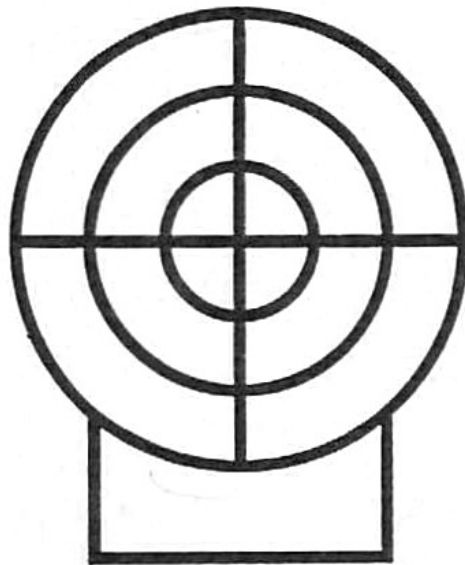


**XII International Perimetric Society
Meeting**

XII VISUAL FIELD SYMPOSIUM



IPS

Würzburg, Germany

Tuesday, June 4 - Saturday, June 8

Program and Abstracts

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INVITATION ADDRESS


Dear Colleagues:

It is our great pleasure to invite you, on behalf of the Organizing Committee, to the XIIth International Perimetric Society (IPS) Meeting to be held in Würzburg, Germany, from the 4th to the 8th of June, 1996.

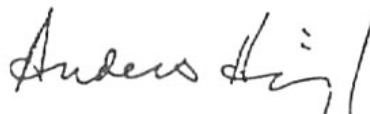
Scientific sessions are scheduled on Wednesday, Thursday, and Friday, June 5, 6, and 7, 1996. The social program begins on the evening of the arrival day, Tuesday, June 4, 1996, and continues through the evening of Friday, June 7 with the traditional IPS banquet. Saturday, June 8 is the departure day.

We expect the meeting to continue the tradition of excellence established by the previous 11 visual field symposia of the IPS and hope you all will enjoy the meeting.

Yours sincerely,



Prof. Michael Wall, M.D.
IPS Secretary



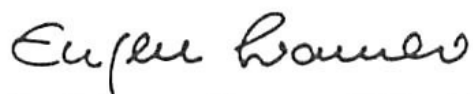
Prof. Anders Heijl, M.D., Ph.D.
IPS President

INVITATION ADDRESS

Dear Colleagues:

As the local host of the XIIth Meeting of the International Perimetric Society and on behalf of the Organizing Committee, it is my great pleasure to invite you to the upcoming meeting to be held in Würzburg from 4th to 8th of June, 1996. Würzburg is an excellent congress venue, being central and accessible from all directions, and also because it is a city, rich in history and culture and situated in a beautiful area. The University of Würzburg was founded in 1402 and is one of the oldest universities in Germany. In the second half of the last century the University of Würzburg gained great significance in the fields of medicine and natural sciences with names such as von Koelliker, von Siebold and Virchow. Several Nobel Prize laureates have worked in Würzburg, the most important being the scientist W.C. Röntgen who discovered the X-ray in Würzburg 100 years ago, the chemists Fischer and Buchner, as well as the physicists Wien, Stark and von Klitzing. We anticipate that the upcoming meeting set in such a historic environment will provide an ideal opportunity for constructive and lively exchange of scientific knowledge between participants coming from many different countries all sharing a common interest in perimetry, glaucoma, neuroophthalmology and image analysis of the optic disc and retina. We hope very much that you will enjoy meeting old friends as well as making many new ones. Our social events and concerts in the Residence Palace and in the Fortress Marienberg, our excursion on the romantic Road to medieval Rothenburg, and the IPS banquet with its traditional singing, are designed to foster exploration, friendship and happy memories. We look forward to seeing you here in Würzburg and trust that your stay in Germany will be a most enjoyable one.

Yours sincerely,



Prof. Eugen Gramer, M.D., L.L.D.

Local host

University Eye Hospital, Würzburg / Germany

International Perimetric Society

Executive Committee

President	Prof. Anders Heijl, MD, Malmö, Sweden
Vice President	Prof. Mario Zingirian, MD, Genova, Italy
Vice President	Prof. Yoshiaki Kitazawa, MD, Gifu-shi, Japan
Secretary	Prof. Michael Wall, MD, Iowa City, U.S.A.
Treasurer	Prof. Fritz Dannheim, MD, Hamburg, Germany
Members at Large	Prof. Toshifumi Otori, MD, Osaka, Japan Dr. Mario Zulauf, MD, Basel, Switzerland Prof. Enrico Gandolfo, MD, Genova, Italy Prof. Elliot Werner, MD, Philadelphia, PA, U.S.A.

Group Chairmen

Standards	Prof. John Wild, PhD, Birmingham, U.K.
Retina/Optic Disc	Prof. Bernard Schwartz, MD, Boston, U.S.A.
Glaucoma	PD Jörg Weber, MD, Köln, Germany
Neuro-Ophthalmology	Prof. Avinoam Safran, MD, Geneva, Switzerland
Color Perimetry	Prof. William Hart, MD, St. Louis, U.S.A.
Data Acquisition & Analysis	Prof. Balwantray Chauhan, PhD, Halifax, Canada
Ergoperimetry	Prof. Bernhard Lachenmeyr, MD, Munich, Germany

XII Visual Field Symposium

Würzburg, Germany

Organizing Committee

Prof. Eugen Gramer, M.D., L.L.D.

Prof. Anders Heijl, M.D.

Prof. Fritz Dannheim, M.D.

Mrs. Ursula Körner

Prof. Michael Wall, M.D.

Program Committee

Prof. Fritz Dannheim, M.D.

Prof. Michael Wall, M.D.

PD Jörg Weber, M.D.

Prof. John Wild, M.D.

Time	Tuesday, June 4	Wednesday, June 5	Thursday, June 6	Time	Friday, June 7
8.00 AM - 9.45 AM	Registration 10.00 AM - 6.30 PM	Opening and Session I Epidemiology, Neural Networks, Visual Field Progression	Session V New Methods of Perimetry	8.00 AM - 9.30 AM	Session VI Image Analysis and Glaucoma
9.45 AM- 11.00 AM		View Posters/Coffee Break/ Technical Exhibition	View Posters/Coffee Break/ Technical Exhibition	9.30 AM- 10.00 AM	View Posters/Coffee Break/ Technical Exhibition
11.00 AM - 12.15 PM		Session II Cataract and Diffuse Loss	11.45 Tour on Romantic Road	10.00 AM - 11.45 PM	Session VII Perimetric Techniques IPS-Business Meeting
12.30 PM - 1.30 PM		Lunch (Maritim)		11.45 AM - 12.30 PM	Lunch (Maritim)
1.30 PM - 3.15 PM		Session III Clinical Observations		12.30 PM - 1.30 PM	Session VIII Reliability, Artefacts and Instruments
3.15 PM - 4.00 PM		View Posters/Coffee Break/ Technical Exhibition		1.30 PM - 2.45 PM	View Posters/Coffee Break/ Technical Exhibition
4.00 PM - 5.30 PM		Session IV Blood Flow and Nerve Fiber Layer analysis		3.00 PM - 3.15 PM	Session IX Psychophysics and Electrophysiology
				3.15 PM - 4.00 PM	Session X Clinical Observations II
7.30 PM - 11.00 PM		Welcoming (Residenz) Reception-Dinner and Concert	Tour of Main-Franconian- Museum (Festung Marienberg) Dinner and Concert	4.15 PM - 5.30 PM	IPS Banquet (Maritim/Dinner)
				7.30 PM - 11.00 PM	

SCIENTIFIC PROGRAM

Tuesday, June 4

10:00 AM - 6:30 PM	Registration, Maritim Congress Center
7:00 PM - 9:00 PM	Welcoming Reception at Garden Hall of the Residence of the Prince-Bishop with concert, dinner and a guided tour of the residence

Wednesday, June 5

8:00 AM - 7:30 PM	Registration, Maritim Congress Center
8:00 AM - 9:45 AM	Opening and Session I (Barbarossa-Saal) Epidemiology, Neural Networks, Visual Field Progression
9:45 AM - 11:00 AM	View Posters / Coffee Break / Technical Exhibition
11:00 AM - 12:15 PM	Session II (Barbarossa-Saal) Cataract and Diffuse Loss
12:30 PM - 1:30 PM	Lunch
1:30 PM - 3:15 PM	Session III (Barbarossa-Saal) Clinical Observations
3:15 PM - 4:00 PM	View Posters / Refreshment Break / Technical Exhibition
4:00 PM - 5:30 PM	Session IV (Barbarossa-Saal) Blood Flow and Nerve Fiber , Layer Analysis
7:00 PM	Bus Departure from Maritim Congress Center
7:30 PM - 11:30 PM	Tour of Main-Franconian Museum in the Fortress Marienberg with dinner, concert and wine tasting
11:45 PM	Buses return to Hotel Maritim

SCIENTIFIC PROGRAM

Thursday, June 6

8:00 AM - 6:00 PM	Registration, Maritim Congress Center
8:00 AM - 9:45 AM	Session V (Barbarossa-Saal) New Methods of Perimetry
10:15 AM - 11:15 AM	View Posters/Coffee Break/Technical Exhibition
11:45 AM - 11:00 PM	Tour on „Romantic Road“ Coach Excursion along the so-called Romantic Road to Rothenburg, where there will be a guided tour with lunch and dinner

Friday, June 7

8:00 AM - 6:00 PM	Registration, Maritim Congress Center
8:30 AM - 9:30 AM	Session VI (Barbarossa-Saal) Image Analysis and Glaucoma
9:30 AM - 10:00 AM	View Posters / Coffee Break / Technical Exhibition
10:00 AM - 11:45 PM	Session VII (Barbarossa-Saal) Perimetric Techniques
11:45 PM - 12:30 PM	IPS Business Meeting
12:30 PM - 1:30 PM	Lunch
1:30 PM - 2:45 PM	Session VIII (Barbarossa-Saal) Reliability, Artifacts and Instruments
3:00 PM - 3:15 PM	View Posters / Refreshment Break / Technical Exhibition
3:15 PM - 4:00 PM	Session IX (Barbarossa-Saal) Psychophysics and Electrophysiology
4:15 PM - 5:30 PM	Session X (Barbarossa-Saal) Clinical Observations II
7:30 PM - 11:30 PM	IPS Banquet, Maritim Congress Center with traditional national singing Barbarossa Saal

Saturday, June 8

Departure and Post Congress Events

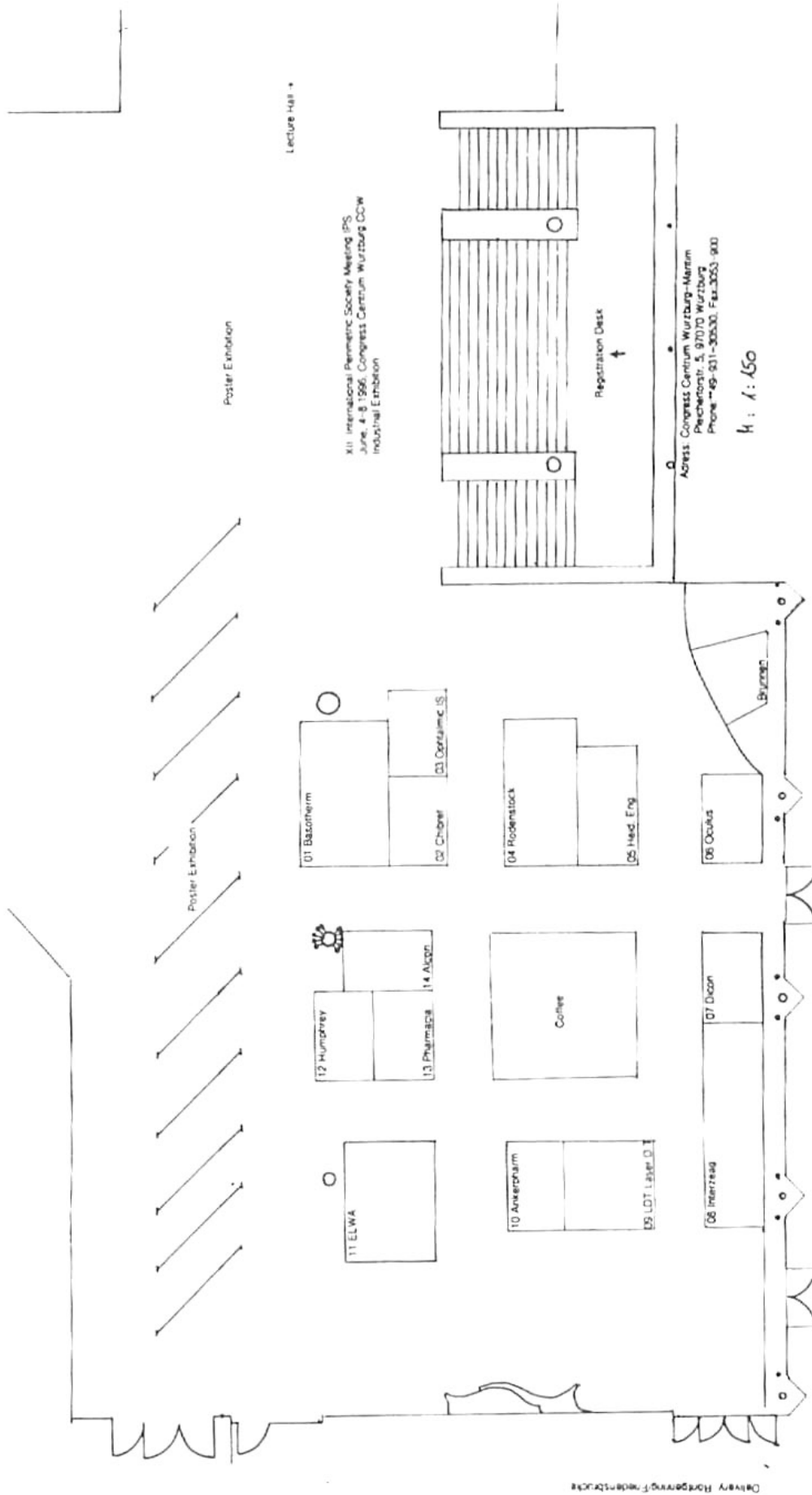
Acknowledgements

In support of the XIIth International Perimetric Society Meeting, generous financial Contributions have been made by the following corporations. The organizing committee is grateful for their generosity, helping to lower registration fees:

Alcon International
Chibret International
Humphrey Zeiss
Pharmacia Ophthalmics

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

Alcon Pharma GmbH
Ankerpharm GmbH
Basotherm GmbH
Chibret Pharmazeutische GmbH
ELWA AG
Heidelberg Engeneering GmbH
Humphrey Instruments GmbH
Interzeag AG
LDT Laser Diagnostic Technologies Inc.
Oculus Optikgeräte GmbH
Ophthalmic Imaging Systems
Pharmacia GmbH
Rodenstock Instrumente GmbH



Social Program

Welcome Reception - Residence of the Prince - Bishops

Date: Tuesday, June 4, 1996
Time: 7:00 pm - 9:30 pm
Place: Garden Hall, Residence
Fee: Free of charge (included in registration fee)

The Meeting will open with the IPS Welcome Reception in the Garden Hall of the Residence of the Prince-Bishops. There will be a baroque concert and a festive dinner as well as a guided tour through the Residence Palace.

Concert: „*Court baroque music with baroque costumes*“, sonata for violoncello and harpsichord, by Antonio Vivaldi, Benedetto Marcello, Pietro Locatelli.

Urs Voßmerbäumer, violoncello
Rudolf Ramming, harpsichord

Fortress Marienberg Evening

Date: Wednesday, June 5, 1996
Time: 7:30 pm - 11:00 pm, transport leaves Maritim 7.00 pm
Place: Festung Marienberg (Fortress Marienberg)
Fee: DM 95.-

Tour of the Main Franconian Museum followed by dinner, wine tasting and concert in the Kelterhalle of the Museum:

Concert: „*Virtuoso cello music of the Romantic epoch*“
Franz Schubert: Sonata A minor D.821 for violoncello and piano

„*Arpeggione-Sonate*“

Urs Voßmerbäumer, violoncello
Rudolf Ramming, grand piano

Social Program

Excursion along the Romantic Road

Date: Thursday, June 6, 1996
Time: 11:45 am - 11:00 pm, transport leaves Maritim at 11:45 am after the last session
Place: Rothenburg
Fee: DM 120.-

Tour along the scenic Romantic Road with stops at interesting places, including the destination of Rothenburg ob der Tauber, with lunch, a stroll through the medieval town and a festive dinner in the famous Hotel Eisenhut.

Banquet

Date: Friday, June 7, 1996
Time: 7:00 pm - 11:30 pm
Place: Maritim Hotel
Fee: Free of charge (included in registration fee)

The IPS Banquet will be held in the Maritim Hotel, one of the finest hotels in Würzburg: The society will also gather for its traditional dinner and national folk singing!

Accompanying Person's Program

Discover Würzburg with Visit of the Prince-Bishops Residence

Date: Wednesday, June 5, 1996
Time: 10:00 am to 3:00 pm
Fee: DM 50.-

Discover Würzburg with its several works of arts and famous buildings. See the picturesque old town, the Rococo house „Zum Falken“, the gothique church „Marienkapelle“ with figures from Tilman Riemenschneider, the old Main bridge with its statues of the saints and last but not least the famous baroque residence, the „castle of castles“.

Lunch in a typical franconian restaurant.

Trip by boat to Veitshöchheim and retour

Date: Friday, June 7, 1996
Time: 2:00 pm to 5:00 pm
Fee: DM 35.- (whithout lunch)

Along the river you see the beautiful landscape of vineyards, arriving Veitshöchheim, a pitoresque old town with the summer residence of the prince-bishops and Europe's most beautiful Rococo garden.

Post-Meeting events and tours

1. Mozart festival Würzburg

Deadline for ticket reservation 2/14/1996, Program: See page 42 of the IPS-brochure

2. Watercolour painting course (in English) and walking in the Alps, staying with the artist in his private guest house in Lech/Arlberg, Austria. (maximum 10 guests).

For reservation and information contact: Emo Henrich

Tel. (0043-Austria) 55 83 / 20 34

Fax (0043-Austria) 55 83 / 37 51

3. For individual pre- and post-congress-tours „American Express Bavaria Travel“ provides complete travel and financial service. For suggestions and reservations please contact:

Tel. (0049-Germany) 931 / 3 55 69 20

Fax (0049-Germany) 931 / 3 55 69 69

Registration

Registration Fee	Early Registration before April 30	Late Registration after May 1
IPS-Member	DM 450.-	DM 550.-
Non-Member	DM 580.-	DM 680.-
Resident	DM 300.-	DM 400.-
Accompanying Person	DM 230.-	DM 280.-

- The late registration fee will also apply to on-site registration

Note:

1. All participants making scientific presentations must be pre-registered.
2. Anyone registering as a resident in training must attach a verifying statement-letter from the department to the registration form. Without this verification, the full participant fee will be charged. Nurses and technicians can register like residents in training.
3. Accompanying persons are: spouses, family members and non-professional friends who wish to participate in all meeting activities, except the scientific program.

Registration fee includes:

- Attendance of all scientific sessions
- Invitation to the Welcome Reception and Banquet
- Receipt of conference materials including the program and abstracts
- The right to purchase tickets for Fortress Marienberg Evening and Romantic Road Excursion

For accompanying persons:

- Attendance of the Opening Ceremony
- Invitation to Welcome Reception, Banquet and the right to purchase tickets for the Accompanying Persons' Program
- The right to purchase tickets for the Fortress Marienberg Evening and Excursion on Romantic Road

Note: Accompanying persons cannot attend the scientific program

WEDNESDAY, JUNE 5, 1996

11:00 AM - 12:30 PM SESSION II Cataract and Diffuse Loss

Chairperson C. Langerhorst
Moderator S. Newman

- 9 O 11:00 AM Diffuse Visual Field Loss and Glaucoma. Initial Experience from the Early Manifest Glaucoma Trial (EMGT)
P. Åsman, A. Heijl and the EMGT Study Group
- 10 O 11:12 AM Cataract and Visual Field: The Influence with and without Glaucoma
J. Weber, B. Müller, H. Machemer
- 11 O 11:24 AM The effect of age-related cataract extraction on achromatic and short wavelength automated perimetry
J. M. Wild, R. P. Cubbidge, R. Robinson, E.C. O'Neill
- 12 O 11:36 AM Influences of Cataracts on Glaucomatous Visual Field Changes
C. Matsumoto, T. Ogawa, H. Suzumura, H. Inoue, S. Kudou
- 13 O 11:48 AM Diffuse Visual Field Loss in Open-Angle Glaucoma
B. C. Chauhan, A. M. Shaw, R. P. LeBlanc, T. A. McCormick, A. B. Chan
- 14 O 12:00 PM New glaucoma change probability maps to separate visual field loss caused by glaucoma and by cataract
A. Heijl, B. Bengtsson, P. Åsman, M. Patella

WEDNESDAY, JUNE 5, 1996

- 1:30 - 3:15 PM **SESSION III Clinical Observations**
- Chairperson F. Dannheim**
 Moderator P. Brusini
- 15 O 1:30 PM Reconsiderations of Visual Field Incongruence
 L. Frisén
- 16 O 1:42 PM Macular Sparing in Patients with Hemianopsia - Re-evaluated Using
 Static and Kinetic Fundus Perimetry
 K. Rohrschneider, R. Glück, R.O.W. Burk, F.E. Kruse, H.E. Völcker
- 17 O 1:54 PM Partial Complex Seizure Disorder; a Prospective Neuro-Ophthalmic
 Study
 S. A. Newman
- 18 O 2:06 PM Correlation of Visual Field and Photoreactive Flow Changes in the
 Posterior Cerebral Artery in Patients with Occipital Lobe Infarction
 S. Pfennigsdorf, W.E. Lieb, P.P. Urban, A. Allardt, B. Tettenborn
- 19 P 2:18 PM Deterioration of Ocular Functions Caused by Internal Hydrocephalus
 in a Patient with Glaucoma
 C. Palotas, I. Suveges, Z. Kopniczky, P. Follman
- 20 P 2:22 PM Persistent Visual Field Defects after Craniopharyngioma Surgery. A
 Comparison between High-pass Resolution and Kinetic Goldmann
 Perimetry
 L. Martin, U. Gedda

SESSION III, Continued

- 21 P 2:26 PM Perimetric Study of Asymptomatic Obstructive Carotid Disease
G. Corallo, E. Gandolfo, P. Capris, G.A. Ottonello, G. Brusa, U. Raiteri, E. Semino, P. Tagliavacche, M. Zingirian
- 22 P 2:30 PM Analysis of Early Visual Field Defects in Multiple Sclerosis Patients: Correlation with Chromatic Sense Evaluation and Pattern Reversal Visual Evoke Potentials
A. Polizzi, M. Schenone, G. Balestra, G. Gatti, G. Mancardi, G. Corallo
- 23 O 2:34 PM Scotopic Perimetry in Night Blinding Retinal Dystrophies, Problems and Potentials
M. Andrassi, M. Stetter, B. Lorenz
- 24 O 2:46 PM The Significance of the Central Visual Field for the Reading Ability
S. Trauzettel-Klosinski, R. P. Tornow
- 25 O 2:58 PM Perimetric Follow-up in Myopic Maculopathy
P. Capris, G. Corallo, F. Rossi, G. Gatti, S. Rovida
- 26 P 3:10 PM Changes in the central visual field after surgical removal of epiretinal membrane
M. A. Rudneva, A.V. Kiselev
- 27 P 3:14 PM High-Pass Resolution Perimetry in the Early Detection of Macular Alterations in Patients Taking Hydroxichloroquine
F. Barosco, P. Brusini, G. DiGiorgio, M. Chizzolini

WEDNESDAY, JUNE 5, 1996

- 4:30 - 6:00 PM **SESSION IV Blood Flow and Nerve Fiber Layer Analysis**
Chairperson **E. Gramer**
Moderator **B. Chauhan**
- 28 O 4:30 PM Scanning Laser Ophthalmoscopy Based Evaluation of Epipapillary Velocities: A Novel Approach
O. Arend, A. Harris
- 29 O 4:42 PM Dorzolamide Effects on Ocular Hemodynamics Measure with a Combined New Approach of Scanning Laser Ophthalmoscopy and Color Doppler Imaging
A. Harris, O. Arend
- 30 O 4:54 PM Visual Field Defect and Perfusion of the Juxtapapillary Retina and the Neuroretinal Rim Area in Primary Open Angle Glaucoma
G. Michelson, M.J. Langhans
- 31 P 5:06 PM Visual Field Damage in Normal Tension Glaucoma With and Without Vasospasm
L. Quaranta, M. Cassamali, O. Braga, E. Gandolfo
- 32 P 5:10 PM Visual Field Defects and Ocular Blood Flow in Glaucomatous Eyes
A. Magnasco, L. Novella, F. Calcagno, M. Zingirian
- 33 P 5:14 PM Validity of Measurements with Confocal Scanning Laser Doppler Flowmetry
B. C. Chauhan, F. M. Smith
- 34 O 5:18 PM Correlation of Nerve Fibre Layer Thickness as Evaluated by the HRT and Optic Disc Hemorrhage Location
A. Béchettoille, H. Bresson-Dumont, M. Slim
- 35 O 5:30 PM Mapping Structural to Functional Damage in Glaucoma
N. Yamagishi, A. Anton, P. Sample, L. Zangwill, I. Irak, A. Lopez, M. De Souza Lima, R..N. Weinreb
- 36 P 5:42 PM Reproducibility and Effect of Operator Dependent Variables in Imaging with Nerve Fiber Analyzer II
R. P. Mills, Y. Takahashi, J. F.G. Stewart, M. M. Leen
- 37 P 5:46 PM Nerve Fiber Layer Thickness Evaluations in the Upper and Lower Retinal Half using the Nerve Fiber Analyzer (NFA I)
S. Serguhn, E. Gramer
- 38 P 5:50 PM Scanning Laser Ophthalmoscope (SLO) Imaging of the Papillomacular Bundle (PMB) Correlated with Static Perimetry in Neuroophthalmic Disease
Murphy, M.A., Groszof, D.H., Hart, W.M.

THURSDAY, JUNE 6, 1996

- 8:00 - 9:45 AM **SESSION V New Methods of Perimetry**
 Chairperson C. Johnson
 Moderator D. Henson
- 39 O 8:00 AM The Role of Spatial and Temporal Factors in Frequency Doubling Perimetry
C. A. Johnson, S. Demirel
- 40 O 8:12 AM Random Dot Motion Perimetry: Properties and Results
M. Wall, C. Brito, K. Stanek
- 41 O 8:24 AM White-Noise Field Campimetry as a Tool in the Detection of Disturbances in Ocular Microcirculation
C. Erb, T.M. Wohlrab, N. Stübiger, H-J Thiel
- 42 O 8:36 AM Contrast Sensitivity Perimetry in Experimental Glaucoma: Investigations with Degenerate Gratings
R. S. Harwerth, E. L. Smith, III
- 43 O 8:48 AM Stimulus Orientation can effect Motion Sensitivity in Glaucoma
M.C. Westcott, F.W. Fitzke, R.A. Hitchings
- 44 O 9:00 AM Short-Wavelength Automated Perimetry (SWAP) and Motion Automated Perimetry (MAP) in Glaucoma
P. A. Sample., C. F. Bosworth, I. Irak, R. N. Weinreb
- 45 O 9:12 AM The relationship between achromatic and short-wavelength automated perimetry with the standard and Fastpac algorithms
R. P. Cubbidge, J. M. Wild, I. Pacey, R. Robinson
- 46 O 9:24 AM Do Fastpac or SWAP Inflate Hemifield Differences?
E. Vesti, G.L. Trick
- 47 P 9:36 AM Is Early Damage in Glaucoma Selective for a Particular Cell Type or Pathway?
S. Lynch, C. A. Johnson, S. Demirel
- 48 P 9:40 AM Blue-on-Yellow Perimetry on the Patients with Ocular Hypertension
H. Maeda, Y. Tanaka, T. Sugiura, K. Mizokami
- 49 P 9:44 AM Nasal-Temporal Asymmetry in the Central Field Assessed by Blue-on-Yellow Perimetry with a SLO
A. Remky, A.E. Elsner, A. Morandi, E. Beausencourt

FRIDAY, JUNE 7, 1996

8:00 - 9:30 AM

SESSION VI Image Analysis and Glaucoma

Chairperson Y. Kitizawa

Moderator W. Hart

- 50 O 8:00 AM Optic Disc Topography in Normal Eyes. A Cross-Sectional Study Using Scanning Laser Tomography and Raster Tomography
K.G. Gundersen, A. Heijl, B. Bengtsson
- 51 O 8:12 AM Prediction of Glaucomatous Visual Field Damage Based on Three-Dimensional Optic Nerve Head Topography
R.O.W. Burk, J. König, K. Rohrschneider, S. Keller, H.E. Völcker
- 52 O 8:24 AM Correlation Between Morphology and Function in Glaucoma at the Age of Scanning Laser Tomography and Polarimetry
J. Stürmer, P. Bernasconi, A. Bernasconi, M.-J. Cauberg, A. Yanar, C.J. Frei, B. Gloor
- 53 P 8:36 AM Laser-Scanning-Tomography of the Optic Nerve Head and Its Correlation with Computerized Perimetry in a Two Year Follow-Up of Glaucoma Patients
A. Mistlberger, E. Alzner, G. Grabner
- 54 P 8:40 AM Comparison of Disc Size and Disc Diameter between Healthy Eyes; Eyes with Low Tension Glaucoma; Primary Open Angle Glaucoma and Ocular Hypertension
C. Kraemer, E. Gramer, H. Maier
- 55 P 8:44 AM Mean Pallor Value of the Optic Disc (MPV) - A New Parameter in Automated Disc Analysis with the Optic Nerve Head Analyzer
M. Siebert, E. Gramer

SESSION VI, Continued

- 56 O 8:48 AM Validation of a Risk Model for Glaucomatous Field Loss: Application to Standard Automated Perimetry and SWAP
S. Demirel, C. A. Johnson
- 57 P 9:04 AM The Role of Raised Intraocular Pressure in the Development of Glaucomatous Optic Neuropathy
P. K. Wishart, A.S. Kosmin
- 58 P 9:08 AM Influence of Carteolol on the Visual Fields of Patients with Normal Tension Glaucoma
Y. Tanaka, H. Maeda, K. Mizokami
- 59 P 9:12 AM Is Calibrated Trabeculectomy Harmful to Visual Function?
G. Welsandt, Jörg Weber
- 60 O 9:16 AM A Correlation between Different Types of Visual Field Defects and Nerve Fiber Bundle Defects. A Comparative Study performed by Automatic Perimetry and Laser Scanning Tomography
R. Sampaolesi, J.R. Sampaolesi
- 61 P 9:28 AM Calculation of a Glaucoma Progression Risk Index (GPI)
E. Gramer, G. Althaus

FRIDAY, JUNE 7, 1996

10:00 - 11:45 AM **SESSION VII Perimetric Techniques**

Chairperson J. Weber

Moderator P. Åsman

- 62 O 10:00 AM Use of Central 10 Degrees Threshold Measurements for Description of Very Early Glaucomatous Field Defects
C.T. Langerhorst, L.L. Carenini, D. Bakker, M.A.C. de Bie-Raakman
- 63 P 10:12 AM Does the Blind Spot Enlarge in Early Glaucoma?
J. H. Meyer, M. Guhlmann, J. Funk
- 64 O 10:16 AM Optimizing Distribution and Number of Test Locations in Perimetry
K. Sugimoto, M. Zulauf, A. Schötzau
- 65 O 10:28 AM Fundus Oriented Perimetry (F.O.P) - A New Concept Increasing Efficiency of Visual Field Examination
U. Schiefer, G. Stercken-Sorrenti, T. J. Dietrich, N. Benda
- 66 O 10:40 AM Is Rapid Assessment of the Visual Field in Glaucoma using Multiple Correlations Useful? An Evaluation of Delphi Perimetry
P. K. Wishart, A.S. Ksomin
- 67 P 10:52 AM Evaluating the Delphi System for Rapid Assessment of Visual Function Using the Humphrey Perimeter
W.R. Elliott, T. D. Quach, B.V. Nguyen, W.E. Sponsel
- 68 P 10:56 AM Accuracy of the Tendency Oriented Perimetry (TOP) in the Octopus 123 Perimeter
M. Gonzalez de la Rosa, A. Martinez, L. Cordoves, M. Losada

SESSION VII, Continued

- 69 O 11:00 AM Evaluation of a New Interactive Threshold Strategy in Normal Subjects
B. Bengtsson, A. Heijl, J. Olsson, H. Rootzén
- 70 O 11:12 AM A New Strategy for Automated Perimetry
M. Schaubberger, E. Glass, G-K. Ebel, B. Lachenmayr
- 71 P 11:24 AM Two Different Techniques of Inquiring Answers in Automated Perimetry
S. Lutz, T.J. Dietrich, N. Benda, B. Selig, U. Schiefer, I. Daum
- 72 P 11:28 AM Discrete Strategies in Perimetry
J. Patzold, N. Benda, T.J. Dietrich, U. Schiefer
- 73 P 11:32 AM Pupil Perimetry with the Octopus 1-2-3
S. Okuyama, C. Matsumoto, A. Iwagaki, T. Otsuki, T. Otori
- 74 P 11:36 AM Age, Gender, and Test Location in Pupil Perimetry
O. Bergamin, A. Schötzau, B. Henzi, M. Zulauf

FRIDAY, JUNE 7, 1996

1:30 - 3:00 PM

SESSION VIII Reliability, Artefacts and Instruments

Chairperson J. Wild

Moderator M. Zulauf

- 75 O 1:30 PM Necessity of Supervision during Humphrey Perimetry
R. P. Mills, R. E. Van Coevorden, H. S. Barnebey
- 76 P 1:42 PM False-Positive Peak of the Bebie-Curve as a Reliability Parameter
M. Zulauf, C. Becht, D. Bernoulli
- 77 O 1:46 PM Fixation Control Following Repeated Macular Threshold Measurements
T. Halda, B. Kovács
- 78 O 1:58 PM The Influence of Target Blur on Perimetric Threshold Values in Automated Light-Sense Perimetry and Flicker Perimetry
C. Matsumoto, S. Okuyama, A. Iwagaki, T. Otsuki, K. Uyama, T. Otori
- 79 P 2:10 PM The Sensitivity Loss by False Correction Glasses: Multiple Influencing Factors are Found in Glaucoma Patients
E. Farvili, J. Weber
- 80 P 2:14 PM Effect of Dislocated and Tilted Correction Glasses on Perimetric Outcome - A Simulation using Ray Tracing
W. Fink, U. Schiefer, E.W. Schmid
- 81 P 2:18 PM Apparent Glaucomatous Visual Field Defects caused by Dermatochalasis
M. K. Birch, A.S. Kosmin, P.K. Wishart
- 82 P 2:22 PM Fitting Angioscotomas
N. Benda, T. J. Dietrich, U. Schiefer
- 83 P 2:26 PM The Transfer of Perimetric Experience From the First Examined Eye to the Counter Eye in Patients with Glaucoma
A. Wegner, I. A. Uti, R. Wertheimer, M. Mertz
- 84 P 2:30 PM Comparing Humphrey Visual Field and Contrast Sensitivity Changes During CO₂ Supplementation and Hyperventilation
Y. Trigo, W.E. Sponsel, W.R. Elliott, J.M. Harrison
- 85 P 2:34 PM Clinical Evaluation of HFA II (Model 750) in Glaucoma Patients
A. Iwase, K. Okada, T. Yamamoto, Y. Kitazawa
- 86 P 2:38 PM Humphrey Statpac vs. Dicon Fieldview Statistical Analyses. A Pilot Study
P. Asman
- 87 P 2:42 PM Three-Dimensional Measuring Method of Visual Field
Z-J. He, J-Q. Yuan, et al

FRIDAY, JUNE 7, 1996

- 3:30 - 4:00 PM **SESSION IX Psychophysics and Electrophysiology**
Chairperson **A. Safran**
Moderator **E. Gandolfo**
- 88 O 3:15 PM Macular Contrast Sensitivity Function Correlates with Automated Threshold Perimetry
E. Mutlukan., B. Skarf.
- 89 O 3:27 PM Application of Video Display Units for Campimetric Purposes - Luminance Characteristics and Calibration Procedures
T. J. Dietrich, M. Fredrich, B. Selig, N. Benda, U. Schiefer
- 90 O 3:10 PM Spatial Summation for Selected Ganglion Cell Mosaics in Patients with Glaucoma
J. Felius, W.H. Swanson, R.L. Fellman, J.R. Lynn, R.J. Starita
- 91 P 3:22 PM Temporal Summation in Glaucoma
S. M. Drance, P. Hnik, B.C. Chauhan
- 92 O 3:26 PM Flicker Perimetry: Optimal Parameters for Detection of Glaucoma
E. J. Casson., D.H. Zackon, W.J. Rock, U.A. Strolenberg
- 93 O 3:38 PM Flicker Resolution Perimetry in Glaucoma
R. S. Anderson, C. O'Brien
- 94 P 3:50 PM Aging Changes in Automated Perimetry: A Comparison of Flicker and Luminance Sensitivity in Normal Subjects
A. S. Kosmin, M.W. Austin, P.K. Wishart, C. O'Brien
- 95 P 3:54 PM Analysis of Spatial Resolution Threshold in Pseudophakic Eyes with Multifocal IOLs
G. Pastori, F. Parentin, F. Baccara, G. Ravalico
- 96 P 3:58 PM Objective Light Threshold Measurement Using VEP from Traditional Perimetric Stimuli
M. Fioretto, C. Burtolo, C. Orione, G.P. Fava, M. Zingirian

FRIDAY, June 7, 1996

- 4:15 - 6:00 PM **SESSION X Clinical Observations II**
Chairperson T. Otori
Moderator L. Frisén
- 97 O 4:15 PM A 3 Point Vernier Alignment Test with Remarkable Properties
J. M. Enoch
- 98 O 4:27 PM Routine evaluation of the filling in phenomenon in clinical practice
A. B. Safran, T. Landis
- 99 P 4:39 PM Visual field alterations in HIV-1-infection
S. Thierfelder, E. Gramer, F. Grehn
- 100 P 4:43 PM Automated Perimetry in Non-Glaucomatous Optic Neuropathies
S. A. Newman, R. C. Baldwin, Y. Kolettis
- 101 P 4:47 PM Bitemporal Intermittent Hemianopia
M.T. Dorigo, R. De Natale, L. Tomazzoli
- 102 P 4:51 PM Analysis of the Relationship between Retinal Disease and Static
Visual Field using a Computer-Assisted Combination System
S. Yamada, A. Sugiyama, K. Higuchi, T. Sawada
- 103 P 4:55 PM A New Fundus Perimeter by which the Target can Automatically
Pursue Eye Movement
Y. Nishida, K. Kani
- 104 P 4:59 PM Scanning Laser Ophthalmoscope and It's Applications in Fundus
Perimetry. Our Experiences
R. De Natale, G. Paolo, A. Crestani
- 105 O 5:03 PM A Comparison of Three Methods for Distinguishing Diffuse,
Localized, and Mixed Visual Field Defects in Glaucoma
P. Brusini
- 106 O 5:15 PM Clinical Validity of the Brusini Glaucoma Staging System (GSS)
I. Kocak, M. Zulauf
- 107 P 5:27 PM Perimetric Damage in Primary Open Angle Glaucoma and in
Pseudoexfoliation Glaucoma: A Classification According to the
"Glaucoma Staging System
C. Tosoni, P. Brusini, G. Migliorati, G. Beltrame, P.A. Barea

Abstracts

I. Epidemiology, Neural Networks, Visual Field Progression June 5, 1996 8:10-9:34 AM

- 1) CAUSES OF FIELD DEFECTS IN A POPULATION; THE ROTTERDAM STUDY
R.C.W. Wolfs^{1,2}, MD, R. Ramrattan^{1,2}, MD, P.T.V.M. de Jong^{1,3}, MD, PhD, FRCOphth
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Medical School, Rotterdam, (3) The Netherlands Ophthalmic Research Institute, Amsterdam, The
Netherlands

Purpose: To study the causes of visual field defects in a population-based study in the Netherlands.

Methods: In the Rotterdam Study, a population based cohort study, 6781 subjects were examined ophthalmologically. Visual fields were screened with the Humphrey Visual Field Analyzer with a 76-points suprathreshold test (central 30 degrees). When a field defect was present the same test was repeated. If this repeated screening test was abnormal, kinetic Goldmann perimetry was performed. Only right eyes were used in these analyses.

Results: The visual field screening was performed in 6216 subjects. In the first screening phase 11.0% of these were abnormal. Refusal occurred in 0.6%. In the second phase 38.3% again was abnormal. A second test was refused in 2.5%. Of the 225 tested Goldmann fields, 103 (45.8%) were abnormal. Most important cause of a visual field defect was glaucoma (35.0%). Of the non-glaucomatous field defects macula degeneration and CVA were the most common causes.

- 2) PREVENT BLINDNESS AMERICA VISUAL FIELD SCREENING STUDY
(W.E. Sponsel, R. Ritch, R Stamper, EJ Higginbotham, DR Anderson, M. R. Wilson, T.J. Zimmerman, for
the Prevent Blindness America Glaucoma Advisory Committee)

Purpose. Findings of this three phase multicenter study (AJO 1995;120:699-708) will be reviewed. Two portable visual field testing methods were evaluated to determine their specificity, sensitivity, and practicability for rapid population screening. **Methods.** Henson CFA3000 and Damato 26-point campimetry were performed in a healthy adult population to determine false positive rates (Phase 1). Established glaucoma patients at six clinical centers were tested with both devices to determine false negative rates (Phase 2). Screenings were carried out at multiple testing sites in Florida, Indiana, Ohio, Tennessee, Texas, Utah, and Wisconsin to assess the practicality of both instruments in actual screenings. **Results.** Phase 1: Henson two-step screening (26 point screening subroutine (single repeat point miss constituting failure) followed by 132 point multiple stimulus suprathreshold 24-degree static perimetry) produced no false positive test failures among 82 adults confirmed as normal by history and comprehensive eye exam. Eighty of 83 normal subjects passed the Damato campimetry test (false positive rate = 3.6%). All presumptive false positives were confirmed to have normal full-threshold Humphrey visual fields. Phase 2: Of 83 glaucoma suspects and patients evaluated at the six glaucoma clinics, 58 produced full-threshold Humphrey 30-2 fields which were abnormal according to the criteria of Hodapp, Parrish and Anderson (Mosby, 1993). The Henson identified 49 of these (84%), including 38/39 (97%) of those with moderate to severe visual field loss. The Damato campimeter identified 55 (81%) of 68 subjects with pathologic fields, including 44/48 (92%) of those with moderate to severe field loss. Phase 3: Among 1,278 subjects tested in general population screenings over a two-month period, 55 (4.3%) failed either or both tests. Clinical follow-up data was obtained for 45 of these, none of whom had intraocular pressures exceeding 22 mm Hg.

3) MASS SCREENING FOR VISUAL FIELD DEFECTS WITH SNOWFIELD CAMPIMETRY – RESULTS OF A FIELD STUDY USING LOCAL TV-BROADCASTING

A.C. Gisolf¹, J. Kirsch², H.K. Selbmann², E. Zrenner³, U. Schiefer³

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Snowfield campimetry immediately transforms usually negative scotomas into perceivable visual field defects. Suitability of this method for mass screening was tested by broadcasting this stimulus to home TV sets. In co-operation with the "Süddeutscher Rundfunk" (SDR) as well as several health insurance companies ("AOK Baden-Württemberg" and "RVO-Kassen") approximately 300000 viewers were addressed by this local test: There were 531 calls for questionnaires which were additionally used for documenting subsequent ophthalmological examinations. Out of these, 127 evaluable questionnaires were returned to the IMI: In 78 cases, the ophthalmologists did not confirm a lesion of the visual pathway; however, in 49 subjects they detected scotomas, which were already known to them in 25 cases. Glaucomatous optic neuropathy and macular degeneration were the most frequent pathological ophthalmological findings causing white noise field defects. Some aspects evaluating costs and benefit of this study will be given.

4) VISUAL FIELD EVALUATION USING ARTIFICIAL NEURAL NETWORKS

Aharon Wegner¹, Gudrun Zahlmann², Marko Obermaier¹, Manfred Mertz¹. ¹ Dept. of Ophthalmology, Klinikum rechts der Isar, Technical University of Munich, 22 Ismaningerstr., 81675 Munich, Germany.

² GSF, Medis Institute, Neuherberg, Germany.

Objective: To evaluate the ability of a neural network to interpret genuine visual field data and to recognize glaucomatous visual field changes.

Methods: A neural network was designed by applying the SIMUL-software package to data sets(program G1-Octopus 500) of 182 patients (126 for net training/testing - 56 for evaluation/application). To asses the data sets we used three approaches; network 1 `black box` all points of the perimetry give an input information to the perceptron, network 2 nerve fiber bundles according to Weber, network 3 upper/lower quadrants.

Results: Using a two step classification (2 output nodes each step) network 1 identified 88% of the normal visual fields, network 2 identified 88% and network 3 identified 75%. Network 1 identified 87% of the pathological visual fields, network 2 identified 83% and network 3 identified 87%. Network 1 identified 90% of the non glaucomatous visual fields, network 2 identified 80% and network 3 identified 95%. Network 1 identified 72% of the glaucomatous visual fields, network 2 identified 89% and network 3 identified 78%.

Conclusions: A neural network can interpret genuine visual field data and recognize glaucomatous visual field changes with a high sensitivity.

5) **FIELDNET: A COMPUTER PROGRAM FOR THE SPATIAL CLASSIFICATION OF GLAUCOMATOUS VISUAL FIELD LOSS.**

David B Henson¹, Susan Spenceley² and David R Bull³,

¹ Dept of Ophthalmology, University of Manchester, ² School of Computer and Information Science, University of S. Australia, ³ Dept of Electrical and Electronic Engineering, University of Bristol.

Purpose. To describe a computer program, FieldNet, which uses artificial neural networks (ANN) to classify the spatial patterns of visual field loss seen in patients with glaucoma.

Networks. FieldNet incorporates two trained ANNs (Kohonen self organising feature maps), one for the superior and one for the inferior hemifield. Pattern deviation data from program 24-2 of the Humphrey Visual Field Analyzer (HVA) was used for training. Each record (737 superior, 734 inferior) had 2 or more defective locations (pattern deviation $p < .01$) in the relevant hemifield.

Program input. FieldNet runs on an IBM compatible system and accepts files of HVA data which have been converted into a DOS-compatible format.

Program output. The program can run in either an interactive or non-interactive mode. In the interactive mode the program can either step through the file one record at a time or present a longitudinal sequence of records. In both cases the perimetrist views a graphical representation of the feature maps and the pattern deviation probability map(s). The classification, or trace pattern, is displayed on the feature maps. In the non-interactive mode the program places the results in an output file.

Applications. To aid the monitoring of progressive loss and to objectively stratify visual field defects.

6)

APPLICATIONS OF FRACTAL ANALYSIS TO DIFFERENTIAL LIGHT-SENSE PERIMETRY IN GLAUCOMA PATIENTS AND NORMAL SUBJECTS

Yoshiki Kono, Aiko Iwase, Mihoko Maeda, Tetsuya Yamamoto and Yoshiaki Kitazawa

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

Fractal analysis is reported to be useful to capture abnormality in high-pass resolution perimetry (Frisén). The authors studied the validity of fractal analysis in differentiation between early-stage glaucomatous visual field and normal visual field using differential light-sense perimetry (Humphrey Field Analyzer 630 (HFA); program central 30-2). Further, we studied the relationships between global indices of HFA and fractal dimension (FD), an index of fractal analysis. Subjects were 46 eyes of 37 normal-tension glaucoma (NTG) patients and 118 eyes of 59 normal subjects. Forty-six eyes of NTG patients consist of 15 eyes of Aulhorn-Greve classification stage I and 31 eyes of stage II. We created a program which was the modified method of Frisén to calculate FD. Mean rank of FD showed 69.3 in normal eyes, 96.2 in stage I eyes and 126.0 in stage II eyes resulting significant difference among 3 groups ($p < 0.0001$, by Kruskal-Wallis' test). Mean FD (\pm standard deviation) showed 1.075 \pm 0.062 in normal eyes, 1.163 \pm 0.199 in stage I eyes and 1.278 \pm 0.266 in stage II eyes. Stage I and stage II glaucomatous eyes showed significantly higher FD than normal eyes did ($p = 0.223$ and $p < 0.0001$, respectively, by ANOVA, Fisher's test). Significant correlations were found between FD and both pattern standard deviation and mean deviation ($r = 0.552$, $p < 0.0001$ for PSD; $r = -0.261$, $p = 0.0009$ for MD, by Spearman's test). These results indicate that fractal analysis may be useful for the differentiation between early-stage glaucomatous eyes and normal eyes, and that FD is related to local visual field defects.

I. Epidemiology, Neural Networks, Visual Field Progression June 5, 1996 8:10-9:34 AM

SPATIAL FILTERING OF GLAUCOMATOUS VISUAL FIELDS USING PROGRESSOR FOR WINDOWS

7)

AC Viswanathan, FW Fitzke, RA Hitchings.

Institute of Ophthalmology and Moorfields Eye Hospital, London, UK.

Background: PROGRESSOR for Windows is a computerized system for the analysis of glaucomatous field progression incorporating a graphical user interface. The software package includes spatial filtering, which has been shown to reduce long-term fluctuation¹. However, some spatial processing, such as Gaussian filtering, may 'blur' early focal defects. **Purpose:** To determine the role of Gaussian filtering in the early detection of glaucomatous loss. **Methods:** 19 field series from untreated normal-tension glaucoma patients which an experienced observer judged as deteriorating were studied. 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, $p < 0.05$) were satisfied by at least one retinal location was calculated with and without Gaussian filtering. **Results:** The unfiltered fields detected progression earlier than the filtered fields in 3 of the 19 field series (mean 1.18 yrs, sd 0.30 yrs). The filtered fields detected progression earlier in 5 series (mean 1.04 yrs, sd 1.48 yrs). Both filtered and unfiltered fields detected progression at the same test in 11 field series. There was no predominance of focal defects in the series where progression was detected earlier by the unfiltered fields. **Conclusions:** PROGRESSOR for Windows is a convenient software tool for analyzing glaucomatous field decay. Gaussian filtering reduces long-term fluctuation without delaying the detection of early loss in normal-tension glaucoma.

References

1. FW Fitzke DP Crabb, AI McNaught, DF Edgar, RA Hitchings. *Image processing of computerised visual field data*. Br. J. Ophthalmol. 1995; 79: 207-212

Supported by the International Glaucoma Association, London, UK.

8)

A PROFILE OF THE SPATIAL DEPENDENCE OF POINTWISE SENSITIVITY ACROSS THE GLAUCOMATOUS VISUAL FIELD.

DP Crabb, FW Fitzke, AI McNaught, RA Hitchings.

Institute of Ophthalmology and Moorfields Eye Hospital, London, UK.

Background. Current methods for determining pointwise visual field progression treat each location independently. We have recognised that the determination of progression can be improved by applying a spatial (gaussian) filter to the recorded data. This technique, commonly used in image processing, may benefit from better knowledge and quantification of the spatial dependence that exists between the sensitivity of different locations within the visual field. **Purpose.** To derive a point by point profile of this spatial dependence. This will be used to develop a new adaptive spatial filter customised to each retinal location to further improve the sensitivity of methods for determining field progression. **Methods.** 440 Humphrey fields of 440 patients with primary open-angle glaucoma were drawn from a large cross-sectional database to provide a wide-range of defect severity. All patients had at least 3 fields prior to the selected field. The sample was divided into two equal samples to provide cross-validation analysis. Multiple regression analysis of sensitivity (dB) values for each location compared to all other locations in the visual field was performed. For each location, a unique set of points with significant dependence, derived using a stepwise and search technique, were determined and the resulting connections mapped onto the field. The process was repeated with the second set of data. **Results.** The connections between highly dependent locations closely follow the architecture of the retinal nerve fibre layer and tend to be between neighboring locations. Connections were generally repeatable in the validation sample. **Conclusions.** These results can be used to derive the shape and weighting of a customised spatial filter process for each individual location within the visual field. These spatial techniques could improve methods for determining the rate of change in a series of fields in glaucoma. (Supported by the RNIB, IGA and MRC.)

9) **DIFFUSE VISUAL FIELD LOSS AND GLAUCOMA.**

INITIAL EXPERIENCE FROM THE EARLY MANIFEST GLAUCOMA TRIAL (EMGT).

Peter Åsman and Anders Heijl, Department of Ophthalmology in Malmö, Sweden,
and the EMGT Study Group

To determine the extent of diffuse visual field loss in early glaucoma we studied 140 fields of 140 patients with early manifest glaucoma. All patients were part of our ongoing EMGT study. The majority of patients were recruited by means of mass screening including optic disc photography and tonometry, but not perimetry. Patients with lens opacities exceeding LOCS II (NI, CII, PI), non-glaucomatous field loss, or previous or current glaucoma treatment were ineligible. Each patient had a reproducible localized field defect. The study field (30-2 test) was obtained at the third test session (first baseline visit in the EMGT). Localized field loss was graded according to the number of abnormal sectors in the Glaucoma Hemifield Test. The diffuse component of field loss was represented by the GH index (7th highest deviation within 24). No significant difference in GH when compared with the Statpac normal database was found for glaucomatous fields with no more than one abnormal GHT sector. With increasing number of abnormal sectors the GH gradually decreased below that found in normal eyes. Our results indicate that the very earliest visual field changes in glaucoma usually are *purely* localized.

CATARACT AND VISUAL FIELD: THE INFLUENCE WITH AND WITHOUT GLAUCOMA

10) J Weber, B Müller, H Machemer: University Eye Clinic, Cologne, Germany

Purpose: In cases of glaucoma combined with cataract, it is difficult to evaluate which part of the visual field defects are caused by cataract and which part by glaucoma. **Methods:** 29 patients with cataract and 19 patients with both glaucoma and cataract were examined before and after cataract surgery. Perimetry used a Humphrey Field Analyzer and program 30-2 or a reduced 8-point program. The amount of cataract was measured objectively using the OLM (Opacity Lens Meter) and the OAM (Optical Acuity Meter). **Results:** The initial MD was -6.5 dB in the cataract group and -12.2 dB in the glaucoma group. After cataract surgery with IOL implantation, the mean MD improvement was 4.1 dB in the cataract group, but only 1.9 dB in the glaucoma group. This difference was significant ($p < 0.01$). The improvement showed a significant, but low correlation (r below 0.4) with OLM and OAM. The general reduction of sensitivity (GRS) of the Statpac analysis showed no correlation with MD improvement in the whole glaucoma group ($r = 0.018$). For low GRS and good MD, however, the correlation was high. Final visual acuity depended on the preexisting field damage (correlation $r = 0.576$). If the MD was below -15 dB, visual acuity did not exceed 20/25. **Conclusion:** If a glaucoma patient has a bad visual field prior to cataract surgery, no considerable field improvement can be expected, and visual acuity is limited, too. The estimation of the cataract effect using GRS is only possible in good fields.

II. Cataract and Diffuse Loss June 5, 1996 11:00 - 12:30

THE EFFECT OF AGE-RELATED CATARACT EXTRACTION ON ACHROMATIC AND SHORT-WAVELENGTH AUTOMATED PERIMETRY.

11)

J.M. WILD^{1,2}, R.P. CUBBIDGE¹, R. ROBINSON², E.C O'Neill²

Aston University, Birmingham, UK¹; Birmingham & Midland Eye Hospital, UK².

Aim: To determine the pre- and post-operative outcome of age-related cataract on the visual field derived by short-wavelength automated perimetry. **Methods:** The sample comprised 17 patients (mean age 74.3 years SD 6.1) with age-related cataract but otherwise normal eyes. The patients underwent perimetry in the designated eye on three separate occasions approximately 4 weeks pre-operatively. At each of the first two visits standard achromatic (stimulus size III) and short-wavelength (440nm narrow band size V blue stimulus; 100cdm⁻² bowl luminance; 500nm to 700nm broadband yellow background) visual fields were obtained using Program 24-2 and the standard 4-2dB algorithm of the Humphrey Visual Field Analyser 640. The order of perimetry was randomised between patients. At the third visit, ocular media absorption and forward light scatter were measured using the methods of Sample et al (1989) and Van den Berg et al (1991) respectively. All patients had received prior training in the perimetric techniques. Six weeks after routine cataract surgery and intraocular lens implantation, and following an uneventful recovery, the experimental protocol was repeated. **Results:** In most patients, cataract resulted in greater attenuation of SWAP mean sensitivity. In some, the degree of attenuation resulted in a loss of SWS isolation. **Conclusions:** The outcome of SWAP in patients with cataract should therefore be treated with caution.

INFLUENCES OF CATARACTS ON GLAUCOMATOUS VISUAL FIELD CHANGES

12)

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TOKYO

We investigated the influences of cataracts on the glaucomatous visual field changes before and after phacoemulsification of cataract and intraocular lens insertion.

Fifty-one eyes of 35 glaucoma patients (average age 73.3 years), which included 9 eyes of POAG, 33 eyes of NTG and 9 eyes of PACG, were studied. All the eyes had glaucomatous visual field changes and cortical or nuclear cataracts. The visual field changes by the Humphrey field analyzer program 24-2, within 6 months before and after the surgery, were evaluated.

The postoperative stages of the glaucomatous visual field changes (Aulhorn classification) remained unchanged in 70 of 102 half fields (68.6%), improved in 23 half fields (22.6%) and progressed in 9 half field (8.8%). Scotomata remained unchanged in 10 half fields, disappeared in 3 half fields and newly appeared in 10 half fields after surgery. Eighty-six out of 102 half fields (84.3%) with a generalized reduction of sensitivity decreased to 58 half fields (56.9%) after surgery.

These results indicated that the influences of cataracts on the glaucomatous visual field changes were not only a generalized reduction of sensitivity but also to make the glaucomatous visual field changes indistinct, although cataracts had little influence on the stage of the glaucomatous visual field changes in the majority of glaucoma patients.

13) **DIFFUSE VISUAL FIELD LOSS IN OPEN-ANGLE GLAUCOMA**

Balwantray C. Chauhan,^{1,2} Alyson M. Shaw,³ Raymond P. LeBlanc,¹ Terry A. McCormick¹ and Angela B. Chan.¹ Departments of ¹Ophthalmology and ²Physiology & Biophysics and ³Faculty of Medicine, Dalhousie University, Halifax, NS, Canada

To determine the frequency of repeatable diffuse loss as the only form of visual field damage in open-angle glaucoma, we analysed data from an ongoing prospective study of patients with early optic nerve damage. Our sample contained 113 patients who are being tested at six-monthly intervals with the 30-2 program of the Humphrey Field Analyser. The median number of fields in the follow-up to date was 7 (minimum 4, maximum 9). All fields were recorded on the same machine by the same technician. Cumulative defect curves for all 782 visual fields, using percentile data from a parallel study of age-matched controls, were rated in a masked randomised fashion as "diffuse," "localised," "combined," or "normal" by the same rater. We defined repeatable diffuse loss as occurring when at least two-thirds of the fields in the follow-up were classified as "diffuse." The clinical charts of 17 (15.0%) patients who were classified as such were reviewed without access to their fields to determine the influence of cataract or other non-glaucomatous factors on the visual field. We were unable to explain diffuse loss in 5 (4.4%) patients, 4 of whom maintained 6/6 acuity throughout the follow-up. We conclude that repeatable diffuse loss occurs in a small number of patients as the only manifestation of glaucomatous visual field damage.

14) **New glaucoma change probability maps to separate visual field loss caused by glaucoma and by cataract .**

Anders Heijl¹, Boel Bengtsson¹, Peter Åsman¹, Michael Patella²
¹Dept of Ophthalmology, Malmö University Hospital, Sweden and ²Humphrey Instruments, San Leandro, CA, USA

We developed a new type of glaucoma change probability maps intended to separate localized glaucomatous field progression from media-induced diffuse progression. These new change probability maps are based on the Statpac pattern deviation maps. Series of Humphrey perimetric tests of 43 eyes of 35 glaucoma patients, who had undergone cataract surgery, were used for evaluation. Considerable improvements were seen between fields obtained before and after surgery, when using the currently available maps judging change in total deviation. Such differences were negligible when using the new pattern deviation based change probability maps. Thus, the common and disturbing effect of increasing cataract was almost eliminated using the new pattern deviation glaucoma change probability maps. This new interpretation tool can facilitate differentiation between progressive glaucomatous visual field loss and deterioration caused by increasing cataract.

III. Clinical Observations June 5, 1996 1:30 - 3:14 PM

RECONSIDERATIONS OF VISUAL FIELD INCONGRUENCE

15)

Lars Frisén

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University of Göteborg, Sweden

Forty-nine subjects with homonymous relative visual field defects due to a variety of intracranial lesions were studied by high-pass resolution perimetry. Statistical analysis balanced for learning and fatigue effects revealed significant incongruence in 15 cases, usually with a slightly larger defect contralateral to the lesion. There was no clear relationship between incongruence and locations or natures of underlying lesions. Instead, methodological and pathophysiological considerations suggested that incongruence was the outcome of individually peculiar interactions between fine anatomical details, spatial distributions of neural conduction defects, and various measurement problems. Hence, incongruence emerged as an epiphenomenon of negligible clinical relevance.

MACULAR SPARING IN PATIENTS WITH HEMIANÓPSIA - RE-EVALUATED USING STATIC AND KINETIC FUNDUS PERIMETRY

16) K. Rohrschneider, R. Glück, R.O.W. Burk, F.E. Kruse, H.E. Völcker

Department of Ophthalmology, University of Heidelberg, 69120 Heidelberg, Germany

Recently it has been reported that macular sparing in patients with hemianopsia is an perimetric artifact (Bischoff et al. 1995). We wanted to re-evaluate this findings by use of our static and kinetic threshold fundus perimetry with the Scanning Laser Ophthalmoscope.

Methods: 20 eyes of 13 patients with homonymous hemianopsia were examined using conventional Goldmann perimetry as well as static and kinetic fundus perimetry with simultaneous documentation of fixation by use of the Scanning Laser Ophthalmoscope.

Results: The findings obtained with either kinetic procedure were identical. Ten eyes showed an area of residual visual field inside the scotomatous hemifield, i.e. a macular sparing. The comparison of the behavior of fixation during fundus perimetry showed no difference between this eyes and those without sparing.

Conclusion: The finding of macular sparing in patients with homonymous hemianopsia was reliably observed during both kinetic perimetry procedures. The different results reported from Bischoff et al. seems to be due to the manual static test procedure used by that group. Findings from MRI investigations suggest that different sites of damage cause variable degrees of macular involvement. This supports our results that macular sparing does exist.

III. Clinical Observations June 5, 1996 1:30 - 3:14 PM

Partial Complex Seizure Disorder; a Prospective Neuro-Ophthalmic Study.

- 17) Steven A. Newman, M.D. Neuro-ophthalmology Division, University of Virginia, Charlottesville, VA, USA

A prospective analysis of visual dysfunction was carried out in a series of patients undergoing assessment of chronic partial complex epilepsy. One hundred forty two patients underwent neuro-ophthalmic evaluation. Perimetry was performed both by kinetically (Goldmann 2-4 isopter) and statically (Humphrey Field Analyzer 24-2). Preoperative visual field defects were uncommon (29% static & 18% kinetic) in spite of occasional structural lesions (seen on MRI) and in most cases felt to represent artifact (homonymous defects in 5.6% static and 3.5% kinetic). Other findings including IVth nerve palsy, pursuit abnormalities, and gaze paretic nystagmus were uncommon. Patients (64) were seen following 66 surgical procedures and re-evaluated. New homonymous VF defects were detected in 74% although unrecognized by the patient in almost all. In 3 patients the visual field defect was seen only on static perimetry and in 2 others only on kinetic perimetry. There was excellent correlation between the static and kinetic VF's when graded on a 0-4 scale (within one category in all). One patient had a dense homonymous; all others were incomplete. One patient developed an optic neuropathy following surgery presumably from vascular spasm. Neuro-ophthalmic findings are rare in untreated patients with partial complex epilepsy. Homonymous visual field defects are common following cortical resection although most commonly unnoticed and rarely clinically significant. Automated static perimetry (Humphrey 24-2) is essentially as sensitive and has excellent correlation with Goldmann kinetic perimetry in patients with induced retrochiasmal field defects.

- 18)

CORRELATION OF VISUAL FIELD AND PHOTOREACTIVE FLOW CHANGES IN THE POSTERIOR CEREBRAL ARTERY IN PATIENTS WITH OCCIPITAL LOBE INFARCTION

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Methods: In 13 patients with unilateral occipital lobe infarction static and kinetic perimetry and transcranial Doppler sonography were performed. We measured maximum mean flow velocity (MFV) of the posterior cerebral artery (PSA) after photic stimulation of the retina. The results were compared with 25 healthy controls.

Results: In the control group MFV was increased by $30.6 \pm 9.7\%$. In 9 patients with homonymous hemianopsia the ipsilateral MFV increase was significantly lower ($3.4 \pm 4.1\%$). The 4 patients with homonymous quadrantanopsia had an ipsilateral MFV increase lowered to $16 \pm 12.8\%$.

Conclusion: Photoreactive flow changes of the PCA are a noninvasive measure of functional impairment due to occipital infarction and have a good correlation with the perimetric findings.

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19) DETERIORATION OF OCULAR FUNCTIONS CAUSED BY INTERNAL HYDROCEPHALUS IN A PATIENT WITH GLAUCOMA

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Authors report the case of a 43 year old male patient with glaucoma in whom the cause of progressive vision fall and visual field deterioration proved to be caused by liquor circulatory disturbance. Examinations (Ultrasound, VEP, CT, MRI) performed because of a temporary loss of vision for 2-3 days immediately after trabeculectomy on the right eye and a lasting deterioration of vision later on showed liquor circulatory disturbance localized in the optic nerve sheath and the oedema of the optic disc. The patient underwent neurosurgical intervention after which no further deterioration of vision was detected. The case demonstrates the correlation between liquor circulatory disturbance, IOP and the deterioration of ocular functions (visual acuity, visual field). The attention was drawn to the unusual progression of glaucomatous visual field loss by repeated automated perimetry (Octopus 500 EZ) after neurosurgical intervention which yielded proof of the connection between optic nerve involvement and liquor circulatory disturbance.

20)

PERSISTENT VISUAL FIELD DEFECTS AFTER CRANIOPHARYNGIOMA SURGERY
A COMPARISON BETWEEN HIGH-PASS RESOLUTION AND KINETIC GOLDMANN PERIMETRY

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Purpose: The aim of the current study is to compare the visual field findings in surgically treated craniopharyngioma patients, obtained and evaluated using two different techniques: high-pass resolution perimetry (HRP) with automatic interpretation and kinetic perimetry a. m. Goldmann with visual evaluation.

Patients and methods: Twenty-three consecutive patients (age 18–71 years) were examined, using Goldmann perimetry, one to 30 years after neuro-surgery. Currently, ten of these (18 eyes) have also been examined using HRP. The Goldmann visual fields were evaluated by visual inspection by two independent ophthalmologists and the resolution fields by the Ring Interpretation eXpert program (RIX).

Results: In eight patients both techniques detected the same type of defect, one homonymous hemianopia, three bitemporal defects and four patients with temporal defects in one eye (two of these were blind in the other eye). Two patients had apparently normal Goldmann visual fields. In one of these patients the RIX program reported a paracentral defect on the temporal side in one eye. In the other patient reduced neural capacity in one eye was detected.

Conclusion: Judging from these preliminary results resolution perimetry with automatic interpretation appears to be somewhat more efficient than visually evaluated kinetic Goldmann perimetry in detecting visual field defects in these patients. A larger group has to be examined in order to verify this impression.

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PERIMETRIC STUDY OF ASYMPTOMATIC OBSTRUCTIVE CAROTID DISEASE.

21) Corallo G, Gandolfo E, Capris P, Ottonello GA*, Brusa G*, Raiteri U*, Semino E,
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Purpose: to detect the earliest ocular functional damage in cases of carotid obstructive disease, without any signs or symptoms of ocular ischemia.

Materials and methods: 36 eyes of 18 patients with uni- or bilateral carotid stenosis more than 70%, without any evidence of retinal ischemia, underwent "central 30-2" program of Humphrey 640 VFA.

Results: visual field defects were found in most subjects (83%); isolated nerve fiber bundle defects (53%) and a general reduction of sensitivity (27%) were the most frequent findings.

Conclusions: perimetry seems to be the only method able to detect a subclinical chronic ischemic retinopathy in cases of asymptomatic carotid obstructive disease.

22)

ANALYSIS OF EARLY VISUAL FIELD DEFECTS IN MULTIPLE SCLEROSIS PATIENTS: CORRELATION WITH CHROMATIC SENSE EVALUATION AND PATTERN REVERSAL VISUAL EVOKED POTENTIALS.

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Thirty young patients, affected by multiple sclerosis (MS) from a period between 2-5 years, lacking signs of optic neuropathy, were examined by means of the Humphrey VFA - 640 Program 10 -2, High-pass Resolution Perimetry (HRP), "Ring" program, visual evoked potential (VEP) pattern reversal and Farnsworth - Munsell 100 Hue test. HRP revealed significant visual field alterations in 50% of patients (functional channels fraction average (FCF) = 70%); Humphrey Program 10-2 showed visual field alterations in 15 % of cases (foveal threshold average = 36 dB). Alterations of VEP responses and Farnsworth 100 Hue test were found respectively in 10% and 40% of cases.

Our study demonstrates the sensibility of HRP and Farnsworth 100 Hue test in detecting early functional alterations of the optic nerve in MS patients not suffering from ocular symptoms.

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SCOTOPIC PERIMETRY IN NIGHT BLINDING RETINAL DYSTROPHIES, PROBLEMS AND POTENTIALS:

23)

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Scotopic perimetry is based on the analysis of the difference between the sensitivities for two defined wavelengths (blue-green and red) at a given retinal locus. All answers are thought to be rod mediated in healthy subjects. In retinal dystrophies the answers may be rod-, mixed- or cone-mediated, therefore it is desirable to define the ranges for rod and cone answers respectively. Depending on the filters used, the normal threshold values and their differences vary in the published data. As we are using a modified Humphrey perimeter (modified by F. Fitzke, London) we verified the rod mediation by (1) investigating the difference between the sensitivities to the blue-green and red stimulus (cut off filters) in two color dark adaptometry and (2) by calculating it based on the spectral power distribution of the filters and the scotopic spectral sensitivity function (V_{λ}'). Measured differences in rod thresholds (mean 6 dB) agreed well with the calculated value (3 dB). In order to determine the difference in cone thresholds at the same wavelengths, photopic perimetry was performed with 2 different backgrounds, 5 cd/m² and 10 cd/m². The values are independent of the background luminance indicating that 10 cd/m² are appropriate to generate photopic conditions and to test cone function. The measured differences in thresholds (mean -15 dB) also agreed well with the calculated value (-19 dB) obtained from the spectral power distribution of the stimuli and the photopic spectral sensitivity function (V_{λ}). Two color dark adaptometry did not provide reliable data at the cone plateau because of marked fluctuation of the answers. The values are used to interpret the results in various hereditary chorioretinal disorders (choroideremia, crystallin retinopathy Bietti, X-linked juvenile retinoschisis) and to illustrate the potential of scotopic perimetry in longitudinal studies.

Supported by a grant of the European Community for the Prevention of Blindness

24)

THE SIGNIFICANCE OF THE CENTRAL VISUAL FIELD FOR THE READING ABILITY

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Reading disability is the main complaint of patients with central field defects. This paper shows the preconditions for reading under physiological conditions and in patients with central scotomas.

Methods: Retinal fixation locus (RFL) and eye movements during reading are recorded simultaneously by a Scanning Laser Ophthalmoscope (SLO). Additionally, fixation behaviour was determined by Tübingen Manual Perimetry (TMP), based on the location of the scotoma and the blind spot. The results of the two methods were compared (n=37 eyes with maculopathy).

Results: A precondition for reading is on the one hand a sufficient resolution of the RFL and on the other hand a minimum extend of the reading visual field. Complete absolute scotoma with eccentric fixation is the best prerequisite for regaining reading ability by magnifying aids. In eccentric fixation the preferred direction of scotoma shift is to the upper or upper right visual field (93%). A remaining central island with persisting central fixation causes reading inability. Fixation behaviour showed high correspondence between SLO and TMP.

Conclusion: The kind of the field defect and the fixation behaviour are of great significance for the reading ability. Analysis of fixation behaviour can explain discrepancies between visual acuity and reading disability. SLO and TMP show high correspondence. The SLO has the advantage of quick assignment of fixation behaviour, also in changing RFL, and of simultaneous assessment of morphologic, sensory and motoric aspects during reading.

PERIMETRIC FOLLOW-UP IN MYOPIC MACULOPATHY.

- 25) Capris P, Corallo G, Rossi F, Gatti G, Rovida S*
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The perimetric evaluation of differential light sensitivity changes in macular diseases and in myopic maculopathies (MM) can be made difficult by the threshold fluctuation. The aim of this study was the measurement of the long-term fluctuation (LF) in a group of clinically stable MM patients in order to evaluate its relationship with defects depth and site. Twenty five subjects who met the following criteria were included in the study: 1) Stable MM. 2) Good reliability indices. 3) Visual field defects inside the 10° central area. 4) Visual acuity better than 0.5. 5) Refraction -5.00 to - 20.00 D.

All the subjects included in this study were subsequently examined at least three times by automated perimetry (Central 10-2 program of the 640 VFA). The time interval between examinations was at least three weeks. The average LF of stable MM patients was 1.55 ± 1.03 dB and not related to defect site and depth. These data provide us a practical guideline for the evaluation of progressive visual field loss in MM.

26)

**CHANGES IN THE CENTRAL VISUAL FIELD AFTER SURGICAL
REMOVAL OF EPIRETINAL MEMBRANES**

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In our paper we report the results of perimetric examination in patients with macular epiretinal membranes.

Functional parameters of the central retinal area were evaluated in 16 patients with automated perimetry, electrophysiologic examination and visual acuity testing. All patients had undergone vitreoretinal surgical procedure including epiretinal membrane removal.

Preoperative changes in central visual field varied from mild to severe, correlation with visual acuity being insignificant. Perimetric data was a significant prognostic factor in predicting functional results of surgery.

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27) **HIGH-PASS RESOLUTION PERIMETRY IN THE EARLY DETECTION OF
MACULAR ALTERATIONS IN PATIENTS TAKING HYDROXICHLOROQUINE**
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Forty patients taking hydroxichloroquine for over 2 years underwent a visual field examination using either High-pass resolution perimetry (Centring program) and computerized automated perimetry (Humphrey 10-2 program).

A control group of 30 healthy subjects was also examined to test the specificity of these two techniques.

The HRP revealed defects in about 40% of cases, while CAP was abnormal in less than 10% of eyes (a statistically significant difference). The biomicroscopy macular examination was generally normal.

A quite high specificity was obtained with both methods.

We conclude that HRP is a sensitive and rapid technique in the early detection and follow-up of macular alterations in patients taking hydroxichloroquine.

I. Blood Flow and Nerve Fiber Layer Analysis June 5, 1996 4:30 - 6:00 PM

SCANNING LASER OPHTHALMOSCOPY BASED EVALUATION OF
EPIPAPILLARY VELOCITIES: A NOVEL APPROACH

28) (O. Arend¹ and A. Harris²) Augenklinik, RWTH Aachen, Germany ¹, Dept. Ophthalmology, Physiology and Biophysics, Indiana University, Indianapolis, IN, USA²

Purpose: Scanning laser ophthalmoscopy is capable in producing high resolution fluorescein angiograms. Measurements of capillary blood velocities in the fovea are established. In this study we use similar technique to measure particle velocities in superficial layers of the optic nerve head. Furthermore we compared these data with velocity measurements of the retinal vasculature.

Patients: In twelve subjects (6male, 6 female) fluorescein angiograms were performed (mean age: 24 ±2 years). Offline, the velocity of hypofluorescent particles through the microvasculature of epipapillary and macular vessels were measured. Furthermore, we assessed the arteriovenous passage time (AVP) of the fluorescein dye front.

Results: Epipapillary blood velocities (EBV) ranged from 3.1 to 6.4 mm/s (mean: 4.7 ±1.0 mm/s) and differed significantly from macular capillary blood velocities (MCBV)(range from 2.2 to 3.3 mm/s; mean: 2.6 ±0.4 mm/s). The AVP in all subjects was 1.98 ±0.4 seconds and was correlated with the with the MCBV (p<0.05, r=-0.6). EBV showed no correlation to AVP and MCBV.

Conclusion: The scanning laser methodology was adapted to objectively measuring velocities in the epipapillary vasculature which may be of importance in studying the pathogenesis or therapy concepts in glaucoma. These measurements did not correlate with velocities in the perifoveal network and retinal transit time.

29)

DORZOLAMIDE EFFECTS ON OCULAR HEMODYNAMICS MEASURED WITH
A COMBINED NEW APPROACH OF
SCANNING LASER OPHTHALMOSCOPY AND COLOR DOPPLER IMAGING
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University, Indianapolis, IN, USA¹, Augenklinik, RWTH Aachen, Germany ²

Purpose. Dorzolamide is the first carbonic anhydrase inhibitor (CAI) for the treatment of glaucoma. In addition to the established hypotensive effects, CAI agents have also been reported to have some vasoactive effects. This study investigated the effects on retrobulbar, retinal and epipapillary circulation following acute application.

Methods. In a double-masked placebo-controlled cross-over design, intraocular pressure (IOP), scanning laser video fluorescein angiography, and color Doppler imaging (CDI) were evaluated in 13 normal subjects at baseline and 2 hours following application.

Results. The drug hastened arteriovenous passage time (p<0.05; 18%) and accelerated capillary blood velocities in the macula (p<0.05; 16%) and the superficial optic nervehead (p<0.05; 15%) while remaining arterial and venous diameters unaffected. The placebo failed to alter these measures. The drug had no apparent retrobulbar effects as measured by CDI. IOP also decreased significantly from 15.7 ±0.7 to 13.7 ±0.7 mmHg (p<0.01; 22%) after the acute application.

Conclusion. Dorzolamide caused an acute increase in retinal and superficial optic nervehead circulation. These results suggest that Dorzolamide may benefit patients with ocular vascular illness characterized by vascular insufficiency.

IV. Blood Flow and Nerve Fiber Layer Analysis June 5, 1996 4:30 - 6:00

VISUAL FIELD DEFECT AND PERFUSION OF THE JUXTAPAPILLARY RETINA AND THE NEURORETINAL RIM AREA IN PRIMARY OPEN ANGLE GLAUCOMA

30) G. Michelson and M.J. Langhans, Department of Ophthalmology, University Erlangen-Nürnberg, 91054 Erlangen

Purpose: To evaluate capillary blood flow of the juxtapapillary retina and neuroretinal rim area and visual field defect in primary open angle glaucoma (POAG).

Method: Juxtapapillary retinal and neuroretinal rim area blood flow was measured by "Scanning Laser Doppler Flowmetry" (SLDF). The visual field was evaluated by static perimetry (Octopus-G1). We examined 89 eyes of 73 patients with POAG (increased intraocular pressure <21mmHg & glaucomatous optic nerve head atrophy) and 55 eyes of 35 healthy individuals. The POAG-group was divided in eyes with a mean defect lower 2dB (POAG-group I) and in eyes with a mean defect equal or greater 2dB (POAG-group II). The mean age of the POAG-group I and of the POAG-group II was 56±12 years and 42±15 years, respectively. The mean age of the control group was 44±12 years. The eyes of the POAG-group I and POAG-group II had an average mean defect of the visual field of 2.3±1.4 dB and 7.3±5.4 dB, respectively. The actual intraocular pressure was in the POAG-group I 17.8±4.18 mmHg, in the POAG-group II 17.45±1.82 mmHg, and in the control group 15.45±1.82 mmHg. For statistical analysis age-matched groups of 28 normal eyes of 28 persons with 27 glaucomatous eyes of 27 patients (POAG-group I) and 10 glaucomatous eyes of 10 patients (POAG-group II) were compared.

Results: In eyes of the POAG-group I and POAG-group II both juxtapapillary retinal blood flow and neuroretinal rim area blood flow were significantly decreased compared to an age-matched control group: neuroretinal rim area "flow" -43% (POAG-group I, p<0.001), -71% (POAG-group II, p<0.001), juxtapapillary retina "flow" -29% (POAG-group I, p<0.001), -71% (POAG-group II, p<0.001). All eyes of the POAG-group I (MD<2 dB) and 56/61 eyes of the POAG-group II (MD>=2dB) showed a retinal perfusion lower the 90%-percentile of normal blood flow. We found no correlation between reduction of juxtapapillary retinal blood flow and mean defect in POAG-eyes

Conclusion: Glaucomatous eyes with no or borderline visual field defects showed already significantly decreased optic nerve head and juxtapapillary retinal blood flow.

31)

VISUAL FIELD DAMAGE IN NORMAL TENSION GLAUCOMA WITH AND WITHOUT VASOSPASM.

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CLINICA OCULISTICA, UNIVERISTY OF BRESCIA, ITALY

Background: There is some evidence that the nature and progression of disease in normal tension glaucoma (NTG) may be distinct from other open-angle glaucomas. Moreover in NTG patients it is possible to make a differentiation in two main groups on the basis of the presence of vasospasm.

Aim of the study: We studied the ocular characteristics of 13 pairs of NTG patients with and without vasospasm who matched closely for the extent of field damage, pupil size, and visual acuity. The diagnosis of vasospasm was formulated on the presence of, alone or in association, migraine, Raynaud phenomenon and by the means of an ocular hemodynamic test proposed by one of us (L. Quaranta et al Surv Ophthalmol 38:S177-S182,1994).

Results: The results evidenced that for an equivalent extent of damage, the patients in the NTG group with vasospasm had greater areas with normal sensitivity, hence a more localized damage. Moreover a significant correlation was found between the entity of vasospasm and the slopes of the scotomas.

Conclusion: The results support the hypothesis that NTG patients with vasospasm have a more localized damage, thus vasospasm has to be considered one of the most important risk factors involved in the onset and progression of anatomic and functional damage in NTG eyes.

32) **VISUAL FIELD DEFECTS AND OCULAR BLOOD FLOW IN GLAUCOMATOUS EYES**

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The Langham Ocular Blood Flow (OBF) System is a non invasive method to calculate the ocular pulsatile blood flow which represents 75-90% of the total ocular blood flow. The total ocular blood flow depends for about 90% on choroidal circle and for the rest on retinal, optic nerve head and other parts of the eye blood flow. The OBF System includes a pneumatic tonometer connected to a personal computer which permits to calculate in real time the pulsatile flow value in microlit./min. by means of an appropriate software. Sixty primary open angle glaucoma patients aged 56 to 81 years, thirtynine of whom with glaucomatous visual field defects and twentyone with a normal visual field and twenty normal subjects aged 59 to 78 were tested with 30-2 program of the Humphrey Visual Field Analyzer. Ocular pulsatile blood flow was measured with the Langham OBF System. In this study the ocular pulsatile blood flow reduction in the glaucomatous eyes, compared to the normal eyes, was statistically significant in correlation to the appearance and progression of the glaucomatous visual field defects.

33)

**VALIDITY OF MEASUREMENTS WITH CONFOCAL SCANNING LASER
DOPPLER FLOWMETRY**

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We wanted to determine the validity of perfusion measurements obtained with confocal scanning laser Doppler flowmetry using the Heidelberg Retina Flowmeter (HRF). Both ends of a 1.70 mm outside diameter glass tube were pulled to create a central parallel capillary in order to allow laminar flow. We used six capillaries with inside diameters ranging 40 to 100 microns. One end of the capillary was coupled to either a 100 ul or 50 ul gastight syringe. A high-precision infusion pump infused the capillary with skimmed milk at up to 18 different flow rates. At each flow rate we obtained 5 HRF measurements. There was a high correlation between the mean HRF measured flow rate and the actual flow rate with r ranging from 0.96 to 0.98. When the actual velocity at the measurement point corresponding to each flow rate was calculated, the slopes of HRF measured velocity versus actual velocity for the six independent experiments were very similar. Our data also showed that HRF measurements saturated and produced aliasing at velocities whose vectors parallel to the laser were beyond ≈ 0.6 mm/s. We conclude that the HRF likely measures reliably and linearly at velocities in the range previously reported in the ocular microcirculation.

IV. Blood Flow and Nerve Fiber Layer Analysis June 5, 1996 4:30 - 6:00

- CORRELATION OF NERVE FIBRE LAYER THICKNESS
34) AS EVALUATED BY THE HRT AND OPTIC DISC HEMORRHAGE LOCATION
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Background: The presence of hemorrhage on the optic nerve head is considered as evidence of ischemic mechanisms in glaucoma patients. It is of clinical interest to establish a correlation between disc hemorrhages and thinning of the retinal nerve fibre layer - RNFL - in corresponding area. **Methods:** Thirty-one eyes of twenty-eight patients with open angle glaucoma including patients with normal tension and those with increased intraocular pressure, who were found to have a disc hemorrhage during routine disc photography were enrolled in this study. All disc hemorrhages occurred between one and twenty-four months prior to enrollment. Mean RNFL thickness, in quadrant and in 10° area, corresponding to the hemorrhage and gradient between mean RNFL thickness of the two 10° areas on each side of the hemorrhage were measured using the Heidelberg Retina Tomograph - HRT - and compared to the mirror image position on the other side of the horizontal meridian. **Results:** Nerve fibre layer thickness was found to be decreased in the quadrant and in the 10° area corresponding to the disc hemorrhage as compared to the mirror image. Overall, fifty-six percent of cases also showed a significant decrease in the RNFL thickness gradient on each side of the hemorrhage. **Conclusion:** Disc hemorrhages correlate nicely with a decrease in the, HRT measured, RNFL thickness in the corresponding location. It is possible that disc hemorrhages are markers for progression of localized nerve fibre layer defects. However, further investigation of this relationship is necessary.

35)

- MAPPING STRUCTURAL TO FUNCTIONAL DAMAGE IN GLAUCOMA
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Purpose. To evaluate the spatial relationship between wedge-shaped nerve fiber layer (NFL) defects and focal HFA visual field defects (standard and SWAP) in glaucoma patients. **Methods.** NFL defects were assessed using stereoscopic photographs and confocal scanning laser ophthalmoscopy (Heidelberg Retina Tomograph [HRT]). Two different examiners evaluated the location of the defect for each of four data sets: standard visual fields (n=12), SWAP fields (n=7), photographs and HRT images (n=13). The relationship between structural and functional defects was evaluated using more detailed topographic localization building on Weber et al.(1) **Results.** The location of NFL defects and visual field defects overlapped comparing standard VF to HRT in 42% and to photos in 56% of eyes, and comparing SWAP to HRT in 57% and to photos in 75% of eyes. **Conclusions.** We have shown that focal defects in the NFL and those in both types of fields can be related with this modified mapping technique.

1. Weber J, Dannheim F, & Dannheim D. *Acta Ophthalmologica* 1990; 68: 568-574.
Supported by NEI grant s EY 08208 and EY 11008

IV. Blood Flow and Nerve Fiber Layer Analysis June 5, 1996 4:30 - 6:00

REPRODUCIBILITY AND EFFECT OF OPERATOR DEPENDENT VARIABLES IN IMAGING WITH NERVE FIBER ANALYZER II

- 36) Richard P. Mills MD, Yasuko Takahashi MD, James FG Stewart MB, ChB, and Martha M Leen MD
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Factors contributing to NFA measurement variability were investigated by having each of 3 photographers image each eye of 5 normal volunteers three times at each of 5 separate sessions over two weeks. Comparisons were made between single images and between baseline images derived from the three images from each session. Effects of variations in the size, shape, and position of the operator-inserted measurement ellipse was investigated. The influence of acquisition parallax in patients with undilated pupils was also assessed.

Neither photographer nor session effects contributed significantly to measurement error ($p > 0.05$). The total variance was small compared to the mean total integral ($CV = 0.049$). Large variations in the shape and position of the operator-designated ellipse have minimal effects on results, but the total integral does vary non-linearly with distance from the optic disc.

The NFA II has the potential to be a useful clinical tool in that it produces easily reproducible measurements. Rather than needing to closely map the contour of the optic disc when designating the operator-inserted ellipse, a standard circle may be used with equivalent efficacy. However, the distance of the outer measurement ellipse from the disc should be set at a standard (such as 1.75 times the disc diameter) to minimize eccentricity-related changes in the total NFL integral value.

37)

NERVE FIBER LAYER THICKNESS EVALUATIONS IN THE UPPER AND LOWER RETINAL HALF USING THE NERVE FIBER ANALYZER I (NFA I)

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Purpose: Questions evaluated: 1) Is there a conformity between the up- down- asymmetry of visual field loss (VFL) and the up- down- asymmetry of nerve fiber layer thickness (NFLT), calculated by laser-polarimetry (LP)? 2) Is there any asymmetry in NFLT between the upper and lower retinal half in normals?

Methods: 1) 38 eyes of 38 glaucoma patients with a defined up- down- asymmetry of VFL were examined. NFLT was calculated by NFA I, VFL by Octopus-Perimeter (prog. 31 or 32). By a change of the software of the NFA I it was possible to calculate NFLT separately in the upper and lower half of the retina. According to the degree of visual field asymmetry we divided the glaucomatous eyes into groups with a small, a medium and a big up- down- asymmetry of VFL. 2) In 62 healthy eyes of 62 probationers NFLT in the upper and lower retinal half was examined.

Results: 1) In case of a small up- down- asymmetry of VFL there was a bigger conformity between the up- down- asymmetry of VFL and the up- down- asymmetry of NFLT (10 of 14 eyes), as for a medium (7 of 12 eyes) or a big up- down- asymmetry (6 of 12 eyes). 2) In healthy eyes we found an about 6% bigger NFLT in the lower than in the upper half of the retina. 3) Even if this NFLT-asymmetry in normals was taken into consideration, for the glaucomatous eyes with a big asymmetry in VFL only an insignificant higher conformity could be found (7 of 12 eyes).

Conclusion: Still in about 40% there was no conformity between the up- down- asymmetry of VFL and the up- down- asymmetry of NFLT, so that a staging of the glaucomatous disease seems not to be possible by LP (software version 06/93) so far.

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38) SCANNING LASER OPHTHALMOSCOPE (SLO) IMAGING OF THE PAPILLO-MACULAR BUNDLE (PMB) CORRELATED WITH STATIC PERIMETRY IN NEURO-OPHTHALMIC DISEASE

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The principal afferent pathway for central vision lies in the PMB, and yet this critical structure is all but invisible to conventional methods of ophthalmoscopy. The SLO markedly improves the ability to see the striations of the PMB in the living eye. Using a commercially available instrument (Rodentstock Instrumente, GmbH), we studied the fundus appearance and central visual field performance of a group of patients with a variety of neuro-ophthalmic diseases. The anatomy of the bundle, the perifoveal radial distribution of fibers and the temporal horizontal raphé are all clearly demonstrable. In optic tract disease, homonymous loss of fibers is visible in the temporal macula of the ipsilateral eye and the nasal macula of the contralateral eye. The vertical transfoveal terminator line separating ganglion cells subserving ipsilateral and contralateral visual field can be seen. In acute, demyelinating retrobulbar optic neuritis, development of atrophy in the PMB can be followed by direct observation. Objective confirmation of the topography of nerve fiber loss in the PMB allows significantly increased confidence in the accuracy of diagnosis when studying diseases of the anterior afferent visual pathways.

39) THE ROLE OF SPATIAL AND TEMPORAL FACTORS
IN FREQUENCY DOUBLING PERIMETRY

Chris A. Johnson and Shaban Demirel

Department of Ophthalmology, University of California Davis, USA

When a low spatial frequency sinusoidal grating undergoes high temporal frequency counterphase flicker, its perceived spatial frequency appears to be twice its actual spatial frequency (frequency-doubling). This percept is believed to be mediated by nonlinear magnocellular mechanisms (M_y cells). Recent studies have shown that contrast thresholds for frequency-doubled stimuli are effective in detecting glaucomatous visual field loss (Johnson, ARVO 1995, 1996). The purpose of the present study was to determine the contribution of spatial and temporal components of the stimulus to its effectiveness in separating patients with early to moderate glaucomatous field loss from age-matched normal controls. Four stimulus configurations were employed: (1) stimuli that induce frequency doubling [0.25 c/d, 25 Hz counterphase flicker], (2) a static 0.25 c/d grating, (3) a static 0.5 c/d grating, and (4) a uniform flickering stimulus [25 Hz]. Stimuli were approximately 8 deg in diameter, and were presented in a 4 by 4 grid over the central 20 degrees radius. Contrast sensitivity was estimated using a MOBS staircase procedure. Contrast sensitivity for glaucoma patients was reduced in areas of localized field loss for all four stimulus conditions. Frequency doubling stimuli showed the greatest abnormality, suggesting that sparsely represented large-diameter M_y cells were isolated by this test, thereby revealing more extensive damage in early/moderate glaucoma.

40)

RANDOM DOT MOTION PERIMETRY: PROPERTIES AND RESULTS

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We studied the fundamental properties of random dot motion perimetry to help determine the test's utility. The retest variability, in terms of slope of frequency of seeing curves, is low in glaucoma patients compared with conventional automated perimetry (greater than 50% reduction). Results of a comparison of motion detection thresholds with direction discrimination thresholds and the effects of increasing motion coherence on lowering of motion detection thresholds suggests motion perimetry is measuring motion perception rather than local flicker. Like other motion processing tasks, motion perimetry is resistant to blur up to 4-6 diopters. The sensitivity and specificity appear to be at least as good as conventional perimetry and like ring perimetry, use of feedback and improved ergonomics enhances patient acceptance.

Some problems encountered are a "floor" effect at the 3° test locations in normal subjects, upper extremity fatigue from the method of the localization response and a relatively long test time (10-15 minutes). Motion perimetry appears to have an acceptable psychophysical profile for clinical use.

V. New Methods of Perimetry June 6, 1996 8:00 - 9:45 AM

WHITE-NOISE FIELD CAMPIMETRY AS A TOOL IN THE DETECTION OF DISTURBANCES IN OCULAR MICROCIRCULATION

41)

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Purpose: White-noise field campimetry (WNFC) was first described by Aulhorn and Köst (1988) and used as a perimetric tool in patients with glaucoma and neuroophthalmological problems. Because there was only a low correlation between the perimetric and the WNFC findings in patients with glaucoma stage I and II, we suggested that WNFC was able to detect not only optic nerve damage but also disturbances in ocular microcirculation. Therefore, the goal of our study was to prove this statement.

Patients and Methods: At the University Eye Clinic, Tübingen we examined 31 patients (m:f=15:16; mean age 37,5 years) with sudden hearing loss and 24 patients (m:f=23:1; mean age 58±9 years) with coronary heart disease in comparison to 23 controls (m:f=12:11; mean age 45±7 years) with no systemic vascular and/or neurological disease. In order to evaluate the functional changes in ocular physiology, we examined the following parameters: morphological status, visual acuity, intraocular pressure, perimetry (TAP 2000 ct, Oculus, Germany), WNFC (TEC, Oculus, Germany) and color vision (Roth 28 HUE desaturated).

Results: Visual acuity, intraocular pressure and excavation of the optic nerve head were normal in all patients. Standard perimetry was normal in 74 patients, 4 patients had scotomas (2x glaucoma, 1x drusinos maculae, 1x branch retinal artery occlusion). In patients with sudden hearing loss, 90% of the scotoma-free patients, in patients with coronary heart disease 91% of the scotoma-free patients and only 13% of the controls had abnormal scotomas in the WNFC. Changes in color vision was observed in all patients, but in none of the controls. **Conclusion:** WNFC seems to be a quick, non-expensive method to determine disturbances in ocular microcirculation. The main disadvantage of this method is the unclear localisation of vascular disturbance. On the other hand, WNFC can be used as a uncomplicated screening method.

42)

CONTRAST SENSITIVITY PERIMETRY IN EXPERIMENTAL GLAUCOMA: INVESTIGATIONS WITH DEGENERATE GRATINGS

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Purpose: Visual deficits from experimental glaucoma occur earlier with grating stimuli than with standard perimetry. To investigate the mechanisms underlying these deficits we studied the changes in contrast sensitivity produced by early glaucoma and by simulated ganglion cell losses. **Methods:** Psychometric functions for grating contrast, using degenerated Gabor patches (5-84% pixel blanking), were measured at three locations in each visual field quadrant during the course of unilateral glaucoma in 5 rhesus monkeys. **Results:** The control functions for sensitivity vs. degeneration were exponential with a rapid decline in sensitivity for pixel blanking greater than 50%. In the early phase of glaucoma, contrast sensitivity was reduced uniformly across all degeneration values, but in later stages the knee of the function was shifted to lower degeneration values. **Conclusion:** In addition to losses of ganglion cells, experimental glaucoma produces pressure-induced contrast sensitivity deficits.

V. New Methods of Perimetry June 6, 1996 8:00 - 9:45 AM

STIMULUS ORIENTATION CAN EFFECT MOTION SENSITIVITY IN GLAUCOMA

- 43) MC Westcott, FW Fitzke, RA Hitchings.
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- Purpose:** To investigate the effect of stimulus orientation on motion detection thresholds in C.O.A.G patients and controls. **Method:** Line displacement thresholds were measured for a 2 degree by 2 min. arc. stimulus moving parallel, perpendicularly, or at 45 degrees to the orientation of the retinal nerve fiber layer, in a randomized order in 8 normal controls and 9 C.O.A.G. patients with reproducible glaucomatous Humphrey 24-2 field defects. Motion measurements were made at 1 of 2 locations in the visual field at an eccentricity of 15 degrees. **Results:** There was no effect of orientation on the motion detection thresholds in the controls. At the test location, the patients showed a range of motion displacement thresholds from normal to severely elevated. There was more marked threshold elevation for stimulus movement perpendicular to the nerve fiber layer, compared to movement parallel to the nerve fiber layer. This difference was significantly greater for patients with more pronounced threshold elevations (spearman rank correlation coefficient of the difference in the thresholds at perpendicular orientation and parallel orientation vs. the mean threshold was significant: $\rho = 0.58$, $p < 0.02$) **Conclusion:** We have identified an orientation dependence sensitivity to motion in some patients with glaucoma. This effect may be useful in improving the sensitivity and specificity of motion sensitivity testing in identifying early glaucomatous damage.

Supported by the Friends of Moorfields & I.G.A.

- 44) SHORT-WAVELENGTH AUTOMATED PERIMETRY (SWAP)
AND MOTION AUTOMATED PERIMETRY (MAP) IN GLAUCOMA
Pamela A. Sample, Charles F. Bosworth, Inci Irak, Robert N. Weinreb
Glaucoma Center, University of California, San Diego, La Jolla, CA
- Purpose.** To compare SWAP, a test favoring detection by the parvocellular pathways of vision, and MAP, a test favoring the magnocellular pathways, in the same eyes. **Methods.** Subjects were 20 glaucoma suspects and 12 glaucoma patients, compared to age-matched normal databases. SWAP was done with usual protocol (24-2). Motion coherence thresholds were measured with 14 random dot targets the 24-2 field area. **Results.** SWAP and MAP were correlated by visual field location (whole field $r = -0.59$ $p < 0.0000$), and especially in superior field ($r = -0.75$, $p < 0.0000$). ANOVA showed a significant effect of diagnosis for both tests (SWAP $p < 0.0000$; motion $p < 0.0003$), with glaucomas significantly different from normals. Although suspects were not significantly different, 40% had abnormal fields by SWAP and 20% by MAP. **Conclusions.** Both tests successfully identified glaucoma eyes and a percentage of the suspects, and they were highly correlated. These results suggest that damage due to glaucoma is localized and non-selective for either the parvocellular or magnocellular type ganglion cell axons.
- Supported by NEI grant EY 08208*

V. New Methods of Perimetry June 6, 1996 8:00 - 9:45 AM

THE RELATIONSHIP BETWEEN ACHROMATIC AND SHORT-WAVELENGTH AUTOMATED PERIMETRY WITH THE STANDARD AND FASTPAC ALGORITHMS

45)

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Aim: To determine the between-subject normal variability of the Standard and FASTPAC algorithms in short-wavelength automated perimetry (SWAP). **Methods:** The sample comprised 55 clinically normal subjects (mean age 52.8, SD 22.8) conforming to rigid inclusion criteria and experienced in both standard achromatic perimetry and SWAP. One standard achromatic and one SWAP field were obtained from the randomly designated eye of each subject at each of three visits. The order for the two types of perimetry was randomized between patients at the first visit and the particular order for a given patient was maintained across the remaining two visits. At the first visit, all subjects were examined using the Standard 4-2 dB algorithm. At the second visit, approximately one half of the sample underwent both examinations with the standard strategy and one half both examinations with the FASTPAC strategy. At the third visit, the type of strategy was reversed between the two sub-groups. At a fourth visit, ocular media absorption, and forward light scatter were measured. **Results:** The group means of the MS derived by SWAP were lower than those of achromatic perimetry in both the standard (4.0dB) and the FASTPAC strategy (3.3dB). The corresponding SDs of the means for SWAP were between 2.5 (standard strategy) and 4.0 (FASTPAC) times higher than for achromatic perimetry. The group mean SF for SWAP was higher than the achromatic SF by 0.3dB irrespective of strategy. The corresponding SDs of the means for SWAP were higher than those for achromatic perimetry by 0.3dB (standard strategy) and 0.15dB (FASTPAC). The group mean SF for SWAP was higher with the FASTPAC strategy by one third. **Conclusions:** SWAP exhibits greater between-subject variability than standard achromatic perimetry.

46)

DO FASTPAC OR SWAP INFLATE HEMIFIELD DIFFERENCES ?

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Purpose: To determine whether either Fastpac or SWAP inflate differences in mean sensitivity between mirror image areas in the upper and lower hemifields.

Subjects & Methods: Visually normal subjects were tested with Humphrey 30-2 perimetry (Statpac) as well as with either the Fastpac procedure (n = 10) or SWAP (n = 8). Mean sensitivity was calculated for seven mirror image areas in the upper and lower hemifields. The difference in sensitivity between corresponding areas was determined.

Results: Fastpac did not increase mean sensitivity differences between mirror image areas. In SWAP hemifield differences were inflated significantly (p < 0.001) relative to achromatic perimetry (up to 3x). The most pronounced effects were in the Bjerrum area.

Conclusions: Normal observers exhibit differences in sensitivity between mirror image areas that are greater in SWAP than in achromatic perimetry. Therefore in SWAP, interpretation of differences between corresponding areas in the upper and lower hemifields must be cautious.

47) IS EARLY DAMAGE IN GLAUCOMA SELECTIVE
FOR A PARTICULAR CELL TYPE OR PATHWAY ?

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There is much debate in the literature regarding the nature of early glaucomatous damage. Histopathologic studies of optic nerve fibers suggest a selective large fiber loss, examination of the dorsal lateral geniculate nucleus suggest a selective magnocellular (M-cell) loss, while other investigations suggest a nonselective loss that is due to undersampling or reduced redundancy of sparsely represented mechanisms. We examined these competing hypotheses by performing a series of visual function tests that are believed to be mediated by different neural subpopulations. SWAP, red/green opponent process perimetry, low (2Hz) and high (16 Hz) temporal frequency modulation perimetry, displacement perimetry and standard automated perimetry were performed in a small group of patients with early glaucomatous damage. Overall, the greatest amount of loss was observed for SWAP. In 7 out of 10 eyes, SWAP deficits were more extensive than those observed for all other test procedures. Although some functions were more greatly affected than others in individual eyes, there were no consistent trends observed, except for SWAP. At the present time, SWAP appears to have the best performance of any of the visual function tests for detection of early glaucomatous damage. Our findings do not support the concept that early glaucomatous losses are predominantly to magnocellular mechanisms or those pathways with the largest fiber diameters. Reduced redundancy or undersampling provides the most parsimonious explanation of our findings.

48)

BLUE-ON-YELLOW PERIMETRY ON THE PATIENTS WITH
OCULAR HYPERTENSION

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Purpose : Blue-on-yellow(B/Y) perimetry enables to access the short wave cone visual field under yellow adaptation. We have evaluated the visual fields of the patients with ocular hypertension using a modified Humphrey automated perimetry .

Method : Threshold values of 14 eyes with ocular hypertension and of 10 normal eyes were measured with B/Y perimetry and were compared with those measured with w/w perimetry(central 30-2 grid).

Results : In normal controls, no remarkable difference in the visual field was found between B/Y and W/W perimetry. In 3 eyes with ocular hypertension, however, glaucomatous visual field defects were detected only with B/Y perimetry.

Conclusions : B/Y perimetry may be of greater value in accessing early glaucomatous visual field defects than standard W/W perimetry. Patients with glaucomatous visual field defects were found in the ocular hypertensive group by B/Y perimetry.

NASAL-TEMPORAL ASYMMETRY IN THE CENTRAL FIELD ASSESSED
BY BLUE-ON-YELLOW PERIMETRY WITH A SLO

49)

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To investigate the effects of retinal location on short wavelength sensitive cone (SWS-cone) sensitivity in the central visual field. In this study we tested 76 normal subjects ages from 18 -85 yr. Blue-on-yellow perimetry was performed with a Scanning Laser Ophthalmoscope (SLO) to isolate SWS sensitivity, while simultaneously monitoring fundus position. A blue background and stimuli (200 ms duration) were generated by an Argon laser ($\lambda=458$ nm). A yellow background, produced by a HeNe ($\lambda= 594$ nm), was superimposed. Fundus visualization was provided by an infrared laser ($\lambda=850$ nm). In a 10 deg central test field, 16 locations were tested by a single crossing staircase procedure with Goldmann V size targets.

The blue-on-yellow sensitivity showed a significant decline by 0.2 dB per decade. SWS-cone sensitivity of the temporal retinal locations was significantly lower ($p < 0.001$) compared to that of the nasal quadrants. The asymmetry showed a significant dependence on age ($p<0.05$) for the inferior quadrants.

There is a nasal/temporal asymmetry in SWS-cone mediated sensitivity in the central visual field. In elderly subjects, this asymmetry becomes more pronounced in the inferior fields. The low sensitivity in the inferior temporal retina is consistent with clinical findings that pathological pigmentary changes are more prevalent in the temporal inferior quadrant.

VI. Image Analysis and Glaucoma June 7, 1996 8:00 - 9:28 AM

OPTIC DISC TOPOGRAPHY IN NORMAL EYES.

A CROSS-SECTIONAL STUDY USING SCANNING LASER TOMOGRAPHY AND RASTER TOMOGRAPHY.

50)

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Objective: To study the influence of age, gender, intraocular pressure and refractive error on optic disc topography in a normal population. For maximum operator independence, we chose to study cup area and maximum cup depth.

Method: We analyzed both eyes of 225 randomly selected, healthy subjects between 20 and 80 years of age using both scanning laser tomography (Heidelberg Engineering, Heidelberg, Germany) and raster tomography Glaucoma-Scope™, Ophthalmic Imaging Systems, Sacramento, CA, USA).

Results: Cup area measurements were independent of age, gender and refraction. Maximum cup depth measurements were independent of age and gender. We found a slight increase of both cup area and maximum cup depth with increasing IOP. This trend was particularly obvious among subjects over 50 years of age. Maximum cup depth increased slightly, but significantly with increasing hypermetropia. All these trends were identical with both methods.

Cup area measurements were comparable for both methods, but highly dependent on depth from reference plane. Maximum cup depth measurements were significantly higher with scanning laser tomography than raster tomography. In spite of differences in absolute values, the two methods were strongly correlated ($R^2=0.714$ for cup area and $R^2=0.806$ for maximum cup depth measurements).

Discussion: Our results indicate that optic nerve head topography does not change with age in normals. This information may have important implications for detection and follow-up of topographic changes.

51)

PREDICTION OF GLAUCOMATOUS VISUAL FIELD DAMAGE BASED ON THREE-DIMENSIONAL OPTIC NERVE HEAD TOPOGRAPHY

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Purpose: Prediction of the result of automated static perimetry (normal or glaucomatous visual fields, 6° grid) based on a linear discriminant analysis of three-dimensional topographic variables.

Methods: A linear discriminant analysis is calibrated using quantitative topographic data (area, volume and contour-line modulation values) obtained by laser scanning tomography from 125 left optic discs. The validation approach is performed in a test-sample of 175 left and 162 right optic discs.

Results: Sensitivity and specificity to predict glaucomatous visual field defects by three linear combination of topometric parameters is 66% (SE) and 88% (SP) respectively in the left eyes and 77% (SE) and 89% (SP) respectively in the right eyes of the test sample.

Discussion: Results indicate that perimetric results using standard techniques can be predicted on the basis of quantitative topographic data to a certain degree. Limiting factors are the high interindividual variability of optic disc topography and the possible time gap between morphological and functional damage, when the latter is defined in a 6° grid.

VI. Image Analysis and Glaucoma June 7, 1996 8:00 - 9:28 AM

CORRELATION BETWEEN MORPHOLOGY AND FUNCTION IN GLAUCOMA AT THE AGE
52) OF SCANNING LASER TOMOGRAPHY AND POLARIMETRY

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The aim of the study was to establish quantitative correlations between morphological changes at the optic nerve head (ONH) and the retinal nerve fiber layer (NFL) and visual field alterations in glaucoma.

A cross-sectional study of open-angle glaucoma patients of various stages was performed. Scanning Laser Tomographic (TopSS™) assessment of the ONH and Scanning Laser Polarimetric (Nerve Fiber Analyzer™) measurements of the peripapillary NFL-thickness (NFLT) were compared to results of computerized static perimetry (Octopus G-1).

157 eyes of 157 patients with suspected or established open-angle glaucoma were assessed. The parameter "modulation" (Δ max.-min. of NFLT) gave the best correlation ($r=0.48$) to mean sensitivity (MS). In the subgroup of glaucoma suspects ($n=58$) only the NFLT at the inferior quadrant showed a significant correlation to MS ($r=0.34$). In general, parameters of NFLT yielded slightly better correlations to visual field indices than ONH parameters. Of those ONH parameters analyzed, combined neuroretinal Rim area (superior & inferior quadrant) gave the best correlations to MS ($r=0.39$).

Quantitative assessment of the NFLT may be superior to ONH measurements in detection (and follow-up) of early glaucoma.

53)

LASER-SCANNING-TOMOGRAPHY OF THE OPTIC NERVE HEAD AND ITS
CORRELATION WITH COMPUTERIZED PERIMETRY IN A TWO YEAR
FOLLOW-UP OF GLAUCOMA PATIENTS

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A complete eye examination including a computerized perimetry using the Octopus 500 G 1 program (Interzeag) was performed on about 40 eyes. The optic nerve head was measured with the topographic scanning system (TopSS, Laser Diagnostic Technologies, USA).

Follow-up exams were scheduled within 12 and 24 months.

Parameters obtained by laser scanning system like „maximum depth“ „ $\frac{1}{2}$ depth area“ „ $\frac{1}{2}$ depth volume“ were compared to changes of the visual field indices.

Trends of changes were obvious and will be explained, but in some cases the „compared images“ evaluated by the scanning system were wrong and could not be correlated to the visual field indices.

VI. Image Analysis and Glaucoma June 7, 1996 8:00 - 9:28 AM

54) COMPARISON OF DISC SIZE AND DISC DIAMETER BETWEEN HEALTHY EYES;
EYES WITH LOW TENSION GLAUCOMA; PRIMARY OPEN ANGLE GLAUCOMA AND
OCULAR HYPERTENSION

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Purpose: Are there any differences in disc size or disc diameter between healthy eyes, eyes with Low Tension Glaucoma (LTG), Primary Open Angle Glaucoma (POAG) and Ocular Hypertension (OH) ?

Methods: Disc diameters were examined in 153 eyes of 153 patients (50 healthy eyes, 30 LTG, 53 POAG, 20 OH) by means of the Laser Tomographic Scanner (LTS). By means of the Heidelberg Retina Tomograph (HRT) the disc size in 105 eyes of 105 patients (20 healthy eyes, 26 LTG, 49 POAG, 10 OH) was evaluated. Eyes with a refraction of more than +/-3dpt were excluded. For glaucoma staging, Octopus 201 programm 31 was performed.

Results: There were no significant differences in disc size, measured with the HRT, between the four groups. Comparing disc diameters with LTS in stages I to IV form differences of the optic disc between LTG and POAG in stage I and II were found. In stage I and II in LTG a smaller vertical disc diameter was found, resulting on average in a more horizontal elliptical form. In POAG a smaller horizontal disc diameter was found than in LTG, resulting in a more vertical elliptical form of the disc. Stages III and IV showed no significant differences in horizontal and vertical diameters. On average, disc size therefore seems not to be different in LTG compared to POAG in the LTS measurements.

Conclusion: This study did not find evidence for a larger disc size in LTG compared to the other groups. The results of our former studies, which, compared to POAG, found in LTG a larger excavation of the disc, a smaller rim area and a steeper slope of excavation, therefore cannot be explained by a larger disc size in LTG.

55)

MEAN PALLOR VALUE OF THE OPTIC DISC (MPV) - A NEW PARAMETER
IN AUTOMATED DISC ANALYSIS WITH THE OPTIC NERVE HEAD ANALYZER

M. Siebert, E. Gramer - University Eye Hospital Würzburg, Germany

Purpose: The Optic Nerve Head Analyzer (ONHA) evaluates the pallor of the optic disc in form of a pallor-map. In order to characterize the vitality of the optic nerve head we calculated the mean pallor value of the optic disc (MPV). The aim of the study was to determine if there is an increase in MPV in ocular hypertensives (OH) compared to healthy eyes and if the size of the MPV has any predictive value in long-term follow-up of the visual fields in OH and eyes with primary open angle glaucoma (POAG).

Methods: I.: The MPV was calculated from double-examinations with the ONHA in 99 eyes of 99 patients (34 healthy eyes, 12 OH, 53 POAG). The Mann-Whitney-test was applied to the data to detect significant differences in MPV in patients with different diagnosis. II.: In 33 patients with well controlled intraocular pressure (10 OH, 23 POAG) a long-term follow-up of visual fields was carried out after measurement of the MPV. The Mann-Whitney-test was used to determine significant differences in MPV in eyes with and without deterioration of visual fields.

Results: I.: Comparing healthy eyes and OHs the MPV was significantly higher in OHs. Therefore an increase in optic disc pallor seems to be an early pressure-induced disc change and might precede a significant increase in cup-disc ratio (CDR) or detectable visual field defects. II.: The long-term follow-up of visual fields revealed an increase in visual field loss in 5 out of 33 patients (1 OH, 4 POAG). The eyes with a tendency to deteriorate had a higher MPV at the beginning of the observation period compared to the eyes without deterioration. A high MPV might be a risk factor for visual field decay.

Conclusions: Changes in MPV in glaucoma patients could give important indications for progressive disease but there are difficulties to be overcome for a meaningful evaluation of the optic disc pallor in longitudinal studies, e.g. changes in lens opacity. Therefore these pallor values seem to be useless for long-term follow-up.

VALIDATION OF A RISK MODEL FOR GLAUCOMATOUS FIELD LOSS:
56) APPLICATION TO STANDARD AUTOMATED PERIMETRY AND SWAP

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Hart et. al. (Arch Ophthalmol, 1979, 97: 1455-58) have developed a retrospective risk model for development of glaucomatous visual field loss in ocular hypertensives that incorporates four factors: IOP, vertical cup-to-disc ratio, age and family history of glaucoma. Kolker et. al. (Invest Ophthalmol Vis Sci ARVO Abstract, 1990, 31: 502) prospectively evaluated this model in a different group of ocular hypertensives. The purpose of this investigation was to determine the validity and generalizability of this risk model by examining our longitudinal data set for 254 ocular hypertensive patients (468 eyes). Over a four year time period 25 eyes developed confirmed glaucomatous visual field loss as determined by standard automated perimetry. Risk probabilities were calculated from baseline data using the Hart model. Of the 25 eyes that converted in the study period, 6 (24%) were low risk, 10 (40%) were moderate risk and 9 (36%) were high risk. In the non converting group 50% were low risk, 25% were moderate risk and 25% were high risk. A χ^2 analysis showed this difference to be statistically significant. We also performed our own multivariate logistic regression using the same four risk factors. Our coefficients for each risk factor were quite similar to those obtained by Hart et. al. The model was also found to be applicable for SWAP results obtained in these patients. Our findings strongly support the validity of the Hart model for risk of developing glaucomatous visual field loss in ocular hypertensives.

57) THE ROLE OF RAISED INTRAOCULAR PRESSURE IN THE DEVELOPMENT OF
GLAUCOMATOUS OPTIC NEUROPATHY.

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From the database of patients attending the glaucoma clinic between 1989 and 1995, we identified 18 patients (21 eyes) in whom the characteristic visual field and optic disc changes of glaucoma had developed from normal. Change from normal to glaucoma was associated with the following features:-

- 1) Intraocular pressure: converting eyes were equally likely to be normotensive (10 eyes) as hypertensive (11 eyes).
- 2) Disc changes: acquired pit of the optic nerve and/or disc haemorrhages occurred in all but 2 eyes.
- 3) Visual field loss: localised paracentral scotomas developed in 17 eyes and isolated nasal steps alone in 4 eyes.

The pattern of optic disc damage and visual field loss seen in both ocular hypertensive and normotensive patients was most commonly that characteristic of the glaucomatous changes associated with low tension glaucoma. 81% of eyes in the series converting to glaucoma had long term intraocular pressure control of 21 mmHg or less indicating that raised IOP may be less important than other undefined factors in the pathogenesis of glaucomatous optic neuropathy.

INFLUENCE OF CARTEOLOL ON THE VISUAL FIELDS
OF PATIENTS WITH NORMAL TENSION GLAUCOMA

58)

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<PURPOSE> The purpose of this study is to investigate the effect of carteolol on the central visual fields of patients with normal tension glaucoma. <METHOD> In a age matched case-control prospective fashion, 22 eyes of 22 patients with Normal-tension glaucoma were randomly assigned to carteolol hydrochloride 2% or unmedicated control group. Intraocular pressure and central visual field (Humphrey central 30-2 Program) were measured at baseline and every 3 months. The data were statistically compared between 2 groups. <RESULTS> The progression of the Corrected Pattern Standard Deviation was statistically less pronounced in the Carteolol group than that in control group. <CONCLUSION> Carteolol is considered to be effective in inhibiting localized deterioration of the visual field.

59)

IS CALIBRATED TRABECULECTOMY HARMFUL TO VISUAL FUNCTION?

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Purpose. Deterioration of visual function, even loss of function ('snuff out') is a well-known side-effect of trabeculectomy. We wanted to study this effect by quantitative analysis of visual function in a larger group of patients. **Methods.** 65 eyes of 51 patients with chronic glaucoma and various degrees of damage underwent trabeculectomy. The method of calibrated trabeculectomy [1] was applied to avoid excessive pressure drop and prolonged hypotony as well as hypertony. Visual acuity and visual fields (Humphrey programs 30-2 or 10-2, resp) were determined before and 4 to 15 weeks after surgery. **Results.** One patient had a shallow AC without corneal touch, all others maintained a deep AC. After 3 months, the mean visual acuity (logarithmic scale) had improved by 0.4 log units (significant). No eye lost more than 2 lines. The visual field improved at the average by 0.11 dB (index MD, not significant). The range of differences was -5.9 dB to +8.0 dB. The standard deviation of differences was 2.4 dB which is in the range of long-term fluctuation in glaucoma. There was no case of excessive change in function. The worst case had a temporary drop of visual acuity from 0.3 to 0.1 due to bleb failure, but recovered in the following months after re-trabeculectomy with Mitomycin C. **Conclusion.** Calibrated trabeculectomy seems to be a safe method with regards to the short-term preservation of visual function.

[1] Weber J. Controlled trabeculectomy by intraoperative tonometry. Invest Ophthalmol Vis Sci 36:S20, 1995

60) **A CORRELATION BETWEEN DIFFERENT TYPES OF VISUAL FIELD DEFECTS AND NERVE FIBER BUNDLE DEFECTS. A COMPARATIVE STUDY PERFORMED BY AUTOMATIC PERIMETRY AND LASER SCANNING TOMOGRAPHY.**

((R.Sampaolesi & J.R.Sampaolesi)) Department of Ophthalmology, School of Medicine, University of Buenos Aires, Buenos Aires, Argentina.

Visual field performed with Octopus perimeter and Optic Disc Tomography, performed with Heidelberg Retina Tomograph where used to evaluate 300 patients with glaucoma and pre-perimetric glaucoma, and 100 voluntary normal people were taken as control group. Visual Field parameters used in this study were MD, CLV, and RF as an exclusion criterion when it's value was bigger than N=10. Most parameters of HRT stereometric analysis were used, both reference plane related or not. Each report is a mean of 3 examinations with STD < 30. HRT was used with soft.version 1.11, with the new standard reference plane. The aim is to compare different types of visual field defects with different parameters to find which of those are in correlation with visual field defects.

61)

**CALCULATION OF A GLAUCOMA PROGRESSION RISK INDEX (GPI).
E. Gramer, G. Althaus, University Eye Hospital, Würzburg, Germany**

Purpose: Development of a formula for calculation of a glaucoma progression risk index (GPI) to identify already at the *first* visual field (VF) examination whether a patient with primary open angle glaucoma (POAG) and regulated intraocular pressure (IOP) is at risk for further VF-deterioration.

Methods: A long term follow up of 109 patients with POAG and regulated IOP was performed with Octopus program 31 or 33, using program Delta for determination of deterioration. Mean visual fields at the beginning and at the end of the observation period were compared. By means of a multiple regression analysis we calculated, which of the following parameters were the best predictors for deterioration of VF: maximum IOP, systolic blood pressure, cup-disc ratio, preexisting VF-damage (total loss in VF, mean loss per testpoint in the upper and lower hemifield, mean scotoma depth). The diagnostic code was set to 1 for deterioration and 2 for preservation of VF.

Results: The systolic blood pressure was found to be the most important risk factor for VF-deterioration followed by the preexisting VF-damage and the maximum IOP without therapy. By means of a formula these 3 risk factors are summarized in a dimensionless GPI-value, allowing a scoring of these 3 risk factors in summary. In 29 eyes with VF-deterioration we found more often a smaller GPI value compared to 80 eyes without further VF-deterioration.

Conclusion: A glaucoma specific pattern (GG-program) and the prognostic message of the GPI may improve the expressiveness of the initial VF-examination for determination of the individual therapeutic IOP-level.

VII. Perimetric Techniques June 7, 1996 10:00 - 11:36 AM

USE OF CENTRAL 10 DEGREES THRESHOLD MEASUREMENTS
FOR DESCRIPTION OF VERY EARLY GLAUCOMATOUS FIELD DEFECTS
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In our clinic for ocular hypertension and glaucoma patients we noticed that sometimes the central 10 degree visual field seems to show an early glaucomatous defect more clearly than the 30 degree field.

We examined retrospectively patients with ocular hypertension, a suspect disk, or early glaucoma. Included were those patients who had no or early defects according to the classification of Aulhorn and Greve, and who had both 30-2 and 10-2 Humphrey Field Analyzer fields performed. A total of about 750 patients with 1000 fields were eligible. Fields were then judged with the criteria described by Hodapp et al to identify accepted early defects. The upper and lower halves were judged separately.

Ten patients were scored as "no defect" on the 30+2 field, who showed a nerve fiber bundle defect with the 10-2 program. Five percent showed more severe defects with the 10-2 program.

53)

DOES THE BLIND SPOT ENLARGE IN EARLY GLAUCOMA?

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Introduction: It has been shown previously that in light sense perimetry a scotoma becomes larger when the tested area of the fundus is excavated. We now wanted to investigate whether the blind spot is larger in early "praeperimetric" glaucoma with already deeply excavated optic discs than in normal persons.

Methods: We examined 10 eyes of 6 patients with definitive glaucomatous optic disc cupping but normal visual fields (Octopus G1 program). 10 eyes of 5 normal healthy volunteers, who had a normal central excavation, served as controls. Microperimetry was performed with a Rodenstock scanning laser ophthalmoscope (scotometry program, version 1.51). First, we determined the differential light sensitivity 0.5° - 1.0° outside the disc margins with Goldmann I stimuli. We further examined the horizontal meridian of the optic discs in 0.5° steps using Goldmann size IV 4dB stimuli. Each test point was examined 10 times. If less than 50% of the stimuli were perceived, the test area was considered "blind". We finally determined the thresholds for the largest available stimulus (Goldmann size V) when it was projected on the optic disc center. The optic disc topography was documented with the Heidelberg Retina Tomograph (HRT).

Results: On average, the differential light sensitivities adjacent to the optic discs did not differ between both groups (normal 8.3dB, early glaucoma 8.4dB). Stimuli with higher luminance power (Goldmann IV, 4dB), presented on the horizontal meridian of optic discs with glaucomatous cupping, were seen up to 0.7° centrally (i.e., towards the optic disc center) of the disc margin. In the normal group this distance was significantly greater (1.3°). The light differential thresholds for the Goldmann V stimuli, presented on the disc center, were significantly higher in the glaucoma group (0 ± 2.8 dB) than in the normal controls (6.6 ± 1.3 dB). Horizontal HRT section profiles confirmed a steep, large and deep excavation in the glaucoma group while in the normal controls the excavation was much less pronounced.

Conclusions: This study supports our hypothesis that the size of scotomas not only depends on the receptive function but also on the surface topography of the tested area. Normal discs appear less blind than deeply excavated discs, possibly due to more light scattering by the normal disc surface towards the adjacent functioning retina. Therefore, we believe that enlargement ("baring") of the blind spot in early glaucoma may really exist.

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OPTIMIZING DISTRIBUTION AND NUMBER OF TEST LOCATIONS IN PERIMETRY

64) Keiko Sugimoto, Andreas Schötzau, Mario Zulauf: Univ.-Augenlinik Basel, Switzerland

Purpose: Are short programs useful for glaucoma-screening? The present study investigates the concept of Program G1x, with Octopus 1-2-3, which permits the user to examine few test locations (i.e. 16, 32, 45, or all 59 test locations), thus reducing examination time and possibly fatigue.

Methods: We studied 99 visual fields of glaucomatous or glaucomatous suspect right eyes and compared mean defect (MD) and loss variance (LV) of the global visual field with:

A) MD and LV of the four stages of the G1x program (16, 16, 14 and 13 test locations).

B) MD and LV of stages newly created on the basis of seven publications.

Results: Mean values (MD and LV) and correlation coefficient (r^2) of 99 visual fields studied:

	stage 1	stage 2	stage 3	stage 4	new stage 1	new stages 1+2	stages 1+2	all stages
MD [dB]	-0.17	0.34	0.47	1.04	0.42	0.29	0.08	0.40
LV [dB ²]	9.44	14.29	11.03	15.19	15.75	14.09	12.02	13.01
r^2 MD all	0.90	0.96	0.96	0.90	0.96	0.98	0.96	1.00
r^2 LV all	0.81	0.77	0.71	0.67	0.85	0.94	0.86	1.00

Stage 1 underestimates the visual field damage present in the entire field. The newly created stages revealed higher correlations with MD and LV and picked up more defects.

Conclusions: The results discourage the use of only the first stage (16 test locations) of program G1x. At least 32 test locations are recommended, i.e. stage 1 and 2. A prospective study is required to evaluate the definite validity of the newly created stages concerning sensitivity and specificity.

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65)

FUNDUS ORIENTED PERIMETRY (F.O.P.) – A NEW CONCEPT INCREASING EFFICIENCY OF VISUAL FIELD EXAMINATION

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This new method (patent pending) uses a digitized fundus image of the tested subject as a basis for "construction" of an individual grid of perimetric stimuli. The fundus image is downloaded from data carrier (diskette, Photo-CD,...), depicted on a control monitor and mirrored if necessary with the help of a novel software. Assuming central fixation, the foveola of the fundus image is aligned to the center of the perimetric field using a cross hair. In a second step, the blind spot, which has been previously determined by means of kinetic perimetry, is interactively superimposed onto the optic disk of the fundus image by automatic activation of rotary and zoom routines. This method allows a direct adaptation of the perimetric procedure to the individual fundus morphology. I.e.: stimuli may be individually condensed or repeatedly presented in regions of special morphological pathology (nerve fiber bundle defects,...). On the other hand, test points can be removed from locations of reduced evidence (e.g. blood vessels). Preliminary results of this new technique are demonstrated: in order to prove its precision, this method was used to detect angioscotomas in normal test subjects. Additionally, the advantages of a locally condensed test grid for detection and precise evaluation of photographically documented nerve fiber bundle defects is demonstrated.

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IS RAPID ASSESSMENT OF THE VISUAL FIELD IN GLAUCOMA USING MULTIPLE CORRELATIONS USEFUL? AN EVALUATION OF DELPHI PERIMETRY.

66)

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Patients with glaucoma or ocular hypertension underwent Humphrey visual field analysis (HVFA) with programme 24 -2 and also Delphi perimetry, which uses multiple correlations and linear regressions to produce a statistical estimation of the visual field in glaucoma from a determination of the sensitivities of 4 critical points of the visual field. The extent, defect depth and location of any field loss identified by Humphrey visual field analysis was compared to the decibel maps and mean scotoma probability maps of the Delphi fields. 259 eyes of 196 patients were studied. Of these HVFA showed glaucomatous defects in 120 eyes and normal fields in 139 eyes. The sensitivity for the detection of glaucomatous visual field loss by Delphi perimetry was 78% and the specificity for the test was 91%. However, Delphi perimetry consistently failed to detect glaucomatous field loss that was confined to the paracentral area and small nasal steps. 26 eyes with such defects were classed as normal by Delphi perimetry and in a further 27 eyes, Delphi perimetry although abnormal, failed to predict central visual field loss that posed a threat to fixation. Delphi perimetry has reasonable sensitivity and specificity for a rapid method of detecting glaucomatous visual field loss, but its inability to detect central visual field loss is a severe draw-back. The addition of two more critical points above and below fixation and the use of a larger data-base of glaucoma patients for the statistical estimation may improve its usefulness.

67)

EVALUATING THE DELPHI SYSTEM FOR RAPID ASSESSMENT OF VISUAL FUNCTION USING THE HUMPHREY PERIMETER

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Purpose. Comparing Delphi perimetry with Humphrey 30-2 visual fields in an age-related controlled group and individuals with early, moderate or severe open angle glaucoma. Evaluating the Delphi perimetry as a useful screening test for glaucoma. **Methods.** Thirty one eyes of patients with glaucoma and eight eyes of age-related subjects with no history of ocular disease were evaluated using both the Delphi perimetry and the Humphrey 30-2 visual field. Using the Hodapp, Parrish, Anderson criteria 5 out of the 31 glaucoma eyes were classified as having early glaucoma, 10 were classified as moderate and 16 classified as severe. **Results.** There were strong correlations between Humphrey mean (MD) versus Delphi MD ($R=.75$) and Humphrey CPSD versus Delphi MD Scotoma Probability ($R=.84$). Using a specificity cutoff greater than 3 S.D($3x.43$) from the mean MD Delphi Scotoma Probability of the control group (.35), sensitivity for detecting all grades of glaucoma was found to be 74%. Sensitivity for detecting severe glaucoma was found to be 94%, with a specificity of 100% in either subset. A testing period of 1.1 minute per eye was required for Delphi perimetry compared to 15.6 minutes required for the Humphrey 30-2 visual field test. **Conclusion.** With its apparent high specificity for glaucoma detection, there would appear to be considerable potential for the Delphi being used as a rapid diagnostic screening tool for glaucoma. Although the Delphi takes 1/15 the amount of time required to perform a full-threshold Humphrey 30-2 visual field, there are strong correlations between the tested Delphi and Humphrey global indices.

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ACCURACY OF THE TENDENCY ORIENTED PERIMETRY (TOP) IN THE OCTOPUS 123 PERIMETER (68) M. GONZALEZ DE LA ROSA, A. MARTINEZ, L. CORDOVES, M. LOSADA. Univ. La Laguna. Spain

Introduction : Using the TOP algorithm each test point is examined only once. The patient's response is used to calculate the threshold in the specific test location and in the adjacent area, conditioning the intensity of the following stimuli. The test point that has been already examined is also influenced by the surrounding test area, when examined posteriorly

Material and Methods: 52 eyes of 42 patients (mean age 54.1 years, s.d. 18.9; 29 males, 23 females, mean DM 10.06 dB, s.d. 7.47) with different diagnostics and defect levels (12 normals, 22 glaucomatous, 8 neuropathies, 10 chorioretinal lesions), were examined with the TOP and the 32 programs in the Octopus 123 Perimeter.

Results: With the TOP program the MD values were 1.65 dB higher, as an average, than the values obtained with the program 32. Upon comparing the resultant values of the total MD, MD of each square, LV and the individual threshold values, the resulting table was obtained:

M D		MD (SN)		MD (IN)		MD (ST)		MD (IT)		L V		Thresholds	
r	e.e.	r	e.e.	r	e.e.	r	e.e.	r	e.e.	r	e.e.	r	e.e.
0.96	1.95	0.96	2.51	0.94	2.76	0.92	2.80	0.96	2.09	0.91	11.96	0.84	5.38

r. correl. coeffic. e.e.: error of estim.

Conclusions: The TOP algorithm produces comparable results to those obtained with the conventional bracketing strategy and it takes only one fifth or one sixth of the time. With the TOP program the threshold obtained are slightly higher than with the 32 one, in a similar proportion to the known threshold reduction due to the "fatigue effect" during long examinations.

69)

EVALUATION OF A NEW INTERACTIVE THRESHOLD STRATEGY IN NORMAL SUBJECTS
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At the 1994 IPS meeting we presented a new family of advanced interactive algorithms developed to achieve the same high performance characteristics as today's most accurate threshold measuring strategies, but using considerable reduction of test time. We have now compared the results of one such strategy with those obtained with the Full Threshold and Fastpac strategies of the Humphrey perimeter. The results from 30-2 from 20 eyes of 20 normal subjects were evaluated in terms of test-retest variation (MSE) and test time. Mean MSE for the new algorithm was 1.59 dB², significantly lower than with Fastpac (p=0.006; average MSE = 2.61dB²). The mean MSE for Full Threshold was 2.12dB², not significantly different from the new algorithm (p=0.131). Average test time of our new algorithm was 6 min 16 sec, which was significantly shorter than with Full Threshold (p<0.0001; average: 12 min 21 sec) and Fastpac (p=0.001; average: 7 min 17 sec). The new interactive strategy gave the same high performance quality as Full Threshold, but attained a 50% reduction of test time. The advantages as compared to Fastpac are obvious.

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A NEW STRATEGY FOR AUTOMATED PERIMETRY

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We present our new strategy "ZAPP" for automated perimetry in which threshold determination is based on a mean likelihood algorithm derived from QUEST (Watson and Pelli, 1983) and ZEST (King-Smith et al., 1994). Our psychometric functions use age-dependent parameters specified for each grid point which were derived from a recent normal value study. During the first phase of the examination only a selected number of locations is tested to determine optimum starting values for the threshold algorithm by estimating individual thresholds for the entire visual field by means of two-dimensional polynomials (Humpert and Witte, 1989).

Using a computer graphic system with a high-resolution 21" monitor for stimulus presentation in the central visual field up to 30° eccentricity this new method is compared to a standard 4/2 dB full threshold strategy. A preliminary study including 20 subjects (10 normals, 10 patients) showed a statistically significant reduction of 7.9% in the necessary number of presentations with the new strategy (normals: 6.4%, patients: 9.1%). A mean difference in mean sensitivity ($MS_{4/2} - MS_{ZAPP}$) of -1.04 ± 0.83 dB (median -0.76 dB) was found (normals: -1.05 dB, patients: -1.02 dB).

Our new strategy requires significantly less stimuli presentations than commonly used perimetric strategies to obtain comparable threshold values. Data based on a larger sample and results from simulation studies using a computerized patient simulator will be presented.

A. B. Watson, D. G. Pelli *Perception & Psychophysics* 33:113-120, 1983; P. E. King-Smith et al. *Vision Res.* 34:885-912, 1994; A. Humpert, F.-O. Witte *mc* 108-114, 1989

This study has been supported by the German Research Foundation (grant La 517/6-1, 6-2, 6-3).

71)

TWO DIFFERENT TECHNIQUES OF INQUIRING ANSWERS IN AUTOMATED PERIMETRY

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Subjects and methods: So far, all computer perimeters use the same technique of inquiring the patient's answers: the tested person is asked to press a button, if the stimulus is perceived; in case of no response within a specific time period, the stimulus will be rated as not seen (yes-time-out-method). In this study, additionally, an alternative method was used: Subjects have the choice to answer by pressing a "yes"- or "no"-button after each stimulus presentation (forced yes-no-method). The luminance difference sensitivity (lds) for bright stimuli (32 γ) was evaluated at 26 test locations within the central 30° of the visual field using a computer monitor and a modified 4/2-staircase-strategy (6 reversals). 61 healthy subjects (aged 20-30 years) were examined on two days with both methods. Threshold estimation was performed by the method of maximum-likelihood.

Results: The lds-thresholds with the forced yes-no-method lie on average 0.11 dB above those measured with the yes-time-out-method - a statistically significant, but clinically not relevant difference. Retest-reliability did not differ significantly between both methods. However, the forced yes-no-method results in a higher number of wrong answers to catch trials ($p < 0.05$, Wilcoxon signed-rank test for the differences).

Conclusion: Compared with the conventional yes-time-out-method, the forced yes-no-method shows no relevant differences of the lds-thresholds and retest-reliability. Concerning the responses to catch trials as an index for correct answering, the forced yes-no-method shows minor performance.

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DISCRETE STRATEGIES IN PERIMETRY

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A common but frequently neglected problem in perimetry results from the discrete set of possible stimulus intensities due to the physical circumstances. In electronic campimetry, this discretisation depends on the restricted number of shades of grey which can be presented by the graphic board. In the region of interest – close to the threshold –, often only few intensities are available. Therefore, the values demanded by the strategy have to be replaced by the really presentable luminances. This problem raises the question whether this modification impairs the quality of threshold estimation. To answer this question, computer simulations employing a logistic regression model for the binary response were conducted to determine the mean squared error of threshold estimation for a 4-2-1 strategy (used by the Tübingen Computer Campimeter, TCC) supposing both an ideal situation with infinite resolution and a real situation with several given resolutions. The simulation results indicate that there is no relevant worsening of the estimation even comparing a simple 24-bit graphic board (256 shades of grey) with the ideal screen (continuous greyscale). Nevertheless, this result is due to the fact that such a strategy is not an uniformly optimal procedure. An optimized strategy must be affected by the resolution of the graphic board. To demonstrate this, we also calculated the a-posteriori mean squared error of threshold estimation using a Bayes-strategy and taking into account prior information. In this case, a higher resolution uniformly improves the threshold estimate.

73)

PUPIL PERIMETRY WITH THE OCTOPUS 1-2-3

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Pupil perimetry was performed in normal subjects, glaucoma patients and patients with homonymous hemianopsia. The amplitude of pupil constriction was determined in 10 normal subjects in the upper nasal field on the 135° meridian using the stimulus sizes of 3 and 5, stimulus intensities of 0 (4000 asb), 2, 4, 6, 8 and 10 dB, background luminances of 0 and 3 asb and the stimulus duration of 200 msec. The amplitude of pupil constriction was also measured in the same test points of Octopus program No.38 using the stimulus size of 5, the stimulus intensity of 6 dB (approximately 1000 asb), the background luminance of 3 asb and the stimulus duration of 200 msec.

It was found that the intraindividual variation of the amplitude of pupil constriction was considerably large. Under the background luminance of 3 asb, the stimulus size of 5 and the stimulus intensity higher than 6 dB were needed to assure the dynamic range large enough for pupil perimetry in the central 30° visual field. It was, however, impossible to detect small scotomata under the above-mentioned conditions. It was confirmed that test locations whose amplitude of pupil constriction was found decreased were those of the decreased sensitivity in differential light-sense perimetry.

74)

AGE, GENDER, AND TEST LOCATION IN PUPIL PERIMETRY

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Purpose. To study the effect of age, gender, and eccentricity of the test location on pupil perimetry in normals.

Methods. Pupil perimetry was performed on sixty normal healthy volunteers with Octopus 1-2-3. The following stimulus parameters were chosen: stimulus size 5, stimulus intensity 1632 cd/m², background illumination 0 cd/m², stimulus duration 200 milliseconds, and interstimulus time 3 seconds. Seven parameters of the pupillary light reflex (PLR) were calculated: velocity of contraction, reaction time, pupillary contraction time, implicit time, pupillary diameters before and after contraction, and amplitude. Age, gender, and test location (= independent variables) were investigated by analysis of variance (ANOVA).

Results. No significant three-factor interactions were observed among the independent variables. A two-factor interaction between age and gender was observed on the three parameters, latency time, duration of contraction, and implicit time, i.e. the age effect was more pronounced in males than in females. All parameters, except pupillary diameter before contraction, showed a significant main effect for test location. All parameters showed a significant main effect for age and gender, i.e. younger persons and males had stronger PLR, shorter pupillary reaction time, and higher velocity of contraction, slower contraction time and implicit time were observed in male and older persons.

Conclusions. In pupil perimetry, gender is differentially influenced by age in pure time parameters, i.e. reaction time, contraction time, and implicit time.

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VIII. Reliability, Artefacts and Instruments June 7, 1996 1:30 - 2:42 PM

75) **NECESSITY OF SUPERVISION DURING HUMPHREY PERIMETRY**

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It is generally acknowledged that patient performance on computerized perimetry improves with active, continuous technician involvement, but this is an expensive requirement. This study asked two questions: (1) What patient characteristics predict the need for technician supervision? (2) Does the HFA II require less supervision than the HFA I?

200 consecutive patients undergoing Humphrey perimetry for glaucoma, glaucoma suspect, or neuro-ophthalmic indication were randomly assigned to standard 30-2 full threshold testing with either HFA I (model 640) or HFA II (model 750). After orientation to testing and a brief supervised trial, one eye of each patient underwent in random order a supervised test and an unsupervised test separated by 15 minutes rest. Excluded eyes were those with MD over 15 dB or visual acuity worse than 0.3.

As expected, supervision improved average reliability parameters and mean defect, but the improvement was observed only in some patients. Correlation with age, prior visual field testing, patient well-being self assessment, but not with educational level was observed in this population. Continuous supervision was less necessary during testing with HFA II. The authors have no proprietary interest.

76)

FALSE-POSITIVE PEAK OF THE BEBIE-CURVE AS A RELIABILITY PARAMETER

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Purpose: To develop a reliability parameter based on the left-side elevation of the Bebie curve observed in subjects with positive responses to catch trials.

Materials and Methods: The parameter, 'false-positive peak' (FPP), was developed on 528 visual fields (G1, 59 points, first phase, Octopus 201) of both eyes of 138 healthy volunteers. Of the mean defect of the six highest ranks of the Bebie curve (10%), the defect value of rank 15 of the Bebie curve (percentile 25) is subtracted to account for diffuse damage. The difference between ranks 18 and 12 is a safety measure of FPP. Clinical validity of FPP was tested on a second set 290 similar visual fields of 58 glaucomatous eyes of 29 subjects.

Results: FPP averaged 2.35 dB (0.3 - 11 dB), the safety measure of FPP averaged 0.68 dB (0-2 dB). FPP correlated with the number of 'false-positive responses' (FP: $r^2=0.34$; $p<0.001$). Mean FPP of each eye correlated with the long-term fluctuation ($r^2=0.47$; $p<0.001$). Compared with FP, FPP of each eye correlated on average higher with the index loss variance (LV: $r^2=0.35$ and, $r^2=0.26$, respectively; $p<0.05$; Wilcoxon). The differences for the correlation coefficients of FP and FPP with the index, mean defect (MD), was insignificant. ($r^2=0.29$ and, $r^2=0.23$, respectively; $p<0.1$, Wilcoxon).

Conclusions: The 'false-positive peak' is a reliability parameter supplementing the 'false-positive responses' to catch trials requiring no additional test time.

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77) FIXATION CONTROL FOLLOWING REPEATED MACULAR THRESHOLD MEASUREMENTS

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The macular thresholds of a laser operator was studied before and after all-green (532 nm) photocoagulation. The macula threshold program of the Dicon AP 2000 perimeter determines sensitivity of the macula by thresholding 14 point along the vertical and horizontal axis. The center points are the same in both axis. One retinal specialist (H.T.) was repeatedly tested.

According to our standards, fixation was right, if no significant difference was found with the one sample t test between two average values of the meridians central points.

Mean sensitivity of the left horizontal meridian decreased significantly ($p=0.05$) - 1.38 ± 2.08 dB half hour after treatment. Vertical mean sensitivity on this eye was also decreased - 0.91 ± 1.27 dB ($p=0.05$).one hour after treatment.

This method is suitable to investigate macular threshold change, and to detect early reversible light induced damage.

78)

THE INFLUENCE OF TARGET BLUR ON PERIMETRIC THRESHOLD VALUES IN
AUTOMATED LIGHT-SENSE PERIMETRY AND FLICKER PERIMETRY

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Purpose : To study the influence of refractive defocusing and artificial media opacities on perimetric threshold values in light-sense perimetry and flicker perimetry.

Subjects and methods : Fifteen eyes of 15 normal subjects and 15 eyes of 12 glaucoma patients were examined by both light-sense perimetry and flicker perimetry using various degrees of refractive defocusing and artificial media opacities. Perimetric threshold values were determined in normal subjects by the addition of spherical plus lenses of +2, +4, +6, +8 and +10 diopters and occlusion diffusers of densities of 1.0, 0.8, 0.6, 0.4, 0.1 (Ryser, Switzerland). Glaucoma patients were tested with an occlusion diffuser of density of 0.1. Light-sense perimetry was performed using SARGON and No.32 programs of the Octopus 201. Flicker perimetry was performed using the Octopus 1-2-3 and its remote software package with our own programs. Above-mentioned examinations were performed using the target size 3.

Results : The diffuse sensitivity loss was detected by light-sense perimetry when additional spherical plus lenses and occlusion diffuser were used. However, there was no significant sensitivity loss when flicker perimetry was performed under the same conditions.

Conclusion : Flicker perimetry is less influenced by refractive defocusing and artificial media opacities than light-sense perimetry.

THE SENSITIVITY LOSS BY FALSE CORRECTION GLASSES: MULTIPLE INFLUENCING FACTORS ARE FOUND IN GLAUCOMA PATIENTS

79)

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Purpose. False correction glasses cannot be avoided in every-day practice. The estimation of its effect on sensitivity could be an important help for the clinician. Up to now, only rules of thumb based on the examination of normals are available. We wanted to study the effect in normals and glaucoma patients and with different stimulus sizes. **Methods.** 10 eyes of 10 glaucoma patients and 5 eyes of 5 normals were examined with stimulus sizes I, III and V using a Humphrey Field Analyzer and a custom program with 8 points. The examination was done repeatedly with right correction and overcorrection of +2 dpt, +4 dpt, +6 dpt and +10 dpt. **Results.** Considering mean values, the sensitivity loss depended nearly linear on wrong correction. In glaucoma, stimulus size 1 and 3 lost 0.7 db per diopter. For stimulus size 5, the effect was only 0.2 dB per diopter. In normals, the effect tended to be higher. Considering single points of single patients, the miscorrection effect ranged from 0.1 to 1.2 dB. It mainly depended on the initial sensitivity ($R > 0.6$ in all groups): the higher initial sensitivity was, the more sensitivity was lost. This correlation also explained the differences between normals and glaucoma in the mean value analysis. For same initial sensitivity, stimulus size I showed the highest and stimulus size V the lowest miscorrection effect. **Conclusion.** Multiple factors have to be taken into account to estimate the effect of miscorrection.

80)

EFFECT OF DISLOCATED AND TILTED CORRECTION GLASSES ON PERIMETRIC OUTCOME – A SIMULATION USING RAY TRACING

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Adequate correction is an essential prerequisite for precise perimetry. Thus, not only the correct glasses have to be chosen but also their positioning should be done carefully. Otherwise a distortion of the stimulus raster as well as a (area enlarging) distortion of the stimuli themselves can occur. Therefore, scotoma may be simulated in visual fields, which are purely optically evoked (refraction scotoma), because the light stimulus is mapped on an enlarged retinal area thus reducing light density.

Ray tracing algorithms are capable of simulating quite realistically the optical properties of the human eye and additional optical correction (glasses, IOL, contact lenses, etc.). Based on an improved Gullstrand eye model the path of light rays is calculated through the refractive media obeying Snellius' law. As an example we have calculated the effect on the mapping of a stimulus raster of the Tübinger automatic-perimeter (TAP).

E. g., both changes in size and spatial translation of the blind spot in myopic/hyperopic patients can be demonstrated. Furthermore, it is possible to visualize the influence of tilted and vertically/horizontally dislocated correction glasses.

Ray tracing is a useful tool for visualization and analysis in ophthalmological research. Therefore, it may contribute to a better understanding of the effects of optically caused mapping errors on perimetric results.

81) APPARENT GLAUCOMATOUS VISUAL FIELD DEFECTS CAUSED BY DERMATOCHALASIS

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Purpose: To quantify the effect of dermatochalasis on the central visual field and thus to assess the potential of this common upper lid abnormality to confound diagnostic perimetry in glaucoma.

Method: We identified a series of ocular hypertensive patients with dermatochalasis who demonstrated reproducible central field loss by Humphrey automated perimetry program 24-2. We confirmed dermatochalasis as the cause of the field loss by demonstrating reversal following taping up the upper lid or blepharoplasty. **Results:** Central field loss due to dermatochalasis was identified in 12 eyes of 7 ocular hypertensive patients. All demonstrated restriction of the superior field, most marked in the temporal field of 10 eyes and in continuity with the blind spot in 5 eyes. Extension of the defect below the horizontal meridian was seen in 4 eyes. The average mean deviation was -5.88dB and average mean sensitivities were reduced at all points including fixation in the superior vertical meridian. The degree of depression increased with eccentricity from fixation.

Conclusions: Dermatochalasis causes more marked restriction of the superior central field than equivalent ptosis. Consequently cosmetically mild dermatochalasis may cause marked central field defects which may confound diagnostic perimetry in glaucoma.

82)

FITTING ANGIOSCOTOMAS

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Since angioscotomas may introduce a nuisance effect in visual field examination their description is an important but difficult task in perimetry. Using a special perimetric grid, thresholds can be estimated along a line of test points crossing the supposed angioscotoma. Due to the restricted number of stimulus presentations the estimated values seem to be rather busy. A two-stage analysis which employs these single estimations to fit a threshold curve turns out to be misleading. An appropriate model should incorporate the threshold as a function of position into the probabilistic description of the binary response (stimulus seen/not seen). A special function based on hyperbolic tangents is proposed, the parameters of which describe depth, position and width of the angioscotoma and can be estimated by the method of maximum likelihood.

As an example we present the evaluation of data collected from 13 ophthalmologically normal subjects with the Tübingen Computer Campimeter (TCC) using bright stimuli (12'). In subjects with detectable angioscotoma we found scotoma depths between 1 dB and 8 dB.

THE TRANSFER OF PERIMETRIC EXPERIENCE FROM THE FIRST EXAMINED EYE TO THE COUNTER EYE IN PATIENTS WITH GLAUCOMA

83)

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Objective: To evaluate the transfer of perimetric experience in visual field tests from the first examined eye to the counter eye in glaucoma patients.

Methods: 212 visual field test (program G1, Octopus 500) of 53 glaucoma patients were evaluated. No patient had previous perimetric experience. All patients had bi-lateral glaucoma. The right eye was the first tested eye. Each patient had his second visual field test within one month after the first test.

Results: In all first tested eyes (right eyes) the visual field improved- mean improvement of mean defect 1.76dB ($p < 0.001$). In 35 (66%) of the second tested (left eyes) the visual field improved - mean improvement of mean defect 0.52dB (not significant). The difference in improvement between the first tested and second tested eyes was significant ($p < 0.001$).

Conclusions: Already, in the first visual field test is a positive transfer of experience from the first to the second eye.

COMPARING HUMPHREY VISUAL FIELD AND CONTRAST SENSITIVITY CHANGES DURING CO₂ SUPPLEMENTATION AND HYPERVENTILATION

84)

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Purpose. Comparing changes from baseline in Humphrey 10-2 mean deviation (MD) and contrast sensitivity (CS) while breathing CO₂ enriched air or hyperventilating. **Methods.** Twelve normal subjects were first evaluated at baseline, while inhaling a mixture of 5% CO₂ and synthetic air, and while hyperventilating room air (attaining +15% and -15% shifts in end-tidal CO₂). A 10- 2 central, full threshold visual field was performed on each subject at each condition using a Humphrey Field Analyzer model 750. CS was also measured in the same subjects under like conditions on a different day using the NeuroScientific 2 alternative forced choice at 1 and 4 cycles per degree, (cpd) at 7.5 Hz. The results were analyzed using paired 2- tailed t-test. **Results.** The difference in MD values between CO₂ supplementation and hyperventilation is significant ($p < 0.02$) (see figure). The difference in CS mean values at 1 cpd, between the conditions of baseline and hyperventilation and the difference between CO₂ supplementation and hyperventilation were significant ($p < 0.01$ and $p < 0.05$) (see figure) but neither showed significance at either condition on 4 cpd. The changes observed were independent of IOP, which increased during CO₂ breathing and decreased during hyperventilation. **Conclusion.** Visual function differences not attributable to IOP exist during hyper- and hypocapnia, and are both detected by 10-2 threshold perimetry and contrast sensitivity at 1 cpd/7.5 Hz. Supported by Merck Research Laboratories and Humphrey Zeiss.



VIII. Reliability, Artefacts and Instruments June 7, 1996 1:30 - 2:42 PM

CLINICAL EVALUATION OF HFA II(MODEL 750) IN GLAUCOMA PATIENTS

- 85) Aiko Iwase, Kazumasa Okada, Tetsuya Yamamoto, Yoshiaki Kitazawa, M.D.
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The new model of Humphrey Field Analyzer (model 750) is the compact, having a non-spherical bowl and the same program as does the standard model 600 series (HFA I). It has been reported that the results obtained with model 750 are not significantly different from those by the standard model. We attempted to evaluate features of the new model and compare the results of the two both models. Thirty eyes of 30 glaucoma patients and 10 eyes of 10 ocular hypertension patients were tested by both models using central 30-2 program. All had the stable IOP and reproducible visual fields with high reliability factors when examined with a HFA I. Three eyes (0.75%) showed the poor reliability factors in HFA II and 7 eyes (17.5%) were judged "low reliability" by the gaze tracking system, the method of the monitoring the direction of the patients' gaze. Between the two model, no significant difference were noted in the threshold of the points in central 24 degree, but the significant difference existed in most peripheral points of the central 30-2 test points. MD and PSD were the smaller in HFA II than in HFA I ($p < 0.01$). The test time was shorter with HFA II than HFA I ($P < 0.01$), The gaze tracking proved to be useful for monitoring fixation closely.

86)

HUMPHREY STATPAC VS DICON FIELDVIEW STATISTICAL ANALYSES. A PILOT STUDY.

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Probability maps facilitate interpretation in perimetry. In glaucoma the pattern deviation map is especially helpful because it filters away any diffuse components added by e.g. media opacities. Maps that are similar in appearance, ARN-delta and HOV-delta (similar to Statpac total and pattern deviation maps respectively), have been developed for the Dicon LD400 perimeter. HFA 30-2 Fastpac and the Dicon 76 point threshold tests were performed in random order in 19 eyes of 19 patients with glaucomatous discs and field abnormalities. In sharp contrast to Statpac, there appeared to be little if any age corrections applied to the Dicon normal values. In one peripheral point an ARN-Delta value of -4dB was highly significant ($P < 0.5\%$) while in one central point a -16dB deviation was non-significant ($P > 5\%$) in contrast with widely published results on physiological threshold variability. The mean number of significant points ($P < 5\%$) was somewhat lower in the Statpac *total* deviation maps than in the ARN-delta maps (39 vs 48). However, in the Statpac *pattern* deviation probability maps the average number of abnormal points (points reaching the $P < 5\%$ limit) was considerably larger than in the HOV-Delta plots (points more than 5dB below expected) (27 vs 17) despite the fact that the latter uses a 5dB limit throughout the field. The results suggest that the Dicon maps may be less sensitive to the localized field loss typically seen in glaucoma. Ongoing analysis in glaucoma patients and in normals will give a better idea of sensitivity/specificity levels.

87)

THREE-DIMENSIONAL MEASURING METHOD OF VISUAL FIELD

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PURPOSE A new measuring method of Vision Island "volume" is suggested.

METHOD A new type of computerized perimeter TTT Pan Visual Field Analyzer has been designed by the authors in China. It can be used to evaluate the "volume" of central visual field (CVF) with Total Greyscal Value (TGV) and measure 30-90 degree peripheral visual field (PVF) with solid angle (SA) in five suprathreshold levels. It can also be communicated with IBM PCs computer to determine light threshold of CVF in dB. The perimetry of 44 cases (72 eyes) of open angle glaucoma were done with TTT.

RESULTS Three-dimensional morphological characteristics of the VF can be shown in greyscale. For example, paracentral scotoma, arch scotoma, central and peripheral nasal step, temporal wedge, etc. The defected TGV of CVF and SA of PVF of each eye can be printed. The percentage of each type of defected VF was discussed.

CONCLUSION SA of PVF and TGV of CVF may reflect VF actual situation, and may be used to evaluate a person's visual working and living ability outdoor and indoor respectively.

88) **MACULAR CONTRAST SENSITIVITY FUNCTION CORRELATES WITH AUTOMATED THRESHOLD PERIMETRY.**

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The relationship between light detection thresholds in the central visual field and the contrast sensitivity function in the macula was studied. A novel pocket contrast sensitivity test which presents patterns with 1 DB steps and a multidirectional spatial frequency of 5 cycles/deg corresponding to peak human spatial sensitivity was used in the macular field. A forced choice method was used to test 214 eyes (108 right, 106 left) of 114 consecutive patients (mean age 55.3 ± 15.8 yrs.) who were taking Humphrey Visual Field Analyser 30-2 test with standard parameters. Regression analysis technique was used to study the correlation between the contrast sensitivity function (CSF) and the field indices of Mean Deviation (MD) and Corrected Standard Pattern Deviation (CPSD) as well as the foveal, parafoveal and average macular light thresholds. Results from both eyes individually as well as interocular differences were determined. Statistically significant correlations between the CSF and average macular light thresholds (MLT) [$CSF=6.20+0.65MLT$; $r=0.53$, $p<0.001$], MD [$CSF=27+0.38MD$; $r=0.42$, $p<0.001$] and CPSD [$CSF=26.1-0.44CPSD$; $r=0.28$, $p=0.003$] were observed. Also, the interocular asymmetry (δ) in macular light thresholds (δMLT) significantly correlated with the asymmetry in contrast sensitivity function (δCSF) [$\delta CSF=0.32 + 0.62\delta MLT$; $r=0.56$, $p<0.001$]. Similar correlations were identified between the interocular differences in Contrast Sensitivity Function and Mean Deviation [$\delta CSF=0.29+0.43 \delta MD$; $r=0.51$, $p<0.001$] as well as CPSD [$\delta CSF=0.38-0.57 \delta CPSD$, $r=0.44$, $p<0.001$]. The results suggest that macular contrast sensitivity testing may predict conventional light sensitivity in the visual field and may be useful in situations where automated threshold perimetry is not possible.

89) **APPLICATION OF VIDEO DISPLAY UNITS FOR CAMPIMETRIC PURPOSES - LUMINANCE CHARACTERISTICS AND CALIBRATION PROCEDURES**

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Video display units (VDUs) render many advantages in campimetric use: in contrast to conventional bowl projection perimeters, presentation of stimuli darker than the surrounding background can be realized.

However, all cathode-ray tubes (CRTs), show an inhomogeneous distribution of luminance, resulting in differences of up to 50%. For campimetric purpose, a homogeneous background luminance is necessary. A new calibration routine, which has been integrated into the software of the Tübingen Computer Campimeter (TCC), yields a homogeneous background luminance with a maximum deviation of 10%. For this, a background image is used, which has been calculated by interpolation of numerous luminance measurements at 48 different locations on the screen. Thus, the quality requirements for perimeters can be maintained.

Additionally, it could be shown, that also the luminance characteristics depend on the location on the screen. For stimulus presentation in campimetric threshold measurements, the luminance characteristics were also interpolated, resulting in an exactly calculated luminance difference at every screen location. By this way, the advantages of VDUs for campimetric purposes can be used without loss of quality in psychophysical examinations.

IX. Psychophysics and Electrophysiology June 7, 1996 3:15 - 3:58

90) SPATIAL SUMMATION FOR SELECTED GANGLION CELL MOSAICS IN PATIENTS WITH GLAUCOMA

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Irregularities in spatial summation have been found in relative defects of patients with glaucoma (Fellman *et al.*, Perimetry Update 1989), possibly due to recruitment of nearby areas that are less defective, or to detection by other ganglion cell types (normally not sensitive enough to play a substantial role) with larger receptive fields. We addressed this issue by studying summation properties within selected ganglion cell mosaics.

In 10 normals and 13 POAG patients, white-on-white (W-on-W), red-on-white (R-on-W), and blue-on-yellow (B-on-Y) thresholds were measured for sizes I, II, III, IV, V in 8 points at 8° and 17°, with at least one point in a relative defect. Cycloplegia and refraction were used to control accommodation. A bilinear function was used to describe the transition (at a critical stimulus area, CSA) from complete summation to probability summation.

R-on-W summation functions typically were very similar to W-on-W in both groups, whereas B-on-Y stimuli summated to much larger sizes. In patients, most locations with clinically elevated thresholds (W-on-W size III) showed abnormally large CSA. Enhanced CSAs were also found *within* selected mosaics, as in the case of the B-on-Y data.

91)

TEMPORAL SUMMATION IN GLAUCOMA

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Temporal summation was carried out on over 50 patients with early glaucoma and normals on the Frisen Ring Perimeter.

Individuals with established glaucoma in one eye and suspicious optic discs in the other, formed the glaucoma group. The eye without visual field defect was chosen for for the testing. In the Normals group, one eye was randomly selected for the testing.

The results indicate that there are statistically significant differences between these two groups of individuals in temporal summation, especially in the high frequency levels.

92) **FLICKER PERIMETRY: OPTIMAL PARAMETERS FOR DETECTION OF GLAUCOMA**

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Flicker perimetry has proved to be valuable in the early detection of glaucomatous visual field damage, but there is little agreement on what combination of luminance, target size and flicker frequency provides maximum discriminability between normal visual field locations and those that are abnormal or at high risk for becoming abnormal. Based on the results of standard automated perimetry (AP) and short-wavelength perimetry (SWAP), we selected specific visual field locations for further testing in two groups of patients: ocular hypertensives and patients with early glaucomatous visual field damage. We tested these locations with targets that varied in luminance (2, 200 cd/m²), size (2, 5, 7.5°) and flicker frequency (2, 8, 16, 32 Hz). These results were compared to the results for normal individuals in the same locations. The lower luminance, larger targets and 8 Hz flicker provided the best combination of reliability, range of response and discriminability between normal and abnormal (abnormal AP and SWAP) or high risk (abnormal SWAP) locations.

93)

FLICKER RESOLUTION PERIMETRY IN GLAUCOMA.

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We developed a novel resolution perimeter that could measure ganglion cell density at different retinal locations. We measured resolution acuity at 12 different retinal locations using sinusoidal gratings in a group of normals, ocular hypertensives and glaucoma patients. Resolution was measured using both stationary gratings, which selectively stimulate parvocellular ganglion cells (P cells), and gratings which phase-reversed at 30Hz, which selectively stimulate a higher proportion of magnocellular ganglion cells (M cells).

With stationary gratings, peripheral resolution was found to be significantly reduced in glaucoma patients compared to ocular hypertensives and in ocular hypertensives relative to normals. When the stimuli phase reversed at 30Hz these differences between groups were larger. The ratio of resolution with and without phase reversal also showed a significant difference between the three groups.

These results provide strong psychophysical evidence for a selective loss of M ganglion cell density over P ganglion cell density in glaucoma and indicate the potential for a new test for the early detection of glaucoma.

IX. Psychophysics and Electrophysiology June 7, 1996 3:15 - 3:58

94) AGING CHANGES IN AUTOMATED PERIMETRY: A COMPARISON OF FLICKER AND LUMINANCE SENSITIVITY IN NORMAL SUBJECTS.

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Flicker perimetry has been shown to detect defects in the visual fields of glaucoma sufferers earlier than traditional luminance based systems. Visual function in general is known to decline with age and currently available perimeters depend on reference to a known pattern of deterioration of luminance sensitivity. The effects of age on flicker sensitivity however have yet to be fully elucidated - previous workers reporting conflicting findings. We have used a custom built computerised automated perimeter to obtain threshold values for flicker and luminance sensitivity at corresponding visual field locations in normal subjects. 60 subjects in the age range 20-70 years were studied (10 per decade) using 32 test points in the central 60 degrees of visual field. Both flicker and luminance sensitivity appeared to change little with age until the sixth decade during which an age related decline commenced. This was considerably more pronounced for flicker than for luminance sensitivity. Whilst flicker perimetry has promise for the early detection of glaucoma in the middle aged it may be of limited value in measuring progression of field loss in the elderly.

95)

ANALYSIS OF SPATIAL RESOLUTION THRESHOLD IN PSEUDOPHAKIC EYES WITH MULTIFOCAL IOLs

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University of Trieste. Eye Clinic (Head: Prof. Giuseppe Ravalico).

The purpose of this study was to compare the spatial resolution threshold in the central visual field of monofocal and multifocal pseudophakic patients, using the "CentRing" program of High-Pass Resolution Perimetry (HRP). Measurements were performed adding spherical correction to test the different foci of the IOL. 20 phakic normal subjects and 3 groups of 20 patients each implanted either with multifocal IOLs (Domilens Progress1, AMO Array MPC25MB or with monofocal IOLs (AMO PC43NB) were studied. No significant differences between phakic subjects and pseudophakic patients with monofocal IOLs were found. At distance, no significant differences among the 3 pseudophakic groups were found. Testing intermediate and near focus, AMO Array group showed a significant lower spatial resolution threshold than the other two groups ($P < 0.01$). In the Domilens group the high spatial resolution threshold at reading distance could be related to the light energy scattering in a large number of foci.

96)

**OBJECTIVE LIGHT THRESHOLD MEASUREMENT USING VEP FROM
TRADITIONAL PERIMETRIC STIMULI**

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University Eye Clinic of Genoa - Italy

The possibility to record VEP using as a stimulus the light coming from a hole of a predetermined diameter and eccentricity was already tested (Fioretto et al, 1992). The long procedure of our previous technique has become by now easier and quickly by using a steady-state stimulation. The new method was tested in ten normal subjects and three simulators. Our results, show the possibility to objectively quantify perimetric thresholds for different light intensity stimulations.

- 97) A 3 POINT VERNIER ALIGNMENT TEST WITH REMARKABLE PROPERTIES
Jay M. Enoch, School of Optometry, U.C. Berkeley, Berkeley, CA, USA

The 3 Point Vernier Alignment Test (VeA) allows assessment of vision through dense ocular media disorders (including mature cataracts where no window through the disorder is present). Now, the test has been (1) refined, (2) shown to work on an applicable patient cohort at Aravind Eye Hospital, Madurai, India, (3) applied to a separate study of normals and macular degeneration patients (6/60 or worse) with or without a pseudo-nuclear cataract (6/60), and (4) prepared for a clinical study.

And the same 3 Pt VeA test, applied to normals has been shown to be virtually unaffected by age; and if the test is conducted above threshold level (and without disability glare), then test luminance, contrast, and veiling glare do not affect measured outcomes. This very sensitive test could serve as a reference or "gold standard" for vision testing. The test has been adapted to perimetry and exhibits fall-off in sensitivity with eccentricity equal to or greater than the increment threshold. Macular disorders and anomalies of fixation affect the results.

98)

ROUTINE EVALUATION OF THE FILLING-IN PHENOMENON IN CLINICAL PRACTICE.

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In patients with localized defects in the visual field, filling-in assessment has both theoretical and practical implications. A simple and rapid technique is proposed for routine evaluation of perceptual completion, by direct comparison of perceived and actual defects in the central ten degree field.

Three patients with homonymous paracentral scotomas and five patients with central scotomas were tested. A white on black Amsler grid was used, first to delineate the perceived defects against the structured background, then to plot actual borders of the scotomas using a tangent screen type target (3w/300). The procedure was conducted twice in succession.

When defects were perceived, delineated areas were at least one third smaller than actual scotomas, a difference that astonished every tested subject. Moreover, perceived scotomas varied in size within minutes.

The Amsler grid is an appropriate tool for evaluating in the central ten degrees perceptual completion with respect to actual borders of the defects. It also demonstrates the dynamic character of the filling-in process. In addition, direct comparison of perceived and actual scotomas contributes to patients' awareness of field defects, and may improve their ability to cope with their visual disorder in everyday life. (FNRS 3200-040780.94/1.)

X. Clinical Observations II June 7, 1996 4:15 - 5:27 PM

VISUAL FIELD ALTERATIONS IN HIV-1-INFECTION.

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Purpose: Visual field alterations in HIV-1-infection should be analyzed.

Method: Since January 1992, 144 HIV-1-infected patients have been submitted to perimetric examinations. The stage of HIV-infection was defined according to the CDC classification (CDC I: 1; CDC II: 52; CDC III 10; CDC IV: 81).

Results: 81 out of 144 patients showed perimetric alterations (CDC I: 0; CDC II: 12; CDC III: 6; CDC IV: 63). At CDC II and III, only a diffuse sensitivity reduction was observed. At CDC IV, in 39 patients a diffuse sensitivity reduction occurred. 21 of these patients also showed HIV-associated retinal microangiopathy. 19 patients showed a diffuse sensitivity reduction combined with peripheral absolute defects caused by retinal opportunistic infections. In 4 patients we found bilateral absolute defects of corresponding visual field squares due to cerebral toxoplasmosis. 1 patient showed bilateral, corresponding paracentral absolute scotoma due to an intracerebral hemorrhage caused by meningeal Kaposi's sarcoma.

Conclusion: Visual field alterations in HIV-infected patients are a frequent ocular manifestation. Their configuration gives first hints about their etiology.

100)

AUTOMATED PERIMETRY IN NON-GLAUCOMATOUS OPTIC NEUROPATHIES

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Although rapidly accepted as the standard means of assessing non-foveal function, automated static perimetry has been accepted with some degree of reluctance in neuro-ophthalmology. One argument has been that neuro-op patients are too sick to adequately perform perimetry. We retrospectively surveyed 1,000 charts coded for non-glaucomatous optic neuropathies for ability to perform automated static perimetry. Of those, 439 of 505 patients were able to complete automated static perimetry. Reasons for inability to complete perimetry included severe visual acuity (31), compromised mental status (24), multiple trauma (13) and youth (8). Of those patient able to complete automated static perimetry reliability coefficients were generally excellent (aggregate false positives .030; false negatives .159). There was no significant difference between reliability coefficients among diagnoses. The patterns of automated fields were assessed. While CPSD (corrected pattern standard deviation) was lowest in compressive and optic neuritis patients (.69 and 7.32) there was no statistical difference between mean defect, PSD and CPSD among diagnoses. Automated perimetry is applicable to the majority of patients with non-glaucomatous optic neuropathy, reliability coefficients are generally excellent, and patterns of field defects are non-specific with gross overlap among diagnoses. So called "classic" patterns of visual field defects may well have been overcalled in the past due to bias.

101)

BITEMPORAL INTERMITTENT HEMIANOPIA

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A 70 years old male patient, refers since 1975 an intermittent bitemporal hemianopia.

Each manifestation lasts approximately 8 days with spontaneous remission.

The ophthalmic check is negative: visual acuity 1,0 in both eyes, IOP 14 mmHg in both eyes, optic disc and retinal vessels within normality in both eyes. The perimetric examination confirm the existence of an intermittent bitemporal hemianopia.

MNR documents the presence of a pituitary neoformation which press on the anterior side of the third ventricule. The surgical asportation of the pituitary neoformation and its histologic examination revealed its nature of cyst.

102)

ANALYSIS OF THE RELATIONSHIP BETWEEN RETINAL DISEASE AND STATIC VISUAL FIELD USING A COMPUTER-ASSISTED COMBINATION SYSTEM

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Many retinal diseases cause visual field defects. Knowledge of the relationship between visual field defects and fundus abnormality is useful for diagnosis and therapy. Therefore, we developed a system for imposing visual field data on photographs of the fundus by computer. First, we take a photograph of the fundus using a non-mydratic retinal camera and we measure the static visual field using a Humphrey Field Analyzer or a Topcon automated perimeter. Next, the photograph of the fundus and the visual field data are entered into a TV monitor and combined using IMAGENet. We studied the relationship between retinal disease and visual field defects using this system. The system is also capable of retinal nerve fiber layer analysis; retinal nerve fiber layer defects are first symptom of early glaucoma. We principally studied the relationship between retinal nerve fiber layer defects and visual field defects in 50 glaucoma cases.

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103) A NEW FUNDUS PERIMETER BY WHICH THE TARGET CAN AUTOMATICALLY PURSUE EYE MOVEMENT

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Using an ordinary perimeter, it is impossible to identify which area is stimulated on the fundus. We developed an infrared television fundus perimeter in order to identify the stimulation points, but there were two problems with it. One was that the image quality of the fundus was poor. The other was that reappearance was not strong because it was very difficult to stably stimulate the same retina because of small eye movements. In order to resolve these problems, we developed a new fundus perimeter. Using an infrared fundus camera which was specially manufactured, the quality of the images with this camera was much improved. Installing the special computer system to the fundus perimeter, the target for stimulation can automatically pursue eye movements and stimulation can be fixed on the same retina.

We measured 10 normal subjects, 10 cases with glaucoma and 5 cases with retinal disease. Many small scotoma could be identified. These improvements made fundus perimetry much more accurate and easier .

104)

SCANNING LASER OPHTHALMOSCOPE AND ITS APPLICATIONS IN FUNDUS PERIMETRY. OUR EXPERIENCES

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Fundus perimetry, performed with scanning laser ophthalmoscope, is a very sensitive technique, which can result useful to study localized retinal lesions. 6 patients, affected by age related macular degeneration and peripapillary atrophy were examined. A threshold up and down strategy is used to circumscribe exactly the borders of the retinal lesion.

Fundus perimetry, in these cases, results more effectful and preferable to traditional perimetry to document the functional conditions of the retinal area surrounding the lesion.

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**A COMPARISON OF THREE METHODS FOR DISTINGUISHING DIFFUSE,
LOCALIZED, AND MIXED VISUAL FIELD DEFECTS IN GLAUCOMA**

105)

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The separation of local and diffuse components of visual field loss is an important step in the functional evaluation of glaucomatous patients. However, there is no general agreement on the methods to assess the type of defects, and even the definition of such defects is controversial.

We compare the ability of three methods (the cumulative defect curve, the Humphrey Glaucoma Hemifield Test, and the Glaucoma Staging System) in making such a separation in a sample of 300 automated visual fields from patients with chronic simple glaucoma at various stages. The reference standard was global indices together with Statpac probability maps.

The cumulative defect curve is an easy and useful method for an at-a-glance classification of the visual field state, but, in some cases, it can miss very small, but significant localized defects.

The GHT is a very efficient method to detect subtle local sensitivity depressions. However, it tends to underestimate the diffuse loss and does not differentiate between localized and mixed defects.

The GSS allows the user to instantly classify the type and the severity of visual field defects, simply applying the MD and the CPSD values to a specially designed nomogram.

106)

CLINICAL VALIDITY OF THE BRUSINI GLAUCOMA STAGING SYSTEM (GSS)

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Purpose: To evaluate Brusini's GSS to follow-up and classify glaucomatous visual-fields.

Patients and Methods: Retrospectively, 610 visual fields (Octopus 201, program G1, all 3 phases, one examiner) of 64 eyes of 32 glaucoma patients (on local β -blockers only) were studied. For each eye a GSS sheet was plotted, comprising basically a scatterplot of Mean Defect (MD; x-axis) and Corrected Loss Variance (CLV; y-axis), with guidelines classifying the fields into 6 categories: Normal, purely and predominantly localized, mixed, purely and predominantly generalized defects. The severity of the visual-field defect was graded arbitrarily into 6 stages. In addition, all visual fields were analyzed on screen with PeriData 7.0.

Results: Classification into the defect categories was comparable to PeriData results in 540 (88.5%) fields. Of the rest, 32 (5%) were wrongly classified as normal. The 8 fields (1.3%) with a marked and the 30 fields (4.7%) with a minor discrepancy presented mostly with a high short-term fluctuation (SF) which led to misleadingly reduced CLV-values. No change was observed in 38 eyes (59.4%), and of those, 19 (29.7%) showed a small, 12 eyes (18.8%) a large long-term fluctuation (LF), mostly due to impaired reliability. However, for the 5 eyes (7.8%) with high LF, there was no apparent reason; for 2 (3.1%), artifacts caused high LF. Change was observed in 26 eyes (40.6%), of those, initial improvement (learning or therapy effect) was present in 6 eyes (9.4%), and deterioration was present in 10 eyes (15.6%). After initial improvement, in 3 eyes (4.7%) there was no change, while in 7 eyes (10.9%) deterioration was observed. In two eyes only (3.1%), progression was obvious in the PeriData analysis, but not so in the GSS-index-based evaluation.

Conclusion: Brusini's GSS is helpful to classify and highlights deterioration for follow-up in glaucoma. However, the study suggests implementing current Octopus normal values and the use of Loss Variance (LV) instead of CLV.

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107)

PERIMETRIC DAMAGE IN PRIMARY OPEN ANGLE GLAUCOMA AND IN
PSEUDOEXFOLIATION GLAUCOMA : A CLASSIFICATION ACCORDING TO
THE "GLAUCOMA STAGING SYSTEM"

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A retrospective analysis of visual field loss in 100 patients with primary open angle glaucoma and in 114 patients with pseudoexfoliation glaucoma has been carried out according to a new classification method, the Glaucoma Staging System. The G.S.S. describes visual field defect as localized, diffuse, and mixed in 6 stages of gravity.

The results confirm that: 1) in pseudoexfoliation glaucoma, severe loss of visual field already occurred at the time of diagnosis; 2) in most patients, irrespective of type of glaucoma, loss of visual field was either generalized or mixed; 3) localized defects, although reportedly typical of glaucoma, were uncommon in our population.