysis showed a higher percentage of significant damage with respect to non-conventional perimetry techniques, and in most cases there was no correlation between anatomical and functional damage.

Our results do not support the hypothesis that early glaucomatous damage is selective.

6)

SOME REMARKS ON BLUE-ON-YELLOW PERIMETRY AND COLOUR VISION IN EARLY GLAUCOMA

A. Serra, I. Zucca, A. Tanda, V. Piras, M. Fossarello
University Eye Clinic, Via Ospedale 46, 09124 Cagliari

Purpose. Changes in colour vision and visual field defects represent well known functional signs occurring in glaucoma. It has been shown that tritan defects usually appear earlier than other functional signs: moreover blue-on-yellow (B-Y) perimetry can reveal visual field defects earlier and show them larger than does white-on-white (W-W) perimetry. The aim of this study was to find out how colour vision correlate with B-Y perimetry and W-W perimetry results and with other clinical parameters (refraction, visual acuity, pupillary diameter) in normal and early glaucomatous patients.

Methods. One randomly chosen eye was evaluated in each of 15 normal subjects and 15 patients with early glaucoma (EG). Colour vision was assessed with Farnsworth 100 hue (total score and axis) and Lanthony D15 tests (axis). B-Y and W-W visual fields (program G2) were obtained with an Octopus 101 perimeter (Interzeag). The visual field mean sensitivity (MS) was utilised for all correlations.

Results. The colour vision measure (total score) showed strongest correlation with the MS of both the B-Y and W-W visual fields in EG, but the statistically significant correlation of the B-Y visual field MS with the FM total score was better than that of W-W perimetry. No statistically significant correlations were found with the other clinical parameters considered in this study.

Conclusions. Colour vision total score is well correlated with B-Y and W-W perimetry MSs in EG.

FREQUENCY-DOUBLING TECHNIQUE AND SHORT WAVELENGTH AUTOMATED PERIMETRY IN OCULAR HYPERTENSION: A COMPARISON

7) F.J. Goñi, M. Guarro, J.C. Ondategui, R. Borrás, E. Peris.
Department of Ophthalmology, Hospital de Mollet. Barcelona, Spain.
Department of Optics and Optometry, Universitat Politecnica de Catalunya. Spain.

PURPOSE. To determine the visual field in a group of ocular hypertensives with standard automated perimetry (SAP), short wavelength automated perimetry (SWAP) and frequency-doubling technique (FDT), in order to compare their capabilities to detect significant, reproducible visual field damage.

METHODS. Forty-one eyes of twenty-two patients with a diagnosis of moderate or high risk ocular hypertension underwent visual field testing twice with SAP, SWAP and FDT in two sessions, one week apart.

RESULTS. SAP classified 39 out of 41 visual fields as within the normal limits and 2 out of 41 as borderline. SWAP separated 9 out of 41 visual fields (22 %) as outside the normal limits and 5 out of 41 as borderline. FDT detected significant damage in 8 out of 41 visual fields (19,5 %) and 3 out of 41 were classified as borderline. When SWAP and FDT results were compared, 9 out of 25 visual fields (36 %) showed a reasonable degree of agreement between both methods.

CONCLUSIONS. SWAP and FDT yielded a higher sensitivity than SAP to detect early visual field damage in ocular hypertensives.The results suggest that both methods can be complementary to better characterize ocular hypertension and early glaucoma.

SHORT-WAVELENGTH AUTOMATED STATIC PERIMETRY AT BASELINE AND FOLLOWING LASER PHOTOCOAGULATION IN PATIENTS WITH CLINICALLY SIGNIFICANT DIABETIC MACULAR OEDEMA (DMO)

8) Chris Hudson [1,2], John G Flanagan [1,3], George S Turner [1], Hean C Chen [1], Lorna B Young [1] and David McLeod [1].
[1]Univ. Dept. of Ophthalmology, Manchester, UK; [2]School of Biomedical Sciences, Univ. of Ulster, Northern Ireland;
[3]Dept. of Ophthalmology, Univ. of Toronto, Canada.

Purpose. To compare the results of short-wavelength (SWAP) and conventional automated static threshold perimetry at baseline and following laser photocoagulation, in a cohort of patients with clinically significant DMO.

Methods. The sample comprised 24 patients with clinically significant DMO (range 45-75yrs). One eye of each patient was selected. All patients had a logMAR visual acuity of 0.25, or better. Exclusion criteria included lenticular opacity. Each patient underwent perimetry using SWAP and conventional parameters in conjunction with program 10-2 of the Humphrey Field Analyzer on two separate occasions prior to treatment; the results of the second perimetry session were taken as baseline. Perimetry was then repeated within 1 week of, and at 1, 2, 4 and 12 weeks after, treatment. A pointwise horizontal hemifield asymmetry analysis was used for SWAP (thereby negating the influence of pre-receptoral absorption), whist the pointwise pattern deviation plot was analysed for conventional perimetry. A database of 400 normal subjects (range 18-84yrs) who had undergone SWAP using program 30-2 was employed. A weighted linear interpolation procedure was utilised to establish confidence limits for the asymmetry of program 10-2 pointwise horizontal hemifield sensitivity values. Abnormality was defined as 3 or more contiguous stimulus locations with reduced sensitivity values, or negative asymmetries, that resulted in a statistical probability level of $p<5\%$.

Results. At baseline, the fields of 8 patients were abnormal as assessed by conventional perimetry while all were classified as abnormal using SWAP; the position of the localised SWAP field loss corresponded with the clinical mapping of the area of DMO Conventional perimetry revealed an increase in the group mean number of abnormal contiguous stimulus locations from 2.4 (SD 4.3. range 0-14) immediately prior to treatment to 12.4 (SD 7.8, range 0-30) within 1 week after treatment; at 12 weeks post-treatment, the group mean number of abnormal contiguous stimulus locations was 8.1 (SD 6.5, range 0-20). Similar but less pronounced changes were observed using SWAP. The spatial position of the post-treatment localised sensitivity loss corresponded with the area of retinal ablation.

Conclusions. SWAP offers improved sensitivity for the psychophysical detection of clinically significant DMO. Despite proven benefit in the stabilisation of visual acuity, laser photocoagulation for clinically significant DMO invariably results in a localised loss of perimetric sensitivity within 10° eccentricity of the fovea.

9)

BLANKOUT PHENOMENON IN STANDARD AND SHORT WAVELENGTH AUTOMATED PERIMETRY

R. Borrás, J.C. Ondategui, E. Peris, X. Bofill, F.J. Goñi, M. Guarro.
Department of Optics and Optometry, Universitat Politecnica de Catalunya. Spain.
Department of Ophthalmology, Hospital de Mollet. Barcelona, Spain.

BACKGROUND. Luminance disparities between both eyes while occluding the non-tested one during bowl standard perimetry (SP) lead to a loss of visual perception or blankout. The purpose of this study is (1) to determine the influence of different occluders (black, white and translucent) in light sensitivity when used in threshold conditions in both SP and SWAP; (2) to characterize the blankout phenomenon (latency, duration and frequency) on both white and yellow luminance backgrounds.

METHODS. 30 healthy subjects underwent a visual field test with the three occluding conditions in both SP and SWAP. To quantify the phenomenon, 12 healthy subjects underwent five one-minute trial period with SP and SWAP, while wearing four different occluding conditions (black, white, translucent and binocularly).

RESULTS. In both SP and SWAP the black occluder showed the highest mean light sensitivity defect compared to the white occluder (SP: 0.7 dB, $p< 0.0001$; SWAP: 1.33 dB, $p<0.0001$) and translucent occluder (SP: 0.85 dB, $p< 0.0001$; SWAP: 0.96 dB, $p=0.0001$). The blankout phenomenon was only significantly present with the black occluder in both white (mean latency: 11.4 sec.; 5.3 times/min.) and yellow (mean latency: 7.9 sec.; 6.4 times/min.) luminance backgrounds.

CONCLUSIONS. These results show that the black occluder reduces significantly the light sensitivity on the tested eye and patients' confort not only in SP but also in SWAP.

10)

THE SENSITIVITY DISTRIBUTION OF BLUE ON YELLOW PERIMETRY

Genichiro Takahashi, Yoko Aoki, Takeshi Koike, Kenji Kitahara
Department of Ophthalmology, Jikei University School of Medicine,
Tokyo, Japan

The characteristics of sensitivity distribution of short-wavelength-sensitive mechanisms were examined with the Humphrey field analyzer. Blue on yellow perimetry was performed with program 30-2 in normal 20 eyes. The results were entered into a computer and analyzed. We found that the sensitivity gradient for short-wavelength-sensitive mechanisms declined toward the fovea and observed the maximal sensitivity at the 3 degree periphery, from which the curve tended to decrease gradually toward the periphery. These findings are consistent with those of psychophysical and immunocytochemical studies.

AN ANALYSIS OF SPATIAL SUMMATION USING BLUE ON YELLOW PERIMETRY

11)

Takeshi Koike, Genichiro Takahashi, Yoko Aoki, Kenji Kitahara
Department of Ophthalmology, Jikei University School of Medicine,
Tokyo,Japan

The characteristics of spatial summation of short-wavelength-sensitive mechanisms were examined with the Humphrey field analyzer. Threshold static perimetry was performed with program 30-2 using test lights of sizes Ⅰ, Ⅱ, Ⅲ, Ⅳ and Ⅴ in 5 normal subjects. The results were entered into a computer and analyzed. The coefficients of summation for each point of examination were calculated with the assumption that the summation curve is a straight line. The average of the coefficient of summation was0.66 at fovea, 0.80 at up to 9 degrees, and 0.83 up to 15 degrees. These results confirm that the coefficient of summation increases with eccentricity. This method is useful for studying the characteristics of spatial summation of short-wavelength-sensitive mechanisms.

12)

EVALUATION OF WHITE-ON-WHITE PERIMETRY USING SIZE I STIMULUS COMPARED WITH BLUE-ON-YELLOW PERIMETRY.

M. Takada, M. Osako, S. Osako, H. Goto, N. Horikoshi, T. Okano
Dept. of Ophthalmology, Tokyo Medical College, Tokyo

Although blue-on-yellow (B/Y) perimetry is expected to detect early glaucomatous visual field loss before the reduction of retinal sensitivity occurred in white-on-white (W/W) perimetry using size III stimulus, it is also reported that the W/W perimetry using size I stimulus is more sensitive in detecting slight change of the visual field than that using size III stimulus. We compared the visual field results which were taken by W/W perimeter using size I stimulus and B/Y perimeter, and evaluated the effectiveness of W/W perimetry using size I stimulus. Methods. Subjects comprised 19 eyes of 19 normals (NP), 33 eyes of 22 cases with large cupping (C/D ratio≧0.7) but no visual field defects (LC), 18 eyes of 14 cases with early glaucomatous visual fields (EG). Program 24-2 of the Humphrey Field Analyzer was performed on all subjects using W/W perimeter (size I, III) and B/Y perimeter (size V). We compared mean retinal sensitivities (MS), mean abnormal points, and short-term fluctuation (SF) in the visual fields among these three groups. Results. The MS (dB) for size I and III on W/W, and for size V on B/Y perimetry were, respectively, 20.7±1.5, 30.0±1.1, 24.2±2.3 in NP group; 19.7±1.9, 29.2±1.2, 23.2±3.0 in LC group; 17.8±2.1, 27.7±1.3, 21.9±3.4 in EG group. The MS of EG group was significantly lower than those of NP and LC groups on size I W/W perimetry ($p<0.01$), whereas only that of EG group was significantly lower than that of NP on the B/Y perimetry ($p<0.05$). The mean abnormal points of size I W/W perimetry was more than that of B/Y perimetry in LC and EG groups ($p<0.01$). Although the SF of EG group was significantly greater than that of NP and LC groups on size I W/W perimetry ($p<0.01$), there was no difference statistically on the B/Y perimetry. Conclusions. These findings suggest that W/W perimetry using size I stimulus is more sensitive in detecting of early glaucomatous change in the visual fields than the B/Y perimetry. We need long-term follow-up study to assess the efficiency of W/W perimetry using size I stimulus.

13) BLUE-ON-YELLOW PERIMETRY USING A GLAUCOMA SCREENING PROGRAM

Satoshi Matsubara, Hidetaka Maeda, Yoshiaki Tanaka, Misao Yamamoto
Department of ophthalmology, Kobe university, Kobe, Japan

Purpose: The purpose of the present investigation was to determine whether B/Y perimetry using a screening program can detect early glaucomatous damage before it is evident with standard screening tests. **Methods**: B/Y as well as W/W perimetry was obtained on a modified Humphrey program (Armaly Full Field). The subjects included 30 normal, 30 ocular hypertensive, and 30 early glaucomatous eyes. **Results**: In normal subjects, no abnormal points were found in the central field by B/Y and W/W perimetry. However, B/Y perimetry alone demonstrated abnormal points in the nasal field in 12 eyes (40%). 7 of 30 ocular hypertensive eyes were revealed to have abnormal points which were also confirmed by full-threshold strategy, while none of visual field loss was detected by W/W perimetry. In 24 glaucomatous eyes (80%), abnormal points were detected more by B/Y perimetry than by W/W perimetry. Five of 30 (17%) glaucomatous eyes were detected to have glaucomatous visual field defects only by B/Y perimetry. **Conclusion**: B/Y perimetry using Armaly Full Field Screening program is more advantageous than conventional screening tests in detecting early glaucomatous visual field defects.

14)

AN ARTIFICIAL SCOTOMA GENERATED BY LOOKING AT CLAUDE MONET'S MASTERPIECE "IMPRESSION. RISING SUN".

Avinoam B. SAFRAN, MD , Neuro-ophthalmology and strabology Unit, and Theodor LANDIS, MD, Neurology Clinic, Geneva University Hospitals, Geneva, Switzerland

The work "Impression. Rising Sun", representing a harbor scene at Le Havre, was painted in 1872 by Claude Monet, and eventually gave its name to the whole impressionist movement. When the head of the sailor standing in the boat is fixated steadily for about 15 seconds, gradual vanishing of the solar disc can be observed, its surface being filled in by the brightness and color of the surrounding sky. At this point, the disc can no longer be distinguished from the sky.

We reproduced the condition experimentally, on a computer screen. We represented the Sun as a red disc against a blue background. When "filling-in" of the solar disc by the surrounding sky had occurred, we found that, if we switched the blue background to a red one, identical in color to the Sun, a bluish color was still perceived for several seconds in the area originally occupied by the solar disc.

The "filling-in" phenomenon which we experience when looking at Monet's painting, is similar in nature to the one described in 1992 by Ramachandran and Gregory, as a reversible artificial scotoma. It reflects a dynamic process of cortical reorganization.

Supported in part by the Swiss National Fund for Scientific Research, grants #3200-049594.96 and #4035-0440 (PNR38).

15)

CORRELATION OF COLOR CAMPIMETRY & HUMPHREY FIELD ANALYSIS IN GLAUCOMA PATIENTS

E.J. Dudenhoefer[1], L.I. Nesteruk[2], M.A. Ohara[1], W.E. Sponsel[3]
Brook Army Medical Center San Antonio, TX.[1], Helmholtz of Eye Diseases, Moscow, Russia[2], University of Texas Health Science Center San Antonio, TX.[3]

Purpose: Comparing the visual field (VF) data acquired using the static 'OCULAR' color contrast campimetry (OCCC) program with standard white on white perimetry using the Humphrey Field Analyzer (HFA). **Methods:** Thirty-two eyes of 16 patients with ocular hypertension or open angle glaucoma underwent testing of the central 21 VF using both the OCCC program and the HFA. The 'OCULAR' technique evaluates subject's response time to a static stimulus of progressively increasing contrast against a constant black background at each of 52 stimulus points in the central 21° field. All OCCC testing occurred within 1 month of SITA-standard type testing with the HFA, and was performed on a 21", high definition color monitor driven by a personal computer. Corresponding quadrants from each of the 'OCULAR' and HF were then evaluated by averaging the 13 tested points in each quadrant, and determining the level of correlation between quadrants using the 'Stat Works' statistical analysis program. **Results:** A high level of correlation between OCCC and HFA data was found. The R values obtained from each quadrant are: R=1.79 supertemporal; R=0.75 inferotemporal; R=0.82 superonasal; R=0.76 inferonasal. (P values for all<0.0001) **Conclusions:** The high level of correlation between the data obtained with the 'OCULAR' color campimeter and the current "gold standard" suggests that this evaluative modality is capable of generating valid data in the analysis of the visual field and further evaluation is warranted.