



**INTERNATIONAL
PERIMETRIC
SOCIETY**

**XI VISUAL FIELD SYMPOSIUM
Program and Abstracts**



**ARLINGTON, VA, U.S.A.
SUNDAY, JULY 3 - THURSDAY, JULY 7, 1994**

PROGRAM AND ABSTRACTS

XIth International Perimetric Society Meeting



July 3 - 7, 1994

**Crystal Gateway Marriott
Arlington, VA**

TABLE OF CONTENTS

Greetings	1
Organization of the Meeting	2
IPS Committees and Chairmen	3
Meeting Information	4
Area Map	5
Registration	6
Technical Exhibition	7
Social Program	8
General Information	10
Program in Brief	11
Scientific Program	12
First Author Index	75
List of Exhibitors	78
Acknowledgements	78

GREETINGS

On behalf of the Organizing Committee, I would like to welcome all of you to Washington, D.C., capital of the United States of America. The program committee has been able to assemble a wonderful scientific program, comprised of contributions from throughout the world. This year for the first time, we have limited the number of papers and posters to a predetermined number, to allow each participant to fully digest the scientific content and be able to comment on the basis of their own experience. Each break in the first two days of the meeting is extended to allow participants to view the posters in an unhurried way.

Our social program here in Washington, D.C. emphasizes our national traditions and celebrations. Our "welcome" tour of the monuments by moonlight is a great introduction to the city, and the Fourth of July on the Mall is not to be missed. The Cannon Caucus Room is the site of many negotiations affecting the U.S. and the world.. Finally, our traditional banquet, in an informal setting overlooking the Potomac River, is a fitting end to our all-too-brief biennial fellowship.

We sincerely hope your time here is rewarding and memorable.

Yours sincerely,

Richard P. Mills MD

IPS Secretary

Organizing Committee Chairman

XI International Perimetric Society Meeting

ORGANIZATION OF THE MEETING

THE INTERNATIONAL PERIMETRIC SOCIETY

The International Perimetric Society (IPS) is the international organization for researchers in perimetry, visual fields, and optic disc imaging. The Society was founded in 1974 and has held its international meetings every second year in the following locations:

I.	1974	Marseilles, France
II.	1976	Tübingen, FRG
III.	1978	Tokyo, Japan
IV.	1980	Bristol, UK
V.	1982	Sacramento, California, USA
VI.	1984	Santa Margherita Ligure, Italy
VII.	1986	Amsterdam, The Netherlands
VIII.	1988	Vancouver, Canada
IX.	1990	Malmö, Sweden
X.	1992	Kyoto, Japan

EXECUTIVE COMMITTEE

Officers

President	Dr. Anders Heijl, Malmö, Sweden
Vice-Presidents	Dr. Mario Zingirian, Genova, Italy Dr. Eric Greve, Amsterdam, The Netherlands
Secretary	Dr. Richard Mills, Seattle, U.S.A.
Treasurer	Dr. Fritz Dannheim, Hamburg, Germany

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Dr. Gordon Douglas, Vancouver, BC, Canada
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Dr. Toshifumi Otori, Osaka, Japan
Dr. Mario Zulauf, Basel, Switzerland

Group Chairmen

Standards	Dr. John Wild
Optic Disc/Retina	Dr. Bernard Schwartz
Glaucoma	Dr. Jorg Weber
Neuro-Ophth	Dr. Michael Wall
Color Perimetry	Dr. William Hart
Data Acquisition & Analysis	Dr. Yoshiaki Kitazawa
Ergoperimetry	Dr. Enrico Galdolfo

MEETING COMMITTEES

Organizing Committee

Dr. Richard Mills, Chair
Dr. Marc Lieberman, IPS Banquet
Dr. Steven Newman, Exhibitors
Dr. Mark Sherwood, Registration

Program Committee

Dr. Elliot Werner, Chair
Dr. Richard Mills
Dr. Michael Wall
Dr. Chris Johnson

MEETING INFORMATION

Period Sunday, July 3 - Thursday, July 7, 1994

Venue Crystal Gateway Marriott
1700 Jefferson Davis Highway
Arlington, Virginia 22302
Telephone: (703) 920-3230
Fax: (703) 979-6332

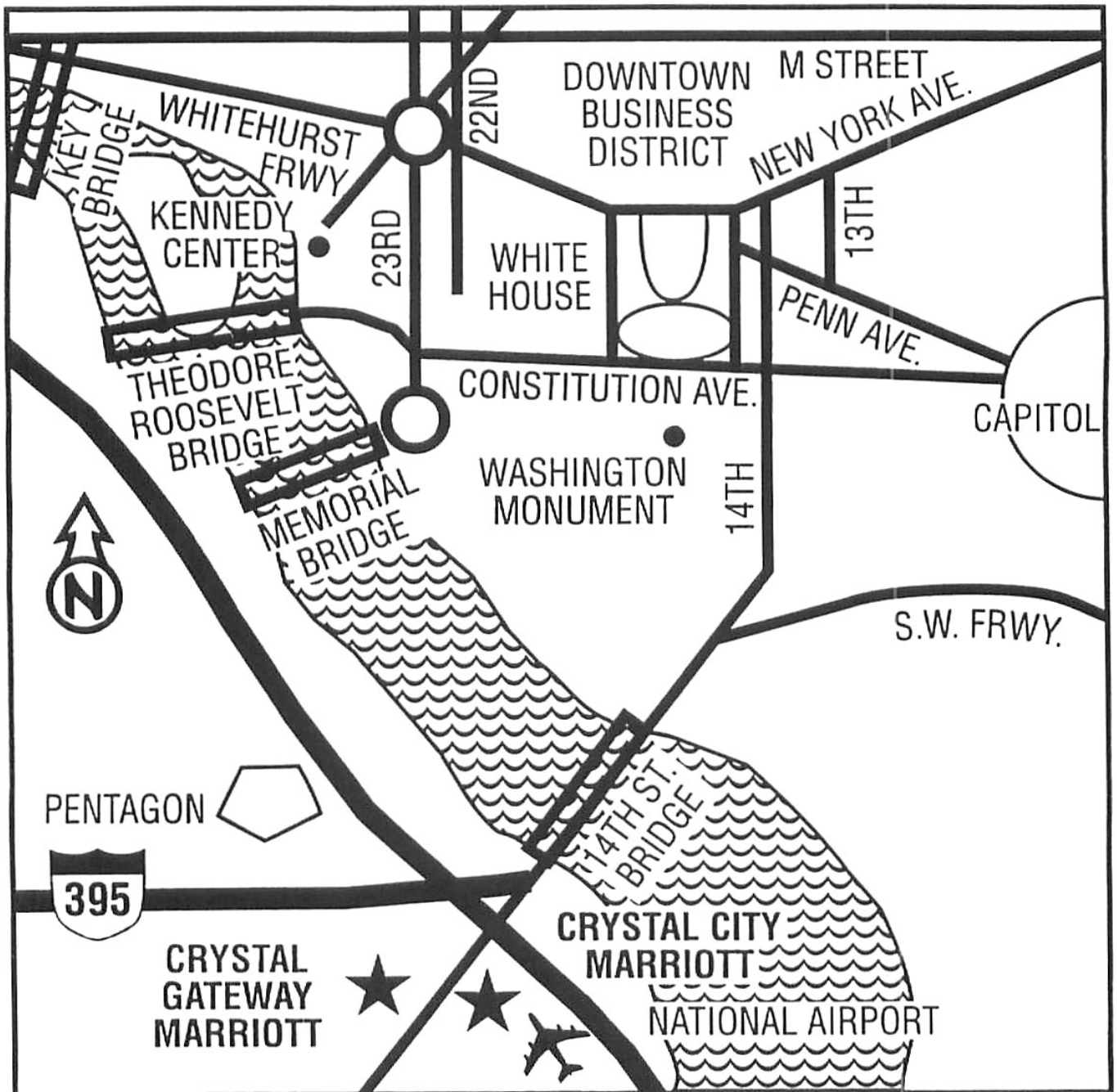
During the Meeting:

Letters and messages to participants during the Meeting should be addressed to the Crystal Gateway Marriott directly (address above).

Language: The official language of the Meeting is English.

Name Badges: Participants are requested to wear their name badges during all Meeting functions. Only registered members will be given access to the conference rooms.

AREA MAP



REGISTRATION

On site Registration

Please complete your registration form and submit it to the Registration Desk on site. Payments may be made in cash in US currency, by credit card, bank or U.S. traveler's checks.

Registration Fee

On Site Registration Fee

IPS Members	\$425
Non-members	\$500
Residents/Fellows	\$350
Accompanying persons (each)	\$325

Full Registration Fee Includes:

Admission to all scientific sessions, commercial and scientific exhibits and posters, copy of final program with abstracts, coffee and refreshment breaks, lunches, continental breakfasts Monday and Wednesday, Monuments by Moonlight, Picnic and Fireworks on the Mall, Cannon Caucus Room Dinner, and IPS Traditional Banquet.

Accompanying persons fee includes admission to all commercial and scientific exhibits and posters, morning hospitality suite, Monuments by Moonlight, Picnic and Fireworks on the Mall, Cannon Caucus Room Dinner, and IPS Traditional Banquet.

Open Hours of the Registration Desk in the Arlington Foyer

Date	Hours
Sunday, July 3	3:00 p.m. - 7:00 p.m.
Monday, July 4	7:15 a.m. - 6:00 p.m.
Tuesday, July 5	1:30 p.m. - 6:00 p.m.
Wednesday, July 6	7:15 a.m. - 6:00 p.m.

TECHNICAL EXHIBITION

Exhibits of perimetric and ophthalmic equipment, imaging devices, and books will be held adjacent to the main meeting hall in Salons IV-VI, Arlington Ballroom.

Exhibition hours are:

Monday, July 4 8:00 a.m. - 5:00 p.m.

Tuesday, July 5 1:00 p.m. - 5:00 p.m.

(Posters will also be available for viewing on Tuesday from 9:00 a.m. until 12:00 noon.)

Wednesday, July 6 8:00 a.m. - 5:00 p.m.

GENERAL SOCIAL PROGRAM

All participants and accompanying persons are invited to attend the social program, which will provide an opportunity to meet with old friends and become acquainted with new ones. At check-in you will receive a packet with admission tickets for the events for which you have registered. Please note that admission will NOT be given without this ticket.

Those who have not yet made a reservation may do so at Registration on Sunday between 3:00 p.m. and 7:00 p.m. or on Monday between 7:15 a.m. and 6:00 p.m. Please note that those wishing to attend the Picnic & Fireworks on the Mall on Monday evening must register on Monday by 12:00 noon.

Sunday, July 3 Monuments by Moonlight 7:00-10:00 PM

Buses leave from the main hotel entrance at 7:00 p.m. The meeting will open with the IPS Welcoming Reception, a sparkling introduction to the Nation's Capital. Aboard chartered coaches, champagne, soft drinks, and finger foods will be served by a waiter while an experienced guide will narrate a leisurely tour of historic Washington monuments and government buildings, beautifully lit for nighttime viewing. Stops will be made at the Lincoln, Iwo Jima, Vietnam and Jefferson Memorials, as well as the John F. Kennedy Center for the Performing Arts.

Monday, July 4 Picnic & Fireworks on the Mall 6:15-10:15 PM

Buses leave from the main hotel entrance at 6:15 p.m. Chartered buses will journey to the National Symphony Orchestra Fourth of July Concert at the West Lawn of the U.S. Capitol. Guides will assist in choosing a choice viewing spot. For pre-concert enjoyment, each guest will be provided a personal picnic alfresco. The concert begins at 8:00, and at 9:15, the famed Washington fireworks show begins over the Washington Monument. Afterwards, back to the buses and straight to the hotel.

Tuesday, July 5 **National Cathedral Tour** 9:30 AM-12:30 PM
(Optional) or **Washington on your own**

The Washington National Cathedral, towering over the northwest section of Washington, celebrated its completion in September, 1990. A guide will lead a journey through the Chapels, and down below the Great Altar to the Bethlehem Chapel. More than 200 stained glass windows and exquisite stone carvings adorn the structure. A ride to the top of the Cathedral tower offers a marvelous view of Washington. The Herb Cottage features herbs, potpourri, and gifts for the home. Bus will leave from the main hotel entrance at 9:30 a.m.

Tuesday, July 5 **Cannon Caucus Room Dinner** 7:00-10:00 PM

Buses will leave from the main hotel entrance at 7:00 p.m. and will transport guests from the hotel to Capitol Hill, arriving at the grand staircase entrance to the Cannon House Office Building, across from the U.S. Capitol. The Caucus Room is the largest ceremonial room on the Hill and is used for important hearings of the House of Representatives as well as for grand dinners.

Wednesday, July 6 **Traditional IPS Banquet** 6:30 PM-12:30 AM

The IPS Banquet will be held at the historic Car Barn in Georgetown with a panoramic view of the Potomac River. After a cocktail reception, the Society will gather for its traditional dinner, square dancing, and national singing late into the night. Buses depart from the main hotel entrance at 6:30 p.m.

GENERAL INFORMATION

Communication Among Participants

A bulletin board will be available for participants' use where telephone or telegram messages may be posted. There will be no paging service.

Business Information Center

Participants have access to facsimile machines and photocopiers. Hotel charges will be made accordingly.

Meals & Refreshments

Meals may be taken in any of the three hotel restaurants. The following complimentary meals will be served to all registrants and accompanying persons: breakfast on Monday, July 4th and Wednesday, July 6th from 7:15 a.m. to 9:00 a.m. in Salon IV-VI; lunch on Monday, Tuesday, and Wednesday at 12:30 in Salon I-II. In addition, for accompanying persons, coffee and tea will be available in the Marquis Suite (top floor, Arlington wing) from 8:00 - 11:00 a.m. on Monday, Tuesday, and Wednesday.

Transportation

The Washington Metro is a modern subway system serving Washington and suburbs in Maryland and Virginia. The hotel is on the "blue" and "yellow" lines. Service is every few minutes. Fare is approximately \$3 round trip to downtown.

Taxicabs operate according to a zone system, the fare depending on the number of zones crossed enroute. No meters are used. Drivers expect a tip of 10-15%. The ride from the hotel to the Smithsonian Institution, for example is about \$8-\$12.

Foreign Exchange and Banking

Currencies may be exchanged at most all major banks. These are usually open from 9:30 AM to 4:30 PM Monday through Friday. The hotel can cash up to \$100 per day in travelers checks for guests of the hotel. In general, currency exchange is more difficult in the U.S. than most other countries.

Proceedings

Please note that manuscripts for the proceedings **MUST** be submitted on site, next to the Slide Reception Desk. They should be approximately 6-15 double spaced pages of 12 point type **including** illustrations and references. Please submit one original manuscript and set of illustrations, with 3 additional copies of each. The proceedings will be published not earlier than March 1, 1995. If publication elsewhere is anticipated, an updated abstract for the Proceedings should be submitted to reflect the actual material presented at the meeting.

PROGRAM IN BRIEF

Sun., Jul. 3, 1994

15:00- 19:00	Registration	Arlington Foyer
14:00 & later	Exhibit and poster setup	Salon IV-VI

Mon., Jul 4 , 1994

07:15 - 18:00	Registration	Arlington foyer
07:15 - 09:00	Breakfast	Salon IV-VI
08:00 - 09:45	Paper session I	Salon III
09:45 - 11:00	Coffee break	Salon IV-VI
11:00 - 12:30	Paper session II	Salon III
12:30 - 13:30	Lunch	Salon I-II
13:30 - 15:15	Paper session III	Salon III
15:15 - 16:30	Refreshment break	Salon IV-VI
16:30 - 18:00	Paper session IV	Salon III

Tues., Jul 5, 1994

12:30 - 13:30	Lunch	Salon I-II
13:30 - 18:00	Registration	Arlington foyer
13:30 - 15:15	Paper session V	Salon III
15:15 - 16:30	Refreshment break	Salon IV-VI
16:30 - 18:00	Poster session I	Salon III

Weds., Jul 6, 1994

07:15 - 18:00	Registration	Arlington foyer
07:15 - 09:00	Breakfast	Salon IV-VI
08:00 - 09:30	Poster session II	Salon III
09:30 - 10:00	Coffee break	Salon IV-VI
10:00 - 11:45	Paper session VI	Salon III
11:45 - 12:30	IPS Business meeting	Salon III
12:30 - 13:30	Lunch	Salon I-II
13:30 - 14:45	Paper session VII	Salon III
14:45 - 15:05	Refreshment break	Salon IV-VI
15:05 - 16:30	Poster session III	Salon III

SCIENTIFIC PROGRAM

MONDAY, JULY 4, 1994

7:55 AM - 8:00 AM

OPENING REMARKS

Richard P. Mills, MD

8:00 AM - 9:45 AM

PAPER SESSION I

Chairperson: Y. Kitazawa

Moderator: B. Chauhan

- 1) Rate of Change of Visual Fields over Time in Glaucoma: Velocity Versus Acceleration
B. Schwartz
- 2) Pointwise Univariate Linear Regression of Sensitivity
J. Flanagan, N. Hutchings, J. Wild, M. Hussey, and G. Trope
- 3) Evaluation of a Technique for Determining Glaucomatous Visual Field Progression Based on Animation Graphics
B. Chauhan, S. Drance, R. LeBlanc, M. Lieberman
- 4) Location of Early Field Deterioration in Glaucoma Suspects
D. Poinoosawmy, A. McNaught, F. Fitzke, R. Hitchings
- 5) Comparison of Early Visual Field Disturbances and Their Progression in POAG and NTG
H. Suzumura, H. Ohkoshik, T. Nonaka, T. Ogawa
- 6) Is The Visual Field of Patients with Advanced POAG Protected By Lowering the IOP?
C. Traverso, E. Semino, F. Morescalchi, U. Murialdo, D. Venzano
- 7) Brovincamine Fumarate, CA2+ Blocker, Favorably Influences the Prognosis of Visual Field Defects of Normal Tension Glaucoma (NTG)
Y. Kitazawa, A. Sawada, I. Okabe, K. Sato

1) RATE OF CHANGE OF VISUAL FIELDS OVER TIME IN GLAUCOMA
VELOCITY VERSUS ACCELERATIONBernard Schwartz, M.D., Ph.D., Tufts University of
School of Medicine, Boston, MA, USA

The rate of change of visual field thresholds over time in glaucoma has been characterized by linear regression analysis. Linear regression analysis is analogous to determining the velocity of the change of the visual field thresholds. However, change in the slope of the linear regression, analogous to acceleration, would be important for detecting a change in the course of the disease.

A software program has been devised to obtain and to characterize the plot of the cumulative change in the slope of the linear regression of visual field thresholds over time. At least 5 visual fields are required. Visual fields for normal subjects and for those of ocular hypertension and glaucoma, which have a constant velocity or slope over time, essentially have a flat acceleration curve. For visual fields that are changing the acceleration plot readily depicts the change in the velocity plot which may be difficult to interpret due to large degrees of scatter. The acceleration plot can be statistically characterized for significance over time. The usefulness of acceleration plots especially in comparison to velocity plots will be presented for following patients with glaucoma.

2)

POINTWISE UNIVARIATE LINEAR REGRESSION OF SENSITIVITY AGAINST FOLLOW-UP TIME.

N Hutchings¹, J M Wild¹, M K Hussey¹, J G Flanagan² and G E Trope³Aston University, Birmingham, UK¹; University of Manchester, Manchester, UK²; University of Toronto, Ontario, Canada³.

Purpose. To investigate the univariate linear regression of sensitivity at each stimulus location against time of follow-up as a technique for defining visual field progression.

Methods. The sample comprised 49 patients with primary open angle glaucoma with a mean age of 58.9 years (SD 14.5). The mean period of follow-up was 5.43 years (SD 1.67) and the mean number of fields per patient (Humphrey Field Analyser Program 30-2 or 24-2) was 10.4 (SD 3.2). Comparison of the statistical significance of the critical value of the slope (the magnitude of the slope divided by the variance of the slope) with the correlation coefficient (R^2) defined several possible outcomes at each test location: a good linear fit of the data, describing either a normal decline of sensitivity with age or a deteriorating (or improving) slope greater than the normal, and an inadequate fit of the data.

Results. Of the two patients exhibiting a significant deterioration in the MD slope, 30 and 34 stimulus locations respectively, manifested deteriorating slopes with the remainder being inadequately fitted. Of the 24 patients with a non-significant MD slope and who exhibited two or more deteriorating locations, a mean of 6.2 (SD 4.8) locations per patient deteriorated, 1.3 (SD 2.8) per patient improved, 0.4 (SD 0.92) were stable and 45.6 (SD 5.5) were inadequately fitted. Of the deteriorating points, 84% had a sensitivity of ≥ 20 dB.

Conclusions. The technique identifies progression of the visual field which is masked by the data reduction of the MD. The proportion of inadequately fitted points suggests that the use of the technique in this manner is of limited value.

3) EVALUATION OF A TECHNIQUE FOR DETERMINING GLAUCOMATOUS VISUAL FIELD PROGRESSION BASED ON ANIMATION GRAPHICS

Balwantray C. Chauhan,¹ Stephen M. Drance,² Raymond P. LeBlanc,¹ Marc F. Lieberman,³ Richard P. Mills⁴ and Elliot B. Werner⁵ Departments of Ophthalmology, ¹Dalhousie University, Halifax, NS, ²University of British Columbia, Vancouver, BC, ³California Pacific Medical Center, San Francisco, CA, ⁴University of Washington, Seattle, WA and ⁵Hahnemann University, Philadelphia, PA

We wanted to determine the usefulness of a visual technique to help determine glaucomatous field progression. The first two visual field examinations of 16 glaucoma suspects and 16 glaucoma patients followed for a median of 7.46 years with 7 examinations were averaged. Three-dimensional colour-coded images of the field (hill of vision) were then generated. After correcting for the expected test-retest variability and inserting one interpolated image per month of follow-up, the images were aligned and presented in rapid sequence to create an animation sequence. After a short learning session five glaucoma specialists classified the visual field sequences as progressing or not progressing. The inter-observer and intra-observer agreement rates were then estimated. Perfect agreement (100% concordance) between the observers was obtained in 18 (56.3%) subjects while at least 80% concordance was obtained in 27 (84.4%) subjects ($\kappa = 0.572$). Of the 8 sequences that were repeated, 4 of the 5 observers had an intra-observer agreement of at least 87.5%.

4)

LOCATION OF EARLY FIELD DETERIORATION IN GLAUCOMA SUSPECTS

Authors. Poinosawmy D, McNaught A I, Fitzke F W, Hitchings R A.

Centre. Glaucoma Unit, Moorfields Eye Hospital & Institute of Ophthalmology, London U.K.

Purpose. To investigate the spatial distribution of the earliest field defects in high and low tension glaucoma suspects.

Method. Visual fields from two groups of glaucoma suspects were analysed using pointwise regression analysis.

Group 1 were ocular hypertensives (OHT IOP > 21). Group 2 were initially normal fellow eyes of confirmed low tension glaucoma (LTG) patients. Eyes which demonstrated at least one location with a statistically significant negative regression slope and rate of loss > 1 dB/year were defined as progressing. In each of the progressing eyes the site(s) of the first regression slope(s) fulfilling the progression criteria was recorded.

Results. There was progression in 12 eyes of 11 patients in Group 1 and 17 eyes in Group 2. There was a significant difference ($p = 0.022$ Unpaired T-test) between the mean number of locations showing the earliest significant regression slopes in groups 1 and 2. The earliest defects in group 1 (OHT) involved more locations than group 2 (LTG). This may indicate a more focal onset of progression in LTG.

5) COMPARISON OF EARLY VISUAL FIELD DISTURBANCES AND THEIR PROGRESSION IN POAG AND NTG

H. Suzumura, H. Ohkoshi, T. Nonaka and T. Ogawa
Department of Ophthalmology, Tokyo Medical College, Tokyo, JAPAN

We compared early central visual field disturbances and their progression in 152 eyes with POAG and 151 eyes with NTG. Central fields were examined with the Humphrey Field Analyser program 24-2 and were classified using the Tokyo Medical College box plot classification. Using 52 examination points excluding 2 examination points around the blind spot, the percentage of eyes showing a p-value of less than 5%, 1% and 0.5% on pattern deviation at each examination point were calculated for each stage.

In the early stage, visual field disturbances in the upper paracentral and the upper nasal areas occurred in a significantly higher percentage of eyes with NTG than with POAG. In the late stage, the nasal, paracentral and Bjerrum areas in the upper visual field were also involved in a higher percentage of eyes with NTG. In contrast, Bjerrum scotomas near the blind spot in the lower visual field were more frequent in eyes with POAG. With progression of disease, the central visual field disturbances in POAG enlarged to involve both upper and lower visual fields, while that in NTG remained localized to the upper visual field. These data suggest that there are some differences in the mechanism for visual field disturbances in POAG and NTG.

6)

IS THE VISUAL FIELD OF PATIENTS WITH ADVANCED POAG PROTECTED BY LOWERING THE IOP?

C.E. Traverso, E. Semino, F. Morescalchi, U. Murialdo, D. Venzano,
E. Gandolfo, M. Zingirian. University Eye Clinic - Genoa - Italy

We evaluated the effect of a large decrease of IOP, obtained surgically, on the VF of patients with advanced glaucomatous damage. Selection criteria were as follows: pre-operative IOP > 21 mmHg; post-operative IOP < 16 mmHg on no medications; stable visual acuity and pupil size; pre-operative visual field with MD > 6 Db (Humphrey 30-2); minimum follow-up of 8 months. Of the 27 patients who met the above criteria 14 had postoperative IOP < 10 and > 4 mmHg. VF data were analyzed using the Statpac 2 glaucoma probability change program and the Wilcoxon Rank-Sum Test. Median follow-up is 14 (8-26) months. Results were:

GROUP	N	MD CHANGES ^(*)	SF CHANGES ^{(*)*}
IOP 4 - 9	14	p < 0.06	p < 0.06
IOP 10 - 16	13	NS	NS
TOTAL	27	p < 0.01	NS

* Wilcoxon Rank - Sum Test

Nine out of 27 cases showed an improvement of the MD with the Statpac 2 program (p < 0.5). Our data support the protective effect of a stable and large reduction of IOP against the progression of severe glaucomatous damage.

7)

BROVINCAMINE FUMARATE, CA²⁺-BLOCKER, FAVORABLY INFLUENCES THE PROGNOSIS OF VISUAL FIELD DEFECTS OF NORMAL TENSION GLAUCOMA (NTG).

Kitazawa, Y., Sawada, A., Okabe, I. and Sato, K.
Department of Ophthalmology
Gifu University School of Medicine, Gifu, Japan.

In an attempt to evaluate the effects of brovincamine fumarate, a Ca²⁺-blocker, on the visual field defects (VFD) in NTG patients, we completed a randomized, controlled study comprising 28 NTG patients (28 eyes). Fourteen received brovincamine 20mg tid PO and another fourteen did placebo for at least 2 years. Visual field was tested by Humphrey Field Analyzer (program 30-2) at least 7 times every 6 months during the study. The changes over time in VFD were judged according to the significance level of MD slope calculated by STATPAC 2. The significant deterioration of VFD was seen in 5 patients (35.6%) in the placebo-treated group and in none in the brovincamine-treated group. The drug may deserve further investigation as a therapeutic means of NTG.

MONDAY, JULY 4, 1994

11:00 AM - 12:30 PM

PAPER SESSION II

Chairperson: M. Zingirian

Moderator: K. Kani

- 1) Displacement Threshold Perimetry in Glaucoma Using a Large 21 Inch High-Resolution Monitor and a Macintosh Computer System
C. Johnson, D. Marshall Jr., K. Eng
- 2) Motion Perimetry in Optic Neuropathies
M. Wall, H. Pujals
- 3) Pointwise Topographical and Longitudinal Modeling of the Visual Field in Optic Neuritis
J. Wild, N. Hutchings, C. Johnson
- 4) Application of Artificial Neural Networks to Progressive Field Loss in Glaucoma
D. Henson, S. Spenceley, D. Bull
- 5) Visual Field In ~~Diabetic~~ Retinopathy
M. Henricsson, A. Heijl
- 6) Perimetry Follow-Up of Patients Affected by Vitamin A Deficiency
A. Polizzi, S. Saccá, G. Camoriano, M. Barbetta, V. Brezzo

1) **DISPLACEMENT THRESHOLD PERIMETRY IN GLAUCOMA USING A LARGE 21 INCH HIGH-RESOLUTION MONITOR AND A MACINTOSH COMPUTER SYSTEM**

Chris A Johnson, David Marshall, Jr. and Kristine Eng

Optics and Visual Assessment Lab (OVAL), Dept. of Ophthalmology, Univ. of California, Davis

Purpose: Our purpose was to develop a Macintosh-based system for performing displacement threshold perimetry, establish age-related population norms, and conduct preliminary comparisons with conventional automated perimetry in patients with early glaucomatous damage. **Methods:** Sixty normal subjects (ages 21 to 83), and 30 patients with early glaucomatous visual field loss were evaluated with both conventional automated perimetry (Humphrey Field Analyzer) and displacement threshold perimetry (0.6 deg targets of 1575 asb on a 31.5 asb background). Displacement thresholds were obtained at 60 locations in the central visual field, corresponding to the Humphrey 30-2 pattern, minus the 4 outermost targets at 27 degrees superiorly, inferiorly, temporally and nasally. **Results:** For normals, displacement thresholds increased with eccentricity ($p < .001$) and age ($p < .001$). The superior temporal quadrant demonstrated the largest effect of age, similar to the normal age-related changes previously found for flicker perimetry. In most glaucoma patients, the displacement threshold perimetry findings revealed a larger area of visual field loss in comparison to the results for conventional automated perimetry. The general location of abnormalities showed good correlation between conventional and displacement threshold perimetry. **Conclusions:** Displacement threshold perimetry can be readily performed using a Macintosh computer system and a large high-resolution monitor. Preliminary results indicate that displacement threshold perimetry is at least as sensitive as conventional automated perimetry, and may be more suitable for detecting early glaucomatous losses. Longitudinal studies are needed to determine its ultimate clinical efficacy.

2)

MOTION PERIMETRY IN OPTIC NEUROPATHIES

Michael Wall, James Pujals, University of Iowa, Iowa City, IA, USA.

Motion perimetry is a method that measures a subject's ability to detect a coherent shift in position of dots (motion) in a defined circular area against a background of fixed dots. Motion size threshold is defined as the smallest detectable circular area in which dot motion is detected. Subjects respond by touching a computer screen with a light pen where they detect motion stimuli. Their reaction times (msec) and localization errors (number of pixels from target center) are then calculated.

Motion thresholds to 44 points were tested within the central 21° (6° spaced grid) and Humphrey 24-2 testing was done on one eye of patients with various optic neuropathies. We also tested 10-15 normal subjects per decade for comparison data. We found that patients with optic neuropathies often have abnormal motion perception and may have prolonged reaction times. Accuracy of stimulus localization is usually unimpaired. Motion perimetry deficits correlate well with conventional perimetry results and also occur in areas with normal conventional perimetry results.

3) **POINTWISE TOPOGRAPHICAL AND LONGITUDINAL MODELING
OF THE VISUAL FIELD IN OPTIC NEURITIS**

N Hutchings¹, J M Wild¹ and C A Johnson²

¹Dept of Vision Sciences, Aston Univ., Birmingham UK, ²Dept of Ophthalmology, Univ of Calif., Davis

Purpose: To evaluate the efficiency of polynomial and multiple regression analysis in the modeling of the visual field in optic neuritis. **Methods:** The sample consisted of 25 patients (mean age 37.08 yrs, SD 7.12 yrs) entered into the Optic Neuritis Treatment Trial. Strict eligibility criteria were enforced. All patients underwent examination with program 30-2 of the HFA. Both the affected eye and the fellow eye were examined at baseline and subsequently at 15 days, 30 days, 13 weeks, 6 and 12 months afterwards. Perimetry was also performed on the affected eye, only, at intervening examinations of 4 days, 7 weeks and 19 weeks after baseline. The pointwise distribution of sensitivity at any given stimulus location for any given examination was described in terms of a joint topographical model. The topographical element modeled the pointwise distribution of sensitivity using a second order polynomial function in terms of the respective stimulus coordinates, whereas the longitudinal element modeled the pointwise distribution of sensitivity using multiple linear regression in terms of the sensitivity at the given location determined at one or more previous examinations. The goodness of fit between the modeled field and the measured field at examination 2,3,4,...n was expressed in terms of the coefficient of determination R^2 . **Results:** The mean goodness of fit between the modeled field and the measured field in the affected eye was 62.1% and in the fellow eye was 70.9%. In those cases exhibiting a typical full recovery, the R^2 was reduced for the field at the second acute phase. **Conclusions:** The model adequately describes the recovery of the visual field in

4) optic neuritis.

**APPLICATION OF ARTIFICIAL NEURAL NETWORKS TO PROGRESSIVE FIELD LOSS
IN GLAUCOMA.**

David Henson¹, **Susan Spenceley**¹ **David Bull**². ¹University of Wales, Cardiff; ²Bristol University.

Problem. The large degree of variability in glaucomatous visual field defects makes it difficult to differentiate between non-significant random variations in the visual field and true progression. The majority of research into the quantification of progression has concentrated on the use of global measures of defect depth, measures which take little or no account of spatial patterns within the data.

Technique. An artificial neural network (ANN) based on an unsupervised learning paradigm (Kohonen self organising feature map) has been trained with a population of glaucomatous defects (139 eyes) to cluster them on the basis of their patterns of loss.

Results. The output classes which can be derived from the ANN extend from the perfectly normal to absolute blindness and encompass all the phases of glaucoma described within the literature.

Examples will be presented showing how patients with progressive loss pass from one class to another and how this path through the derived classes varies from that of patients with noisy but stable defects.

Conclusions. Changes in the spatial characteristics of glaucomatous field loss as evidenced by the path through classes derived from ANNs may prove a fruitful way differentiating between progressive loss and random noise.

5)

THE VISUAL FIELD IN DIABETIC RETINOPATHY

Marianne Henricsson* and Anders Heijl†

Depts of Ophthalmology in *Helsingborg and †Malmö, Sweden

We performed automated static threshold perimetry (Humphrey 30-2 full threshold program) in 63 diabetic patients at all stages of diabetic retinopathy. Each eye was tested three times giving a total of 378 visual fields. The study was designed in this way to limit disturbing effects of random field variability and lack of perimetric experience. MD, PSD and Statpac Total Deviation Probability Maps were used in the analysis of the results.

We found no evidence of visual field loss in eyes without retinopathy or with very mild and mild disease (levels 20 - 35 in the ETDRS final scale). Significantly increased field loss started in moderate diabetic retinopathy and increased with the severity of the disease. However, field loss was usually mild or at most moderate also at later stages of retinopathy.

6)

PERIMETRY FOLLOW-UP OF PATIENTS AFFECTED BY VITAMIN A DEFICIENCY

Polizzi A., Saccà S., Camoriano G.P., Barbetta M., Brezzo V.,

Schenone M., Marinari V., Gandolfo E.

University Eye Clinic - Genoa, Italy

In a previous preliminary report (Xth IPS Congress) the authors presented a transversal study on perimetric alterations in the presence of hypovitaminosis A. In the present paper the Authors report a longitudinal study in a wider group of patients.

Functional and morphological parameters were evaluated in 20 patients (12 females & 8 males), who underwent a surgical bilio-pancreatic by-pass, by means of automated perimetry, dark adaptation test, and impression cytology of conjunctiva (Wittpen's method.). Ten normal subjects (5 females & 5 males) comparable for age were examined as a control group. Significant and characteristic perimetric alterations were found, particularly in the upper visual field, associated with dark adaptation and conjunctival cytology abnormalities when low vit. A levels were present. The severity of defects was correlated with the retinol blood level rates. Those findings were promptly reversible after substitutive therapy.

Key words: Visual field, dark adaptation, hypovitaminosis A., bilio-pancreatic surgical by-pass.

MONDAY, JULY 4, 1994

13:30 PM - 15:15 PM

PAPER SESSION III

Chairperson: E. Gandolfo

Moderator: B. Lachenmayr

- 1) The Significance of the Peripheral Visual Field in Detecting Early Visual Field Changes in Glaucoma
A. Haas
- 2) Early Perimetric Diagnosis of Glaucoma By Stato-Kinetic Dissociation Assessment
E. Gandolfo, M. Zingirian, D. Erimini, R. Rossi, C. Guidi, S. Romiti
- 3) Spatial Summation in Glaucomatous Visual Fields
J. Weber, J. Baltes
- 4) Reliable False Response Rates For Perimetry
S. Demirel, A. Vingrys
- 5) Improved Reliability Estimates in the Humphrey Visual Field Test in Glaucoma Using a Knowledge Based System
J. Wu, G. Cheng, D. Poinooswamy, X. Liu, R. Hitchings
- 6) Reliability of High-Pass Resolution Perimetry in Glaucoma
B. Lindblom
- 7) Improving Estimation of False Positive and False Negative Responses in Computerized Perimetry
J. Olsson, B. Bengtsson, A. Heijl, H. Rootzén

1)

THE SIGNIFICANCE OF THE PERIPHERAL VISUAL FIELD IN DETECTING EARLY VISUAL FIELD CHANGES IN GLAUCOMA

Anita L. Haas, University Eye Clinic, Berne, Switzerland

R.P. LeBlanc, Dalhousie University, Halifax, Canada

Introduction: We asked ourselves whether you find in patients with borderline glaucoma and a normal central OCTOPUS program G1 a pathological peripheral visual field.

Patients: 77 patients with either early glaucoma or ocular hypertension were tested with the program G1 and a special program for the quantitative testing of the peripheral visual field.

Results: We found that 12% of the patients tested had an abnormal peripheral visual field but a normal G1.

Conclusions: We believe that it is necessary to test the peripheral visual field in patients having ocular hypertension and a normal G1.

2)

EARLY PERIMETRIC DIAGNOSIS OF GLAUCOMA BY STATO-KINETIC DISSOCIATION ASSESSMENT

E. Gandolfo, M. Zingirian, D. Ermini, F. Rossi, C. Guidi & S. Romiti

University Eye Clinic of Genoa - Italy (Director: Prof. M. Zingirian)

A recent investigation (Gandolfo et al., 1993) demonstrated that glaucomatous eyes with mild perimetric defects had a significant decrease of stato-kinetic dissociation (SKD), particularly in the central and paracentral visual field (VF). The aim of the present study was to verify if this alteration was also present in hypertensive eyes, as a sign of initial optic nerve damage. Fifty hypertensive eyes with normal VF (Humphrey 30-2) underwent a perimetric custom test designed for the assessment of SKD. The results were compared with those of 2 control groups (50 normal and 50 glaucomatous eyes), by means of the analysis of variance (Anova). In comparison with the normal group, SKD was, on average, significantly decreased both in glaucomatous ($p < 0.001$) and in hypertensive ($p < 0.01$) eyes. The difference between glaucoma and hypertension groups was also significant ($p < 0.01$). A statistical normality limit was calculated, in order to separately evaluate the responses of hypertensive subjects. In our sample, 16 out of 50 eyes showed a pathological SKD, that could represent the first sign of optic nerve suffering, even if further investigations and extended follow-up are needed to confirm our hypothesis.

3) **SPATIAL SUMMATION IN GLAUCOMATOUS VISUAL FIELDS**

J. Weber and J. Baltes, Department of Ophthalmology, University of Cologne

Spatial summation is the increase of sensitivity by increasing the spot size of a perimetric stimulus. Despite Ricco's law and Piper's law, it is not a constant factor but dependent on sensitivity. We investigated the amount of summation under different conditions. **Study 1:** Five Normals and five glaucoma patients were examined with stimulus sizes I, II, III, IV and V (Goldmann notation) in random order using a Humphrey Field Analyzer and a custom program with 16 test points. The resulting 80 summation curves of both groups showed great similarity. The plot of sensitivity increase against initial sensitivity showed greatest summation for low sensitivity and very low summation for high sensitivity. This relation was nearly linear and about the same for all stimulus sizes and both groups. **Conclusion 1:** Summation is mainly a function of basic sensitivity and not dependent on disease or basic stimulus size. **Study 2:** 40 glaucoma patients were examined with stimulus sizes III and V in random order using Humphrey program 24-2. The plot of sensitivity increase against initial sensitivity (IS) could be proved to be exactly linear. It was +22 dB at IS=0 dB, +10 dB at IS=20 dB and 0 dB at IS=37 dB. Eccentricity had no influence on this function. The standard error of estimate of a linear regression analysis was only 2.47 dB. **Conclusion 2:** Summation is not dependent on eccentricity. The sensitivity increase by changing from stimulus size III to V can be forecasted with very high precision. The data should be used for conversion

4) programs.

RELIABLE FALSE RESPONSE RATES FOR PERIMETRY

Shaban Demirel and Algis J Vingrys

Department of Optometry, University of Melbourne, Parkville Victoria, Australia 3052.

A 33% False positive (FP) or False negative rate (FN) is commonly used to flag an unreliable test. This cut-off value has been determined by considering the response profiles of normals rather than the effect such errors have on perimetric outcomes.

In this study we evaluate the effect that different FP & FN levels have on perimetric outcomes. Both FP's and FN's were generated automatically while a subject, who had previously demonstrated good reliability, underwent full thresholding in the central visual field. Four threshold tests were performed in the same 1 hour test session. FP and FN rates of 0%, 33% and 50% were simulated. Mean threshold and field variance (FV) were calculated and compared for the three FP and FN rates; FV is the mean of the point-wise variance of the field over the 4 tests.

FV and mean threshold increased significantly by 33% FP or FN rate ($p < 0.001$). This leads us to conclude that the 33% reliability cut-off is too high with significant changes in field parameters occurring by this level. A 33% FP or FN rate may hinder monitoring of field progression.

5) IMPROVED RELIABILITY ESTIMATES IN THE HUMPHREY VISUAL FIELD TEST IN GLAUCOMA USING A KNOWLEDGE BASED SYSTEM

Wu J^{1,2}, Cheng G³, Poinoswamy D¹, Liu X³ and Hitchings R¹: ¹*Glaucoma Unit, Moorfields Eye Hospital;* ²*Institute of Ophthalmology;* ³*Department of Computer Science, Birkbeck College, U.K.*

In the Humphrey visual field output file, it provides first threshold, second threshold and *number of questions asked* for each testing point. Several visual field data analysis packages have used those threshold data to enhance visual field interpretations.

Using the principal that interesting properties in data are more stable than the noise, the authors proposed a method which can be used effectively to filter noise in psychophysical test in glaucoma (OSA, 1994). By examining the *number of questions asked* we have applied the same principal to distinguish between unstable and stable threshold and to provide an instant assessment of reliability for each threshold obtained from the output file. In particular, a knowledge based system is being developed using both expert knowledge and the Humphrey visual field database from the Moorfields Eye Hospital. The database includes 49,653 records between January 1986 and January 1994, collected from approximately 15,000 normal volunteers, glaucoma patients, glaucoma suspects and other patients. The results achieved with this new method are being compared with those of the conventional methods in terms of false negative and false positive responses under both simulated and clinical conditions. Preliminary results have suggested that the *number of questions asked* for each threshold may provide very important information for estimating reliability of the threshold and the method may provide a satisfactory way of detecting learning effect, inattention and fatigue in the test.

6)

RELIABILITY OF HIGH-PASS RESOLUTION PERIMETRY IN GLAUCOMA

Bertil Lindblom, MD, PhD, Department of Clinical Neuroscience
Division of Ophthalmology, University of Göteborg, Göteborg, Sweden

Reliability of high-pass resolution perimetry (HRP) was studied in patients with ocular hypertension or glaucoma with various degree of visual field damage. Records from 134 eyes were analyzed. The HRP instrument judged reliability to be good in 75 (56%), dubious in 36 (27%) and poor in 23 (17%) examinations. Most rejections were due to fixation losses. Fixation errors were less common in fields with more advanced damage, regardless of subject's age. The second most common cause for rejection was an excessive number of false-negative responses. This error occurred more often in badly damaged visual fields, regardless of subject's age.

In a second study of 44 eyes with ocular hypertension or glaucoma tested by both HRP and the Humphrey Field Analyzer (HFA), reliability in the two tests were compared. Both fixation losses and false-negative responses were more common in HRP than in HFA. When HFA criteria were applied, 20% of the fields were unreliable in HRP compared to 11% in HFA.

In summary, HRP fields in patients with ocular hypertension or glaucoma were often judged unreliable. One probable reason is the larger blind spot test target in HRP compared to HFA. Another could be that some indices are sensitive not only to poor cooperation but also to the glaucoma disease process itself.

7) IMPROVING ESTIMATION OF FALSE POSITIVE AND FALSE NEGATIVE RESPONSES IN COMPUTERIZED PERIMETRY

Jonny Olsson*, Boel Bengtsson†, Anders Heijl†, Holger Rootzén*; *Dept of Mathematical Statistics,
†Dept of Ophthalmology in Malmö, University of Lund, Sweden

We have developed new methods for estimating the of false positive and false negative responses during visual field testing without the use of catch trials. Frequencies are estimated with maximum likelihood techniques using using full staircase data assuming a model: (i) that false responses occur randomly (with fixed intensity), (ii) that the threshold value at each test point location is a random variable with Gaussian distribution.

Twenty-one glaucoma patients underwent computerized testing of the central 30° field two times each. FP and FN frequencies were evaluated with our new method and the standard catch trial method. FP and FN variability decreased with the new method. Thus the square root of the average test-retest FP variance decreased from 7.6% to 1.6% for FP, and from 4.7% to 4.2% for FN. These new methods can thus simultaneously improve FP/FN accuracy and decrease test time.

MONDAY, JULY 4, 1994

16:30 PM - 18:00 PM

PAPER SESSION IV

Chairperson: C. Langerhorst

Moderator: C. Johnson

- 1) Pupil Perimetry - Methods of Pupil Threshold Determination
R. Kardon, S. Thompson
- 2) Pupil Perimetry with the Octopus 1-2-3: First Experience
O. Bergamin, S. Turtschi, A. Schotzau, J. Flammer, M. Zulauf
- 3) The Control of Blinking During Pupil Perimetry
G. Laffi, A. Safran, C. Mermoud, S. Beatty, F. Ustun, R. Meduri
- 4) Motion Sensitivity Testing in Occupational Health Screening
L. Wright, R. Wilcox, X. Wu, F. Fitzke, R. Wormald, G. Johnson
- 5) Oculokinetic Perimetry (OKP) in Health Screening Program
A. Iwase, Y. Kato, Y. Kitazawa
- 6) Ramp Stimulation Perimetry in Testing X-System
M. Takashima, S. Nagata, K. Kani, H. Tsukada, N. Obata

1) "PUPIL PERIMETRY" - METHODS OF PUPIL THRESHOLD DETERMINATION

Randy Kardon MD PhD and Stacy Thompson, Dept. Ophthalmol, Univ of Iowa, Iowa City

Purpose: To determine an optimal method of pupil threshold determination, enabling pupil and visual threshold to be compared at different locations within the visual field.

Methods: Two different methods were compared for determining pupil threshold; one method used cumulative probability functions and the other used stimulus-response functions of the pupil. A computerized infrared pupillometer was linked to a Humphrey Field Analyzer to record pupil contractions to stimuli over a range of intensities at 10 different locations in the visual field of normal subjects.

Results: There was a highly linear correlation between pupil threshold determined by probability function compared to that determined from stimulus-response curves ($R^2 > 0.9$). Using these methods, the "hill of pupil threshold" was steeper compared to visual threshold under mesopic conditions.

Conclusions: When the variability of pupil responses at a given stimulus intensity followed a normal Gaussian distribution, the two methods of threshold determination compared favorably. This implied that the stimulus-response curve at a given perimetric location can be used to derive threshold.

2)

PUPIL PERIMETRY WITH THE OCTOPUS 1-2-3: FIRST EXPERIENCE

O.Bergamin, S.Turtschi, A.Schötzau, J.Flammer, M.Zulauf - University Eye Clinic, Basel, Switzerland

The purpose of this study was to mathematically quantify the pupillary light reflex (PLR) to determine parameters appropriate for pupil perimetry with a modified OCTOPUS 1-2-3. **Materials and methods:** In 60 healthy volunteers (mean age \pm SD = 39.3 \pm 2.6 years) we compared standard pupil-perimetric parameters [Goldmann stimulus 5 (S5) at 410 apostilbs (asb) intensity, no background illumination] with three experimental conditions: A [S5 at 1632 asb] and B [S3 at 4100 asb], both with no background illumination, and C [S5 at 410 asb on a 31.4 asb background]. The raw data was processed with the analysis package provided by the manufacturer, supplemented by software of our own design. The interindividual coefficient of variability (ICV) with regard to latency time of the PLR and to the response amplitude was calculated for each experimental condition at 0°/0° and 20°/20° eccentricities.

Results: The variability for latency of PLR onset ($ICV_{latency} = 8.1\%$) was considerably smaller than that for amplitude of pupil reaction ($ICV_{amplitude} = 48.1\%$). Only for condition C [S5] were marked differences in ICV's observed at the 2 eccentricities ($ICV_{latency} = 8.4\%$ at 0°/0° and 13.6% at 20°/20°; $ICV_{amplitude} = 44.6\%$ at 0°/0° and 86.2% at 20°/20°). Thus, in conclusion, condition C [S5 at 410 asb on a 31.4 asb background], with its higher interindividual variation in both latency and amplitude, proved less suitable for pupil perimetry than did conditions A and B, i.e. without background illumination.

3) **THE CONTROL OF BLINKING DURING PUPIL PERIMETRY.**

G.L. Laffi, A.B. Safran, C. Mermoud, S. Beatty, F. Üstün, R. Meduri.

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

When pupil perimetry is performed with an illuminated background (a 3 asb background has been suggested for pupil perimetry (R. H. Kardon, 1992)), reopening of the eyes following a blink results in a transient pupillary contraction. This study was undertaken to determine the minimal time lag required between blinking and the presentation of the light stimulus, which will prevent superimposition of the pupillary contraction following reopening of the eyes with that induced by the light stimulus, when examination is performed with a 3 asb background.

Fifteen normal subjects were tested using an Octopus 1-2-3 automated perimeter, fitted with a pupillographic recording device. The background was 3 asb in intensity. A 150 msec tone was presented at ten-seconds intervals. Tested subjects were required to blink immediately following the tone. In each subject, pupillary recordings were averaged with respect to the time of blinking.

In all averaged tracings, distinct contraction and redilatation of the pupil were noted following the act of blinking. Changes lasted from 1750 to 2900 msec (mean 2200 msec) following the tone. It is therefore advised that at least 3 sec should elapse between tone and light stimulus presentations, when performing pupil perimetry using the procedure described above.

4)

MOTION SENSITIVITY TESTING IN OCCUPATIONAL HEALTH SCREENING

L.A. WRIGHT¹, R. WILCOX², X. WU³, F. W. FITZKE⁴, R.P.L. WORMALD¹, G.J. JOHNSON³

¹UNIT OF OPHTHALMOLOGY, ST MARY'S HOSPITAL MEDICAL SCHOOL; ²CABLE AND WIRELESS PLC, OCCUPATIONAL HEALTH; ³DEPARTMENTS OF PREVENTIVE OPHTHALMOLOGY AND ⁴VISUAL SCIENCE, INSTITUTE OF OPHTHALMOLOGY, UK

Since the UK Health and Safety Executive directive on workers exposed to Visual Display Units at work which was instituted as a result of EEC legislation, departments of occupational health in Industry, commerce and public services have been obliged to provide free sight testing should their employees request it. The occupational health department of Cable and Wireless PLC have exploited this opportunity to screen employees for ocular abnormalities and vision defects as a part of a general health assessment. A software package developed at the Institute of Ophthalmology for the delivery of an intermediate distance visual acuity test and a motion sensitivity test on a "notebook" computer with a monochrome Liquid Crystal Display. The results of screening the first 1283 individuals, aged 29.5 yrs SD 12.7 (ranged from 18 to 61) over the last year will be presented. 165 had repeat testing and to date, 15% persons have been referred for further assessment to several centres across the UK. Amblyopia and persons with cataracts have so far been detected but only one unconfirmed glaucoma suspect. The acceptability of the test to the work force and occupational health physicians is good. The relationship of intermediate Logmar Acuity to Motion Sensitivity will be discussed.

5) OCULOKINETIC PERIMETRY (OKP) IN HEALTH SCREENING PROGRAM

Iwase, A.* , Kato, Y.** , Kitazawa, Y.*

*Department of Ophthalmology, Gifu University School of Medicine

**The Gifu-ken Industrial Health Center

As a preliminary attempt to evaluate the ability of OKP to detect eye diseases in the public health care program which does not enroll ophthalmologists, the OKP Glaucoma Screener was used by a health care personel in 794 subjects as a part of the health screening. Eighteen subjects (22 eyes) who had the abnormal OKP results underwent ophthalmological examinations including funduscopy, tonometry and perimetry with Humphrey Visual Field Analyzer. The abnormal OKP results were attributable to open-angle glaucoma in 6 (8 eyes), retinal branch vein occlusion in 4 (4 eyes), macular degeneration in two (2 eyes), optic atrophy secondary to optic neuritis in one (1 eye), brain tumor in one (1 eye), and myopic chorioretinal atrophy in one patient (1 eye), respectively. Five eyes of 3 patients were judged to be false-positives of OKP. OKP is worthwhile to be included into the ophthalmic health care screening where funduscopy or fundusphotography is not available.

6)

RAMP STIMULATION PERIMETRY IN TESTING X-SYSTEMM. Takashima, S. Nagata, K. Kani¹, H. Tsukada and N. Obata²*1 Dept. of Ophthalmology, Shiga University of Medical Science, Otsu, Japan**2 Topcon, Tokyo, Japan*

We developed a perimetry method using ramp stimulations with an automatic perimter (SBP-2020). Stimulus sizes were 1.6, 3.2, 6.5, 13, 26 and 52 minutes. The stimulus intensity increased log. linearly in 3 seconds. Ten normal subjects were tested. The subject was requested to press a button as soon as he or she recognized the stimulation and the intensity when the button was pressed was registered as threshold. Threshold was determined at 0, 5, 10, 15 and 20 degrees from the fovea on the upper nasal line. The area-threshold curves were drawn and compared to those obtained using pulse stimulations. Th receptive field obtained using ramp stimuli was smaller than that obtained using pulse stimuli. It was similar to Okamoto's X-system results. Perimetry using ramp stimulations is simple to use and may be clinically useful. Moreover, it will provide new visual field information.

TUESDAY, JULY 5, 1994

13:30 PM - 15:15 PM

PAPER SESSION V

Chairperson: B. Schwartz

Moderator: R. Fechtner

- 1) Regional Contribution to the Reproducibility of Topographic measurements Using a Confocal Laser Scanning System
R. Fechtner, E. Essock
- 2) Inter-Operator Variability in Laser Ellipsometry of the Nerve Fiber Layer
W. Swanson, J. Lynn, R. Fellman, R. Starita, S. Schumann, D. Birch, S. Nusinowitz, J. Anderson
- 3) Accuracy and Reproducibility of the Heidelberg Retina Tomograph: Results of Volume Measurements in a Model Eye
P. Jankenecht, J. Funk
- 4) Reproducibility of Optic Disk Measurements with the Heidelberg Retina Tomograph
F. Dannheim, S. Pelka
- 5) Image Acquisition With the Heidelberg Retinal Tomograph: the Required Number of Images
C. O'Brien, N. Bolton
- 6) Three Confocal Laserscanners Compared with Retinal Nerve Fiber Layer Photography
C. Langerhorst, A. Niessen
- 7) Correlation of Visual Field Images with Scanning Laser Tomographic Imaging in Glaucoma
L. Brigatti, M. Weitzman, J. Caprioli

1) REGIONAL CONTRIBUTION TO THE REPRODUCIBILITY OF TOPOGRAPHIC MEASUREMENTS USING A CONFOCAL LASER SCANNING SYSTEM.

R.D. Fechtner, M.D., E.A. Essock, Ph. D. Department of Ophthalmology and Visual Sciences, University of Louisville School of Medicine, Louisville, KY.

Purpose: The ability to detect topographic changes in the optic nerve by sequential examinations will depend, in part, on obtaining reproducible measurements. While the reproducibility of the entire field has been studied, the reproducibility within the highly contoured optic nerve compared to the relatively flat surrounding retina has not been examined. **Methods:** One eye from each of five subjects with no known eye disease was imaged using a topographic scanning system (Laser Diagnostic Technologies Inc., San Diego). Five independent images were acquired for each eye without dilation. **Results:** Most, but not all, images could be put in registration. At each pixel, the standard deviation of the height measurements was calculated. The region of the optic nerve was defined with a circle. The mean standard deviation for the pixels inside and outside the circle were calculated. These values did not differ significantly. **Conclusions:** There was no significant difference in mean standard deviation of height measurements in the region of the optic nerve compared to outside the optic nerve in the healthy eyes studied.

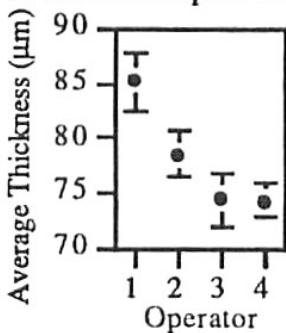
2)

INTER-OPERATOR VARIABILITY IN LASER ELLIPSOMETRY OF THE NERVE FIBER LAYER

William H. Swanson*, John R. Lynn**, Ronald L. Fellman**, Richard J. Starita**, Stephen P. Schumann**, David G. Birch*, Steven Nusinowitz*, Jane L. Anderson*

*Retina Foundation of the Southwest; **Glaucoma Associates of Texas, Dallas

Purpose: To measure operator-related variability of nerve fiber layer thickness images obtained by laser ellipsometry. **Methods:** Images were obtained with the Nerve Fiber Analyzer™ (Laser Diagnostic Technologies, Inc.), which computes 5 indices for a circle around the optic disc: average thickness, and thicknesses for 4 quadrants. Four trained operators tested 11 normal subjects twice. **Results:** Repeated-measure analysis of variance (ANOVA) showed significant effects of operator on four indices; the table and graph are for the index of average thickness.



Source	SS	df	ms	F	p
Total	9051.12	87	104.04		
Operator	1727.58	3	575.86	5.875	0.002
Session	61.88	1	61.88	0.809	0.377
Operator x Session	281.72	3	93.91	1.228	0.312
Error Operator	3921.00	40	98.03		
Error Session	3058.94	40	76.47		

Conclusion: Operator-related sources of variability must be reduced before laser ellipsometry can be widely used for detection of early glaucomatous damage or for longitudinal followup.

3) ACCURACY AND REPRODUCIBILITY OF THE HEIDELBERG RETINA TOMOGRAPH:
RESULTS OF VOLUME MEASUREMENTS IN A MODEL EYE

P.Janknecht, J. Funk, University Eye Hospital, Killianstraße 5, D-79106 Freiburg, FRG

Introduction: The Heidelberg Retina Tomograph (HRT) permits to measure the volumes of retinal elevations and depressions. We wanted to quantify the reproducibility and accuracy of the HRT in a model eye.

Methods: The HRT was used to measure 3 elevations and 3 drillings of known size which were fashioned on buttons that could be inserted into a model eye. Each of the 6 buttons was measured three times. The reproducibility was defined to be the variation coefficient of the three measurements, the relative error was defined to $\sqrt{(100 - \text{mean of the three measurements/real value} * 100)^2}$.

Results: The pooled reproducibility of the parameter "volume below (above) surface was 2.1%, the relative error was 9.5%.

Conclusions: The HRT is the first automatic device able of both measuring elevations and depressions on the retina. The instruments does so with an accuracy and reproducibility that 4) should make it possible to use the HRT for follow up of patients with glaucoma or tumors.

REPRODUCIBILITY OF OPTIC DISK MEASUREMENTS
WITH THE "HEIDELBERG RETINA TOMOGRAPH"

Fritz Dannheim & Sylvia Pelka, Dept. of Ophthalmology, University of Hamburg

Four examiners evaluated the optic disk of one eye of 12 subjects with the "HRT" 6 - 10 times. One examiner was experienced in the data acquisition with this instrument, the others were trained within a few days. The contour line around the disk of each eye was marked by one of us (F.D.) and transposed to all available measurements. The six most characteristic disk parameters were evaluated. A T-test showed significant differences between the set of measurements of each examiner in 7 eyes, highly significant differences in 4 eyes. Outlying sets of data were found for each one of the 4 examiners. The coefficient of variation of the 6 pooled parameters, falling in the range of 1.3 - 61.1%, was significantly different between the examiners in 5 eyes. These eyes were not coinciding with the ones with deviating measurements, however. Obvious high variation again occurred in each one of the examiners. There was no correlation between deviating values of disk parameters (p-value of T-test) and the coefficient of variation. Deviation and fluctuation of values independently occur in all disk parameters and cannot clearly be attributed to insufficient examiner's training. A quality parameter for each single examination might help to reject improper tests and thus improve reproducibility.

5) IMAGE ACQUISITION WITH THE HEIDELBERG RETINAL TOMOGRAPH:
THE REQUIRED NUMBER OF IMAGES.

Colm O'Brien, Nicky Bolton, Princess Alexandra Eye Pavilion, Edinburgh.

Five 10 degree optic nerve head images of 10 normal and 15 glaucoma eyes were obtained by a single experienced operator at a single session. The reproducibility (mean standard deviation of pixel height in microns) of the mean topographic image increased significantly in the glaucoma group ($p < 0.03$) with each additional image as follows:

Number of Images	2	3	4	5
Normal	18.5 ± 6.2	24.2 ± 5.8	28.9 ± 12.0	29.5 ± 11.4
Glaucoma	28.7 ± 10.7	35.4 ± 10.3	37.3 ± 11.3	41.3 ± 11.4

Thus, it may be argued that a minimum of 5 images are necessary, although the rate of increase in reproducibility reduced considerably after the acquisition of 3 images in the glaucoma group and 4 images in the normal eyes.

6)

THREE CONFOCAL LASERSCANNERS COMPARED WITH RETINAL NERVE FIBER
LAYER PHOTOGRAPHY

CT Langerhorst, AGJE Niessen, Academic Medical Center, Amsterdam.

The retinal nerve fiber layer (RNFL) of 101 glaucoma patients and ocular hypertensives, and of 24 normal controls were investigated with three confocal laser scanners: the Nerve Fiber Analyzer (NFA), the Heidelberg Retina Tomograph (HRT), and the Rodenstock Scanning Laser Ophthalmoscope (SLO). The results were compared with standard RNFL photography with a Canon CF60U fundus camera.

The most objective measurements were obtained with the SLO and HRT. Unsteadiness of fixation posed a problem with the HRT and less with the NFA. In the NFA pictures it was not possible to distinguish true RNFL defects from pseudo-defects caused by the larger retinal vessels.

Sensitivity and specificity results will be presented.

7) CORRELATION OF VISUAL FIELD INDICES WITH SCANNING LASER TOMOGRAPHIC IMAGING IN GLAUCOMA.

Brigatti L, Weitzman M, Caprioli J, Yale University School of Medicine

Purpose: To assess the correlation between automated static visual field indices and structural optic disc data obtained with a confocal laser tomographic imaging system.

Subjects and methods: One eye of forty five patients (mean age 63 ± 10 years) with early to moderate glaucoma (mean defect 4.7 ± 6.2 dB) was randomly selected. Static automated perimetry and retinal tomography (Heidelberg) was performed on all eyes. Results: Topographic data was used to describe structural characteristics of the optic disc and peripapillary nerve fiber layer. The height of the peripapillary nerve fiber layer showed a statistically significant correlation with the corrected pattern standard deviation (CPSD): $p = 0.05$, 0.003 and 0.002 for the global, inferonasal and inferotemporal quadrants. The cup depth also showed a significant correlation with both mean defect (MD) and CPSD ($p = 0.015$ and $p = 0.027$ respectively). The highest correlation ($p < 0.0001$) was found between the third central moment of the frequency distribution of the depth values and the visual field indices. The Pearson's correlation coefficient was $r = 0.657$ and $r = 0.56$ for MD and CPSD respectively. This parameter describes the skewness of the frequency distribution of heights and it is related to the overall structure of the optic disc as points with depth values far from the average (as can be found in discs with deep cups and steep cup borders) make the third moment value higher than that of discs with points of relatively uniform depth (small or no cup). Conclusions: The third central moment of the depth distribution may be considered a good indicator of the degree of damage of an optic nerve.

TUESDAY, JULY 5, 1994

16:30 PM - 18:00 PM

POSTER SESSION I

Chairperson: M. Wall

Moderator: P. Asman

- 1) New Thresholding Algorithms for Automated Static Perimetry
J. Olsson, B. Bengtsson, A. Heijl, H. Rootzen
- 2) Color-Coded Probability Maps; Separation of Field Defect Types
P. Åsman
- 3) Spatially Enhanced Modelling of Sensitivity Decay in Low Tension Glaucoma
D. Crabb, A. McNaught, F. Fitzke, R. Hitchings
- 4) Fixation Accuracy of Patients with Glaucoma During Full Threshold Perimetry
D. Henson, J. Evans
- 5) Is the Binocular Esterman Field Sensitive Enough?
M. Harris, N. Jacobs
- 6) Updating the Role of Diffuse Field Loss in Glaucoma Diagnosis
G. Corallo, M. Zingirian, E. Gandolfo, P. Capris, M. Fioretto, M. Rolando, M. Bovero, S. Cerruti, C. Guidi
- 7) Long Term Visual Field Preservation after Glaucoma Surgery
J. Funk, A. Frank
- 8) The Influence of Mitomycin C on the Visual Field
A. Gaspar, J. Flammer, D. Stümfig

POSTER SESSION I, continued

- 9) High-Pass Resolution Perimetry in Suspected Glaucoma and Ibopamine Test Positive Patients
C. Tosoni, G. Migliorati, G. Beltrame
- 10) Fluorescein Filling Defects of Glaucomatous Optic Discs and Visual Field Changes
T. Ogawa, H. Suzumura, S. Wakasugi, H. Matsumoto
- 11) Topographic Change in the Optic Nerve Head Following Acute Reduction of IOP in Glaucoma
J. Flanagan, E. O'Donoghue
- 12) Intervisit Reproducibility of the Glaucoma-scope Optic Disc Imaging System
R. Mills, M. Leen, A. Weingeist, B. Clifton
- 13) A Study of an Integrated Glaucoma Analysis System Using Computer-Assisted Image Processing Techniques
S. Yamada, S. Sugiyama, K. Kani
- 14) Scanning Ophthalmoscopy Adaptation and Stiles-Crawford Functions
F. Van de Velde, A. Jalkh, C. Schepens
- 15) Static Automated Perimetry and Scanning Laser Ophthalmoscope Microperimetry in the Assessment of Functional Damage in Operating Microscope Light Retinopathy
P. Brusini, G. Di Giorgia, E. Midena, M. Chizzolini, M. Valenti

1) NEW THRESHOLDING ALGORITHMS FOR AUTOMATED STATIC PERIMETRY

Jonny Olsson*, Boel Bengtsson[†], Anders Heijl[†], Holger Rootzén*;

*Dept of Mathematical Statistics, [†]Dept of Ophthalmology in Malmö, University of Lund, Sweden

A new type of algorithms for threshold determination in automated static perimetry is presented. The new test algorithms employ advanced models of normal and glaucomatous visual fields to calculate a posterior distribution of thresholds which is used for threshold estimation and for estimating measurement errors in real time. Algorithms can optimize stimulus presentation, and interrupt testing at prespecified levels of accuracy. This may reduce measurement errors and/or the number of questions.

We evaluated the new algorithms in simulations:

1. Measurement errors were reduced by approximately 15% when using the new method for threshold estimation, without changing the standard staircase strategy.
2. The new data acquisition methods were tested in 50 normal fields, and 50 glaucomatous fields. As compared with the standard Humphrey full threshold algorithm the mean squared threshold error decreased from 3.0 to 2.5 dB² in normal and from 4.6 to 4.5 dB² in glaucomatous fields. The number of questions decreased from 462 to 322 in normal and from 496 to 385 in glaucoma fields. The reduction in the number of questions without increased measurement error shows the usefulness of the visual field models and the ability to keep control of accuracy.

2) COLOR-CODED PROBABILITY MAPS; SEPARATION OF FIELD DEFECT TYPES

Peter Åsman, Dept. of Ophthalmology in Malmö, University of Lund, Sweden

Color-coding is introduced to increase the information content in the probability maps of the Humphrey perimeter. The maps are identical to the standard probability maps but the individual symbols are colored according to defect type. In a measured visual field the choice of color depends on the results in cluster and GHT analyses in the following way.

- All arcuate clusters with significant volume and all sectors with significant loss in the GHT are identified. Test points in these defects (the typical defect patterns in glaucoma) are plotted *red*.
- All traditional clusters (i.e. clusters of non-specific shape) with significant volume are searched and their points are plotted *blue*.
- The general height, GH (sensitive to uniform depressions across the field), is calculated. If the GH is significantly reduced all points are plotted *cyan*.

Points in normal areas are plotted *green*. The following color hierarchy is used: red–blue–cyan–green, e.g. a test point qualified for red as well as blue colors will be plotted red. Thus, typical glaucomatous defects will stand out red while other non-specific defects will be blue (localized) or cyan (diffuse). These maps are intended as a graphic complement to text-based computer-assisted interpretation tools such as the GHT.

3) SPATIALLY ENHANCED MODELLING OF SENSITIVITY DECAY IN LOW TENSION GLAUCOMA

Authors. D.P. Crabb, A.I. McNaught, F.W. Fitzke, R.A. Hitchings
Centre. Moorfields Eye Hospital, Institute of Ophthalmology and City University, London U.K.

Purpose. Application of statistical modelling and image processing techniques to describe sensitivity decay over time in low tension glaucoma (LTG).

Method. We selected 12 initially normal fellow eyes of confirmed LTG. All subjects had at least 17 Humphrey visual fields (mean follow-up 5.7 years). Competing statistical models of sensitivity loss were investigated using pointwise x (sensitivity, dB) and y (time) data with curve fitting software. The goodness of fit and predictive performance was examined. Fields were then filtered using a spatial process which extracts and quantifies the inherent variability in field data. The effect of this image processing technique on the modelling of sensitivity loss was assessed.

Results. Complex polynomial expressions provided the best fit to pointwise sensitivity loss. However, in this group a linear model of glaucomatous field decay provided the best prediction of future field status. This predictive power was enhanced by an image processing technique.

4)

FIXATION ACCURACY OF PATIENTS WITH GLAUCOMA DURING FULL THRESHOLD PERIMETRY.

David Henson, Jane Evans. University of Wales, Cardiff.

Problem. A significant problem in perimetry is the enhanced variability of visual field results in patients with and suspected of having glaucoma. One possible source of this problem is poor fixation. The purpose of this study was to determine the accuracy of fixation in a population of glaucoma patients during a full threshold visual field examination.

Technique. Results were collected from 15 clinically stable glaucoma patients all of whom exhibited a definitive nerve fibre bundle defect. Eye position was monitored with a video based system which captured a magnified image of the eye during each stimulus presentation. The locations of the first and forth Purkinje images of a collimated infra red source were used to give a measure of eye position which was accurate to within 10 mins of arc in both the horizontal and vertical meridians.

Results. The main findings of this study is that patients fall into different categories with respect to their fixation accuracy. There are those whose fixation is impeccable throughout the test, errors never, or hardly ever, exceeding 1 deg. There are those who are generally accurate but have periods during the test where fixation is unstable. During this period medium to large errors in fixation are made. Finally, there are those whose fixation is unsteady throughout the examination, and whose eyes, no matter what encouragement you give them to fixate accurately, wander all over the place. These latter patients, fortunately, tend to be few in number (2 very poor fixators in this study).

5)

IS THE BINOCULAR ESTERMAN FIELD SENSITIVE ENOUGH?

M.L.Harris, N.A.Jacobs.

London, United Kingdom.

In this study we tested 34 patients with moderate to severe glaucomatous visual field loss, to see how the severity of the disease related to the binocular Esterman field score. Patients were recruited from the glaucoma clinics of two London hospitals, all were experienced on the autoperimeter. Standard Humphrey 24-2 fields were performed for each eye, followed by the binocular Esterman test. The average mean deviation ((left MD+ right MD)/2) was used to give an indication of the severity of glaucomatous field loss. All of the average mean deviations were negative (Range -7.54 to -26.57), the range of the Esterman scores was 50 to 100. The correlation between the average mean deviation and the Esterman score was $r = 0.751$. However the Esterman score never fell below 50, suggesting that the sensitivity could be increased.

6)

"UPDATING THE ROLE OF DIFFUSE FIELD LOSS IN GLAUCOMA DIAGNOSIS"

G. Corallo - M. Zingirian - E. Gandolfo - P. Capris - M. Fioretto - M. Rolando - M. Bovero -
S. Cerruti - C. Guidi

(University Eye Clinic of Genoa - Italy) Head: Prof. M. Zingirian

The aim of our study was to investigate whether the debated hypothesis, that a diffuse light sensitivity loss may be an early sign of glaucoma, could be supported by additional clinical tests beyond perimetry with threshold strategy. We assumed, according to other Authors, that the MD in the two eyes of a normal subject is nearly identical and considered as significant a difference more than 1.5 dB. Sixty-five glaucoma suspects underwent, in addition to automatic perimetry: High-pass Resolution Perimetry, Pattern-ERG and Computerized Optic Disc Analysis. When the results of at least two of these additional tests revealed to be altered, the subjects were arbitrarily classified as glaucomatous patients. Our results were the following: 31 (88.57%) of the 35 subjects whose difference in MD value between the two eyes was lower than 1.8 dB showed normal responses in the other tests. Among the 30 subjects who showed a difference equal or higher than 1.8 dB, 14 (46.6%) had a glaucoma diagnosis confirmed by the other tests.

We conclude that an asymmetry of MD values between the two eyes in "clinically normal" visual fields can be considered as a further risk factor and suggests the need of additional investigation and more accurate follow-up of the patients.

7)

LONG TERM VISUAL FIELD PRESERVATION AFTER GLAUCOMA SURGERY

Funk J, Frank A; University eye clinic, Killianstr. 5, 79106 Freiburg, FRG

In 1983, we started a prospective monitoring of patients requiring either goniotrephination or argon laser trabeculoplasty. We now examined the visual fields (Goldmann or Octopus perimetry) of these patients after a minimum follow up of 8 years.

98 eyes could be included. After argon laser trabeculoplasty, stable fields or only minor deterioration was found in 38 of 64, after goniotrephination, stable fields or only minor deterioration was found in 23 of 34. Obviously, visual field preservation was slightly better after goniotrephination than after argon laser trabeculoplasty, although many patients treated with goniotrephination initially had more advanced glaucoma damage than patients treated with argon laser trabeculoplasty.

There was a significant ($p < 0.05$) correlation between visual field preservation and IOP regulation. Goniotrephination group: 20 fields were stable, 8 deteriorated markedly when IOP was regulated; 3 fields were stable, 3 deteriorated markedly when IOP was not regulated. Argon laser trabeculoplasty group: 22 fields were stable, 11 deteriorated markedly when IOP was regulated; 16 fields were stable, 15 deteriorated markedly when IOP was not regulated.

8)

THE INFLUENCE OF MITOMYCIN C ON THE VISUAL FIELD
Ana Z. Gaspar, M.D., Joseph Flammer, M.D., and Daniela Stümpfig
University Eye Clinic Basel, Switzerland

In patients with poor prognosis for the intraocular pressure after trabeculectomy, encouraging results with the application of Mitomycin C have been reported. However, hypotonous maculopathy, which does not always improve with resolution of the hypotony, and other complications have been described. We present our own experience with trabeculectomy combined with Mitomycin C and its influence on visual field and visual acuity.

We applied Mitomycin C (0.28mg/ml) during 2 to 5 minutes intraoperatively in 27 eyes of 27 patients. Their ages ranged from 27 to 79 years (mean \pm standard deviation, 60 ± 13 years). Refractory glaucomas, such as young and pseudophakic patients, were included in this study. They all had a perimetric follow-up of at least 6 months. The visual field was measured with OCTOPUS Program G1 several times before and at least once after surgery. As expected, 6 months after surgery the mean intraocular pressure was statistically significantly decreased. Despite frequent choroidal effusion the visual field and the visual acuity recovered in all these patients during this 6-month follow-up period and was on the average even slightly but statistically not significantly improved.

In glaucoma patients with uncertain prognosis for intraocular pressure, the intraoperative application of Mitomycin C definitely and considerably improves the intraocular pressure prognosis and seems to have no adverse effect on visual acuity or visual field. However, long-term studies on a larger group of patients will be necessary to confirm the present results.

9)

HIGH-PASS RESOLUTION PERIMETRY IN SUSPECTED GLAUCOMA AND
IBOPAMINE TEST POSITIVE PATIENTS.

TOSONI C. MIGLIORATI G. BELTRAME G.

DEPARTMENT OF OPHTHALMOLOGY GENERAL HOSPITAL UDINE ITALY

Ibopamine is a new drug with mydriatic properties without cycloplegia. Topically administered it induces IOP increase in a high percentage of patients with open-angle glaucoma but not in normal subjects.

Preliminary results regarding the efficacy of Ibopamine as a provocative test in subjects in danger of developing glaucoma, obtained with High-Pass Resolution Perimetry, are presented.

Fifteen patients with increase of intraocular pressure (IOP >21mmHg in more than two measurements), normal visual field (Humphrey 30-2 or Octopus G1 programs), normal optic disk and Ibopamine test positive, were compared with an analogue, age-matched group of Ibopamine test negative patients.

10)

FLUORESCEIN FILLING DEFECTS OF GLAUCOMATOUS OPTIC DISCS AND VISUAL
FIELD CHANGES

T. Ogawa, H. Suzumura, S. Wakasugi and H. Matsumoto

Department of Ophthalmology, Tokyo Medical College, Tokyo, JAPAN

We studied the relation between fluorescein filling defects of capillaries at the optic disc (using the scanning laser ophthalmoscope) and visual field disturbances in 10 eyes with POAG and 10 eyes with NTG.

Fluorescein filling defects of the optic disc corresponded to the location of visual field defects in all cases possessing visual field disturbances. There were no significant differences in filling defect pattern between POAG and NTG eyes of similar severity of visual field defects. Filling defects were also found in parts of the optic disc not corresponding to any visual field defect in cases of both POAG and NTG. Comparison of the percentage of area of disc filling defects and visual field defects revealed that the former tended to be larger than the latter. These results suggest that circulatory disturbances of capillaries on the optic disc may be occurring before visual field defects can be detected.

11)

**TOPOGRAPHIC CHANGE IN THE OPTIC NERVE HEAD
FOLLOWING ACUTE REDUCTION OF IOP IN GLAUCOMA**

Flanagan JG and O'Donoghue EP,
University of Manchester, Manchester

PURPOSE: To investigate topographic change in the morphology of the optic nerve head using the Heidelberg Retinal Tomographer (HRT), following acute reduction of IOP in a glaucomatous population. **METHOD:** The HRT was used to record baseline and post-therapeutic images in 18 patients undergoing trabeculectomy or Diamox therapy. Seven trabeculectomy subjects and 5 Diamox subjects met the rigorous inclusion criteria for image quality and IOP reduction. A minimum of 3 images (10° field) were recorded in each session and Mean Topography (MT) files were generated. **RESULTS:** The Topographic Difference (TD) utility was used to analyze pre- and post-therapy images. Only 1 subject with trabeculectomy demonstrated a significant and repeatable difference (NoCP = 0.44). When further analyzed using custom software within the limits of the optic nerve and for stereometric measurements, more of the sample indicated significant change. **CONCLUSIONS:** Gross change in the morphology of the optic nerve is required for the TD utility of the HRT to designate such change as significant.

12)

INTERVISIT REPRODUCIBILITY OF THE GLAUCOMA-SCOPE OPTIC DISC IMAGING SYSTEM

RP Mills, MM Leen, A Weingeist, and BC Clifton

Departments of Ophthalmology, University of Washington, Seattle WA 98195

In order for an optic disc imaging system to be useful clinically for detecting change, its reproducibility must be established. Thirty-three eyes of 33 patients underwent optic disc topographic imaging using the Glaucoma-Scope (Ophthalmic Imaging Systems, Inc., Sacramento, Calif.). In order to simulate two visits at one sitting, sets of three optic disc images were obtained first of the study eye, then of the non-study fellow eye, followed by a repeat set of the study eye. The eye chosen for the study corresponded to the eye with more disc pathology. The best disc image of the study eye in the second set was then compared against the best disc image in the first set using the system's change analysis software program. Using this protocol, a system with good reproducibility would not be expected to demonstrate change, since approximately 5 min elapsed between the first and second set of images. Qualitative (location of change) and quantitative (size and depth of change) criteria were used to categorize each pair of disc images as demonstrating GOOD, BORDERLINE or POOR reproducibility. A determination of POOR reproducibility included all those discs which would have been interpreted as showing a definite change if the Glaucoma-Scope alone were used to make a clinical decision. Reproducibility was categorized as GOOD in 30/33 (90.9%) discs, BORDERLINE in 2/33 (6.1%) discs and POOR in 1/33 (3.0%) discs. The Glaucoma-Scope optic disc imaging system offers reasonable intervisit reproducibility. Due to the potential for false positive results, any change interpreted by the change analysis program should be confirmed with careful disc and visual field examination.

13)

A STUDY OF AN INTEGRATED GLAUCOMA ANALYSIS SYSTEM USING COMPUTER-ASSISTED IMAGE PROCESSING TECHNIQUES

S. Yamada, A. Sugiyama and K. Kani

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

We developed an integrated glaucoma analysis system using computer-assisted image processing techniques, in order to evaluate the visual field, optic nerve head and retinal nerve fiber layer. This system consists of a nerve fiber coordinate system on a color fundus image and an analysis of a nerve fiber coordinate system on a color fundus image and an analysis of five parameters: visual field, pallor distribution, nerve fiber bundle defect, curve of the vessels at the disk cup, and an evaluation of four parameters in the nerve fiber coordinate system. We applied the system to eyes with glaucoma. There were overlaps of parameter peaks in some directions. This system may be useful in diagnosing glaucoma.

14)

SCANNING OPHTHALMOSCOPY ADAPTATION AND STILES-CRAWFORD FUNCTIONS.

F. J. Van de Velde, A. E. Jalkh, and C. L. Schepens. Clinical Research Unit, the Schepens Eye Research Institute and Harvard Medical School, Boston MA.

The scanning laser ophthalmoscope is used to obtain localized dark-adapted thresholds, recovery times after bleaching and Stiles-Crawford I parameters.

Three normal subjects have been tested to obtain the reference data for the horizontal meridian using microperimetry. A combined 632 nm and 780 nm illumination has the advantage of maximal transmittance and minimal scatter within the eye, minimal interference with xanthophyll and hemoglobins, and a monophasic cone response. A second infra-red Newtonian viewing channel focuses on the iris plane and documents the position of the entry pupil of the Maxwellian view SLO.

Dark-adapted thresholds, varying between 0.40 Td at the fovea, 1.87 Td at ten degrees, and adaptation curves with an average T_0 of 120 seconds are found to be independent from the residual background below 0.10 Td. The data reflects the pigment-threshold relation of Dowling-Rushton, $\log(T/T_0) = c(1-p)$. A strong Stiles-Crawford I effect is present and corroborates the empirical $\log \eta = -pr^2$ formula.

In clinical research, these techniques will be valuable in the focal assessment of the pigment epithelium-photoreceptor complex. The abnormalities that are found may indicate e.g. a dysfunction of the pigment epithelium or failure to maintain a critical O_2 gradient across the complex and as a result a reduced photopigment regeneration in Wald's cycle.

15)

STATIC AUTOMATED PERIMETRY AND SCANNING LASER OPHTHALMOSCOPE MICROPERIMETRY IN THE ASSESSMENT OF FUNCTIONAL DAMAGE IN OPERATING MICROSCOPE LIGHT RETINOPATHY.

*Paolo Brusini, *Giuseppe Di Giorgio, **Eduardo Midena, ** Marzio Chizzolini, ** Massimo Valenti

*Dept.Ophthalmology - Hospital of San Donà di Piave, Venice, Italy

*Eye Department - University of Padua, Italy

Automated static perimetry was used to examine 14 patients with retinal damage resulting from the illumination of the operating microscope after a cataract extraction. The Humphrey 30-2 program and a 2° grid custom test, aimed at the retinal lesion, were employed. The Rodenstock Scanning Laser Ophthalmoscope (SLO), using manual static microperimetry, was also employed with some patients. A fluorescein angiography was performed in all cases and the extension of the area involved was measured with the Ophthalmic Imaging System.

With the grid custom test several points with significant depression of sensitivity (6-11 dB) in the damaged area were found. The defect was not very deep and a trend towards improvement was often found in the follow-up. Moreover a foveal threshold depression was a common finding.

The use of fundus microperimetry improves the definition and localization of the damage. Setting up new fully automatic programs should improve the efficiency and ease of SLO in small retinal lesions testing.

WEDNESDAY, JULY 6, 1994

~~13:30 PM - 15:15 PM~~
0800 - 0930 AM

POSTER SESSION II
Chairperson: J. Flanagan
Moderator: J. Weber

- 1) Relationship Between Quadrants of Neuroretinal Rim Area of Glaucomatous Optic Disc and Both "Neural Capacity" of High-Pass Resolution Perimetry and Mean Deviation of HFA: A Comparative Study
Y. Kono, Q. Chi, G. Tomita, T. Yamamoto, Y. Kitazawa
- 2) Optic Disc Features and "Functional Channels" of High-Pass Resolution Perimetry
U. Iester, M. Rolando, B. Mochi, E. Semino, C. Traverso, M. Zingirian
- 3) Automated Flicker Perimetry in Glaucoma
C. Matsumoto, S. Okuyama, K. Uyama, A. Iwagaki, T. Otori
- 4) Forced Choice Flicker Perimetry in Glaucoma and Ocular Hypertension
M. Austin, C. O'Brien, A. Kosmin, P. Wishart
- 5) Correlation Between Large Field Flicker and Automated Perimetry Quantification Indices in Glaucoma Patients
A. Bechetoille, B. Boussion
- 6) The Phantom Contour Illusion Letter Test: A New Psychophysical Test for Glaucoma?
D. Williams-Lyn, J. Flanagan, G. Trope, W. Hatch, E. Harrison
- 7) Variability of Normal Visual Fields in a Prospective Study
B. Chauhan, T. McCormick, J. Whelan, R. Mohandas
- 8) Determining Progressive Visual Field Loss
M. Birch, N. O'Donnell, P. Wishart
- 9) Threshold Fluctuation in Clinically Stable Age-Related Macular Degeneration
P. Capris, M. Soldati, G. Di Lorenzo, G. Corallo, S. Rovida
- 10) Efficiency of the Standard Octopus Bracketing Procedure Compared to that of the "Dynamic" Strategy of Weber
M. Zulauf, P. Fehlmann, J. Flamer

Poster Session II, continued

- 11) Perimetric Fatigue and its Reduction Using Strategies to Improve Vigilance
L. Coman, J. Flanagan, J. Wild
- 12) Changes in Spatial Summation and SKD in the Normal Aging Eye
E. Casson, D. Zackon, H. Shillingford-Ricketts, M. Lafontaine
- 13) The Perimetry and Electrophysiological Tests in Hypovitaminosis A: Their Significance and Biological Correlations
A. Polizzi, S. Sacca, M. Fioretto, M. Schenone, C. Buono, M. Barbetta, A. De Censi, E. Gandolfo
- 14) ARGUS- A Model for an Interactive Perimetric and Functional Neuroanatomic Atlas
U. Schiefer, G. Stercken-Sorrenti
- 15) Screening for Glaucoma in a Small Town in the Netherlands
C. Langerhorst, A. Niessen, H. Geijssen, E. Greve
- 16) Vision Assessment Behind Dense Cataracts in Developing Nations
J. Enoch, M. Giraldez, D. Huang, H. Hirose, R. Knowles, P. Namperumalsamy, L. La Bree

1)

RELATIONSHIP BETWEEN QUADRANTS OF NEURORETINAL RIM AREA OF GLAUCOMATOUS OPTIC DISC AND BOTH "NEURAL CAPACITY" OF HIGH-PASS RESOLUTION PERIMETRY AND MEAN DEVIATION OF HFA : A COMPARATIVE STUDY.

Yoshiki Kono, Qi-min Chi, Goji Tomita, Tetsuya Yamamoto and Yoshiaki Kitazawa
Department of Ophthalmology, Gifu University School of Medicine, Gifu, Japan

"Neural Capacity (NC) " index of high-pass resolution perimetry (HRP) is correlated with neuroretinal rim area of the optic disc (Tomita, 1993). To clarify whether HRP or conventional differential light sensitivity perimetry (Humphrey Field Analyzer 630, HFA) relates better to glaucomatous optic disc abnormalities, the authors investigated the relationship between rim area and both NC and MD. Subjects were 47 eyes of 33 normal-tension glaucoma (NTG) patients. Rim area which was divided into temporal, superior, nasal and inferior quadrants was measured using laser scanning tomograph (Heidelberg Retina Tomograph). Local mean NC (LMNC) was calculated using the resolution thresholds corresponding to each quadrant. Local MD (LMD) was calculated using total deviations of HFA. In a total of 47 eyes, NC was significantly correlated with total rim area ($r=0.394$, $p<0.01$), but MD failed to. Superior and inferior rim areas were significantly correlated with both LMNC and LMD (superior, $r=0.503$, $p<0.01$ for LMNC ; $r=0.309$, $p<0.05$ for LMD ; inferior, $r=0.456$, $p<0.01$ for LMNC ; $r=0.403$, $p<0.01$ for LMD). However, no correlation was found between the rim areas and both LMNC and LMD in either temporal or nasal quadrant. NC was significantly correlated with total rim area in 21 eyes with early changes (stage I and II of Aulhorn's classification), but not in 26 eyes with advanced changes (stage III, IV and V). These results indicate that NC may relate better to glaucomatous optic disc changes than MD in NTG, especially in early stage.

2)

OPTIC DISC FEATURES AND "FUNCTIONAL CHANNELS"
OF HIGH-PASS RESOLUTION PERIMETRY

Iester M., Rolando M., Mochi B., Semino E.,
Traverso CE., Zingirian M. Genoa, Italy

The correlation between disc changes, measured using computerized videostereography by Topcon Imagenet and visual field defects observed with high-pass resolution perimetry (HPRP), which has been studied provides quantified results as a percentage of "functional cortico-neuro channels". In glaucomatous eye, Rim/Disc ratio showed a direct correlation with the active functional channels (FC) ($r=0.407$; $p=0.043$; $n=25$) and an indirect correlation with the global defect (GD) ($r=0.488$; $p=0.013$; $n=25$). A direct correlation between FC and nerve fiber layer height was found only in patients with less than 75% residual FC's ($r=0.512$; $p=0.25$; $n=19$). Our results demonstrated that HPRP correlates well with disc changes in glaucoma, and shows potential advantages for the assessment of glaucoma damage.

3)

AUTOMATED FLICKER PERIMETRY IN GLAUCOMA

C. Matsumoto, S. Okuyama, K. Uyama, A. Iwagaki and T. Otori

Department of Ophthalmology, Kinki University School of Medicine, Osaka-Sayama, Japan

Using the Octopus 1-2-3 and its remote software package, we developed an automated flicker perimeter and studied the static flicker fields of 150 eyes of 82 early glaucoma patients. Static fields of these patients were also tested using the program No.32 of the Octopus 201. In this study we tested the same test points using both the flicker perimeter and the Octopus 201. In addition, using red free fundus photographs and a scanning laser ophthalmoscope (SLO), we studied the correlation between the light sensitivity and the critical fusion frequency (cff) in the area where nerve fiber bundle defects were observed. At the test points where the light sensitivity showed a decrease of less than 10 dB, the cff values measured by flicker perimetry were found to decrease significantly. Fifty nine percent of test points where the light sensitivity was between 1 and 15 dB were found to be 0 Hz by flicker perimetry. It was thus concluded that automated static flicker perimetry was more sensitive in detecting early glaucomatous visual field defects than Octopus perimetry.

4)

FORCED CHOICE FLICKER PERIMETRY IN GLAUCOMA AND OCULAR HYPERTENSION

M.W. Austin, C. O' Brien, A. Kosmin, P.K. Wishart

St. Paul's Eye Unit, Royal Liverpool University Hospital, Liverpool, U.K.

We have used a prototype flicker perimeter of our own design to investigate temporal contrast sensitivity in patients with glaucoma, high risk ocular hypertension and normal controls. Three novel thresholding strategies were used based on critical flicker fusion frequency, stimulus modulation and differential light sensitivity respectively.

The results for each strategy correlated closely both with each other and with the mean sensitivities for corresponding visual field locations as measured by the HVFA using program 24 - 2. All strategies identified similar field defects in the glaucomatous subjects. For the ocular hypertensive subjects (normal fields with 24 - 2) the mean flicker perimetry threshold values did not differ significantly from those of the normal controls. There were however significant differences between the standard deviations of the two groups of subjects when thresholding by the critical flicker fusion strategy ($P = 0.001$). These results confirm the use of forced choice strategies for flicker perimetry in glaucoma and provide further evidence for flicker field defects in ocular hypertensives.

5)

CORRELATION BETWEEN LARGE FIELD FLICKER AND
AUTOMATED PERIMETRY QUANTIFICATION INDICES
IN GLAUCOMA PATIENTS

Alain BECHETOILLE and Bertrand BOUSSION

Centre Hospitalier Universitaire Angers, FRANCE

Purpose : To compare quantification indices of large field sinusoidal flicker (ARVO 93, 2773) and automated perimetry in glaucoma patients. **Method :** 41 chronic open angle glaucoma patients, age range 40 to 60, intraocular pressure normalized below 21mmHg, were tested by : 1/flickersystem - flicker index (FI), 2/Humphrey Field Analyzer, program 30-2 - mean deviation (MD), corrected pattern standard deviation (CPSD). **Results :** There was, statistically and individually, a positive correlation between FI and MD. The link was not as good between FI and CPSD. **Conclusion :** Large field sinusoidal flicker test might be usefull in screening and follow up of glaucoma patients, especially when, structural and visual, global defects are concerned.

6)

THE PHANTOM CONTOUR ILLUSION LETTER TEST: A NEW
PSYCHOPHYSICAL TEST FOR GLAUCOMA?

Williams-Lyn D¹, Flanagan JG^{1,2}, Trope GE^{1,3}, Hatch W¹, Harrison E¹,

¹The Toronto Hospital Glaucoma Research Unit, Toronto, ² University of Manchester, Manchester, ³University of Toronto, Toronto

PURPOSE: To validate the Phantom Contour Illusion Letter Test (pCILT) for a glaucomatous population. **METHOD:** The pCILT is a low spatial, high temporal frequency test generated using a phase-reversing textured border of random dots to define the 10 standard Sloane optotypes. The phase contrast threshold was determined using 2 subject groups: Group 1 consisted of 29 glaucoma subjects with repeatable visual field loss and Group 2 had 99 high risk OHTs and glaucoma subjects without visual field loss. The study was incorporated into the 5 year prospective Toronto Hospital Glaucoma Detection Study. **RESULTS:** 37 of the 99 Group 2 subjects were outside the normal, age-matched 95% confidence limits. 26 of the 29 Group 1 subjects were classified as abnormal, with the remaining 3 being within normal limits. Results will be compared to the year 1 to 3 results for Blue on Yellow Perimetry, Peripheral Displacement Thresholds and for those Group 2 subjects that have converted. **CONCLUSION:** The pCILT is a rapid, simple test capable of detecting early glaucoma prior to standard automated perimetry.

7) VARIABILITY OF NORMAL VISUAL FIELDS IN A PROSPECTIVE STUDY

Balwantray C. Chauhan, Terry A. McCormick, James H. Whelan and Rajender N. Mohandas
Department of Ophthalmology, Dalhousie University, Halifax, NS

We present results from a prospective study of clinically normal subjects undergoing psychophysical tests including the 30-2 program of the Humphrey Field Analyser. We examined the serial changes in inter-individual variability and intra-individual test-retest variability of the visual fields. A total of 144 subjects (mean age 50.24 years, range 30 to 84 years) were enrolled and are tested every six months. Currently, 129 subjects have had a 1-year follow-up (3 exams), 94 a 2-year follow-up (5 exams) and 9 a 3-year follow-up (7 exams). In all exams, the inter-individual variability increased exponentially with eccentricity of test location. At exam 1, the 95% confidence interval of threshold deviations of the fitted function was 18 dB for the most peripheral locations. This value decreased to 13 dB for exams 2 and 3. The corresponding values for the most central locations, however, remained constant at 6 dB for exams 1-3. Test-retest variability was estimated in manner described previously in glaucoma patients (Heijl et al., 1989). Age effects on test-retest variability were not meaningful when subjects were divided into three age groups. For locations with negative deviations, normal subjects had a larger regression-to-the mean effect compared to glaucoma patients. The 90% confidence interval of test-retest variability were compared for deviations ranging -6 to 4 dB. Even when matched for deviation level, glaucoma patients showed up to twice the test-retest variability compared to normal subjects.

8)

DETERMINING PROGRESSIVE VISUAL FIELD LOSS

MK Birch, NP O'Donnell, PK Wishart.

Royal Liverpool University Hospital, Liverpool

Serial Humphrey Fields of 101 eyes (65 eyes with ocular hypertension (OH), 36 eyes with glaucoma) were examined to detect progressive field loss over a mean follow-up period of 4 years. We compared the following 4 methods to detect deterioration: Clinical evaluation of serial Grey Scales (CESGS), Statpac 2 Glaucoma Change Probability (GCP), Linear Regression Analysis (LRA), Fitzke's Progressor Programme (PP). CESGC of 65 eyes with OH showed 2 eyes converted to glaucoma. Fitzke's PP identified these 2 eyes as deteriorating and classified all other eyes in the OH group as stable. However GCP identified 14 OH eyes and LRA 6 OH eyes as deteriorating. Of 36 eyes with glaucoma, CESGC classified 3 eyes as deteriorating while GCP identified 6 eyes, LRA 4 eyes and Fitzke's PP 26 eyes as showing deterioration.

9)

THRESHOLD FLUCTUATION IN CLINICALLY STABLE AGE-RELATED MACULAR DEGENERATION

Capris P. - Soldati M.R. - Di Lorenzo G. - Corallo G. - Rovida S.
University Eye Clinic - Genoa - Italy
(Head: Prof. M. Zingirian)

The clinical evolution in age-related macular degeneration (ARMD) is usually evaluated by means of visual acuity, fluorangiography and perimetry. Perimetric evaluation of differential light sensitivity changes in macular diseases is difficult in consequence of threshold fluctuation. The Authors studied the long-term fluctuation of light sensitivity in a group of patients affected by clinically stable ARMD to estimate the magnitude of non progressive variability of static threshold. Fiftythree eyes of 31 patients underwent clinical, fluorangiographic and perimetric examinations every 4 months. Twenty eyes of this group, which showed no evidence of clinical deterioration were finally included in the study. Perimetric evaluation was carried out with threshold static examination inside 10° (Central 10-2 program - Humphrey 640 VFA). The overall mean sensitivity fluctuation resulted 2.1 ± 0.3 dB. The point by point fluctuation appeared to be related to sensitivity and not to location. The data collected can help to differentiate real decrease in sensitivity from non-progressive fluctuation.

10)

EFFICIENCY OF THE STANDARD OCTOPUS BRACKETING PROCEDURE COMPARE TO THAT OF THE "DYNAMIC" STRATEGY OF WEBER

M.Zulauf, P.Fehlmann, J.Flammer - University Eye Clinic, Basel, Switzerland

Purpose: There is ample reason to strive for a shorter test strategy with reproducibility similar to that of standard bracketing procedures. In this investigation we compared the standard OCTOPUS bracketing procedure with the "dynamic" strategy of Weber.

Materials and methods: In 24 glaucoma patients, examinations were made with an OCTOPUS 1-2-3 (Program GLX, first stage) employing these two strategies pairwise on three occasions at least two days apart.

Results: The mean defect gained with the standard procedure was 5.2 ± 7.5 dB; that obtained with the Weber "dynamic" strategy was 4.6 ± 7.2 dB. Short-term fluctuations averaged 3.0 ± 4.2 dB for the former group and 3.7 ± 5.2 dB for the latter group. The numbers of stimuli applied were 5.8 ± 1.4 and 3.0 ± 1.0 , respectively.

Conclusion: The Weber "dynamic" strategy, producing 23% more short-term fluctuations but requiring 48% fewer stimuli, is obviously the more efficient of the two procedures.

11)

PERIMETRIC FATIGUE AND ITS REDUCTION USING STRATEGIES TO IMPROVE VIGILANCE

Coman L¹, Flanagan JG² and Wild JM³, ¹University of Waterloo, Waterloo, ² University of Manchester, Manchester, ³ Aston University, Birmingham

PURPOSE: Quantification of the perimetric fatigue effect and its reduction using strategies designed to improve vigilance. **METHODS:** 21 normal subjects (mean age 57 years) performed routine automated perimetry using Programme 30-2 of the HFA 630. 7 sessions were undertaken including a training session and a baseline test. The other 5 sessions represented different strategies intended to improve vigilance and included visual and auditory cues, enforced rests and encouragement. The study employed a simple randomised crossover design with the order of eye examination randomly assigned and maintained for each session. A repeated measures ANCOVA was performed with Eye Sequence, Stage and Strategy as separate within-subject factors. **RESULTS:** There was a significant effect for Eye Sequence and Stage for all Strategies but no effect for Strategy itself. **CONCLUSIONS:** The fatigue effect dominated all attempted strategies to maintain a singular level of performance throughout the examination period in a trained, normal, elderly population.

12)

CHANGES IN SPATIAL SUMMATION AND SKD IN THE NORMAL AGING EYE

E. J. Casson, D. H. Zackon, H. Shillingford-Ricketts, M. Lafontaine
University of Ottawa Eye Institute, Ottawa, Canada

Physiologic statokinetic dissociation (SKD) and spatial summation effects (SS) are known to exist in normals, as well as in patients. We have previously reported that increased SKD and SS are found in the same patients. However, the relationship between these two variables needs to be assessed in the normal population as our first step in understanding how it is altered by pathology. We used automated static and kinetic perimetry to investigate SS and SKD in a group of 46 normals ranging from 20 to 75 years of age. We found that both SKD and SS increase with age and the two variables are directly related in all age groups. Furthermore, the slope of the function relating the amount of SKD and SS increases substantially with age. These findings suggest (1) a role for changes in the number and interaction of functional detectors across the visual field with aging and (2) that caution is needed in the comparison of static and kinetic fields in older individuals

Supported by a grant from the OGH Research Fund.

13)

THE PERIMETRY AND ELECTROPHYSIOLOGICAL TESTS IN
HYPOVITAMINOSIS A: THEIR SIGNIFICANCE AND BIOLOGICAL
CORRELATIONS.

Polizzi A., Saccà S., Fioretto M., Schenone M., Buono C., Barbetta M.,
De Censi A., Gandolfo E.

University Eye Clinic - Genoa - Italy

Fifty-one patients, affected by mild hypovitaminosis A, caused by the use of fenretinide (HPR), a synthetic retinoid anti-metabolite, were examined. Twenty-eight normal subjects were examined as control group. During a follow-up of several years the patients showed perimetric alterations (absolute scotomas, fascicular relative defects and global threshold elevation) and electrophysical alterations of amplitude of the ERG and VEP waves in these patients. These alterations are the result of the reduction of vitamin A: in fact HPR competes with retinol and seems to influence not only the metabolism of the photoreceptors but also that of the entire visual nervous system. The defect in the field of vision can be restored to normality with vitamin A therapy.

Key Words: Automated perimetry, electrophysiological test, ERG, VEP, vitamin A, fenretinide (HPR)

14)

A.R.G.U.S. – A MODEL FOR AN INTERACTIVE PERIMETRIC AND FUNCTIONAL
NEUROANATOMIC ATLAS

U. Schiefer, G. Stercken-Sorrenti

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

A.R.G.U.S. is a data base that connects scotomata directly with possible sites of lesions in the optic pathway that are presented graphically.

Visual field defects can be depicted on a VDU by means of a touch-screen or a "mouse" while on a second monitor the computer program simultaneously shows the resulting defects in the visual pathway and the specific pattern of optic atrophy. It is possible to page through different sections of the visual pathway; the lesion is most probably located in that section where on the one hand the affected fibers lie most closely to each other and on the other hand the non-affected fibers are maximally apart, respectively. Additionally, the VDU depicting the visual pathway can show the surrounding anatomic structures in the form of brain sections. Even in these sections, lesions can be superimposed interactively; the resulting scotomata are simultaneously depicted on the "visual field VDU". Anatomic and functional details can be displayed by touching the structure of interest. For educational reasons, a video clip (demonstrating neuro-ophthalmological symptoms like refraction scotoma, afferent pupillary defect or different types of nystagm) can be activated in the same way. New anatomic findings can be considered by modifying the course of the fibers of the visual pathway. This new technique is especially helpful in distributing comprehensive neuro-ophthalmological knowledge.

15) SCREENING FOR GLAUCOMA IN A SMALL TOWN IN THE NETHERLANDS

CT Langerhorst, AGJE Niessen, HC Geijssen, EL Greve,
Academic Medical Center, Amsterdam.

In total 1259 inhabitants over 50 years of age were screened for glaucoma with the following investigations: Pulsair non-contact tonometry, Henson (CFS 3000) perimetry, fundus photography of optic nerve head and retinal nerve fiber layer (Canon non-mydratic camera) and anterior chamber depth (von Herick method). These measurements were performed by an especially trained team of university students.

Generally the students performed their task well. The non-contact tonometers in this study proved to give unreliable results when used so intensively. After fundus photography of one eye, the pupil of the other eye remained miotic for quite a while, which gave some logistic problems. 25 % of the photo's could not be judged due to inferior quality. Blond fundi posed another problem.

Practical experience with this type of screening will be presented, as well as sensitivity and specificity outcomes.

16)

VISION ASSESSMENT BEHIND DENSE CATARACTS IN DEVELOPING NATIONS.

Jay M. Enoch¹, M. Giraldez², D. Huang³, H. Hirose⁴, R. Knowles⁵, P. Namperumalsamy⁶, L. La Bree⁷: School of Optometry¹⁻⁵, UC Berkeley; School of Optom, Santiago y Compostela², ES; Pacific Med Ctr, San Francisco³; Dep't Ophthalmol, U. Nagoya, JA⁴; Aravind Eye Hospital, Madurai, IN^{1,5,6}, Dep't Biometry, USC, Los Angeles⁷.

An advanced design Vernier acuity (hyperacuity) test instrument is being tested at Aravind Eye Hospital, Madurai, India. This device has evolved from earlier forms. A high luminance orange three point display is used. The patient sets the moveable central point in line with two vertically disposed fixed points. This instrument is a precursor to a field device which will be used in a Clinical Study to be initiated at Aravind late in 1994. Both central and non-central points can be tested, and means are taken to minimize the effects of uncorrected (or poorly corrected) refraction. We seek to predict post-surgical vision outcome for the ophthalmic surgeon. This is a critical issue in developing nations where 20-30% of surgeries do not result in a satisfactory visual result.

WEDNESDAY, JULY 6, 1994

10:00 AM - 11:45 AM

PAPER SESSION VI

Chairperson: E. Werner

Moderator: P. Capris

- 1) High Resolution Central Visual Field to Detect Progressive Glaucomatous Damage
M. Weitzman, T. Zeyen, J. Caprioli
- 2) Central Visual Dysfunction in Early Glaucoma
K. Mizokami, Y. Tanaka
- 3) Blue-on-Yellow Perimetry in Glaucoma Suspects and Confirmed Glaucoma
I. Moss, J. Wild, D. Whitaker, E. O'Neill
- 4) Automated Perimetry for a Blue Test Light on an Intense White Background in Glaucoma
H. Gunji, K. Kitahara, G. Takahashi
- 5) Glaucomatous Visual Field Loss Detected by Threshold Light Offset Stimuli
E. Mutlukan, B. Skarf
- 6) Diagnostic Value of Asymmetric Optic Disc Parameters in Patients with Unilateral Glaucoma
J. Meyer, J. Funk
- 7) Correlation Between Visual Field and Optic Disk in Congenital Glaucoma
R. Sampaolesi

1) HIGH RESOLUTION CENTRAL VISUAL FIELD TO DETECT
PROGRESSIVE GLAUCOMATOUS DAMAGE

M. Weitzman, T. Zeyen, J. Caprioli

Yale University Department of Ophthalmology and Visual Science

Purpose. To evaluate the sensitivity of determining glaucomatous progression with Octopus programs G1 and C08 (a high resolution, central 8 degree test) in patients with advanced glaucomatous visual field loss.

Methods. Eighty patients were identified who had completed a mean of 5.7 (range 4-12) pairs of same days tests with both programs G1 or 32 and C08 over a mean of 53 months (range 13-103). Each patient's central and standard size fields were separately evaluated for glaucomatous progression in a masked fashion by three experienced observers.

Agreement by at least two observers was required to define progression.

Results. Forty patients were graded stable on both types of fields. Of the 40 patients who showed progression on at least one type of field, 13 (32.5%) progressed on both types, 22 (55%) progressed on program C08 only, and 5 (12.5%) progressed on program G1 or 32 only. C08 detected significantly more of the progressing patients, 35 (87.5%), while G1-32 detected 18 (45%) ($p < 0.0001 \chi^2$).

Conclusion. In this patient population, program C08 is more sensitive than standard 30 degree tests in determining glaucomatous visual field progression.

2)

CENTRAL VISUAL DYSFUNCTION IN EARLY STAGE GLAUCOMA

Kuniyoshi Mizokami, Yoshiaki Tanaka

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

In this study we statistically evaluated the characteristics of central visual dysfunctions in early to middle glaucomatous stage. The central visual functions were determined by visual acuity and modulation transfer function in 184 eyes.

Nerve fiber bundle atrophy (NFA) in papillo-macular bundles was also determined in 102 eyes. The correlation between these central visual dysfunctions and several clinical factors (age, refractive error, visual field damage, intraocular pressure, therapy) were statistically analyzed. These results suggested that myopia and younger age are risk factors for disturbance in the central visual function of glaucoma.

3)

BLUE-ON-YELLOW PERIMETRY IN GLAUCOMA SUSPECTS AND CONFIRMED GLAUCOMA

LD Moss¹, JM Wild¹, D Whitaker¹ and E C O'Neill²

¹Department of Vision Sciences, Aston University, Birmingham, UK. ²Glaucoma Department, Birmingham and Midland Eye Hospital, Birmingham, UK.

Purpose: To evaluate Blue-on-Yellow (B-Y) perimetry in glaucoma suspects (GS) with normal White-on-White (W-W) fields and in confirmed glaucoma (POAG) patients with varying degrees of W-W visual field loss.

Methods: The sample comprised 20 GS and 20 POAG patients (Mean age 69.0 years SD 7.7). All patients underwent the standard W-W perimetric examination in one designated eye using program 24-2 and B-Y perimetry using a modified HFA 640 (Schott OCLI blue stimulus (size V), yellow Schott OG530, background luminance 330cdm^{-2}). B-Y sensitivity was corrected for individual ocular media absorption using the standard technique of Sample et al (IOVS 29: 1989). Results were compared to an age-matched normal database of 40 subjects (Mean age 69.6 years SD 6.54 Range 60-81years). Mean deviation (MD) and corrected pattern standard deviation (CPSD) indices were calculated for the W-W and B-Y fields of each patient. Total and pattern deviation probability maps were also calculated for both W-W and B-Y fields.

Results: GS patients exhibited a negative MD, ie a reduced perimetric sensitivity, for B-Y compared to that for W-W. Furthermore, 6 out of 20 eyes showed a B-Y focal abnormality compared to the normal W-W field defined by the pattern deviation map and the CPSD. In POAG, where early W-W field loss exists, the B-Y loss appeared wider (pattern map) and possibly more diffuse in nature when represented by the total deviation probability map. Where marked visual field abnormality existed, there were no significant differences in the appearance of the probability plots and in the global indices between the B-Y and the W-W field.

Conclusions: B-Y perimetry can detect visual field loss in glaucoma suspects before that found using conventional W-W perimetry. In early POAG the extent of loss is greater for B-Y stimuli. Caution, however, is necessary in cases of established glaucoma since SWS isolation may not be preserved in areas of deep scotomata.

IDM is funded by a research studentship from the RNIB.

4)

AUTOMATED PERIMETRY FOR A BLUE TEST LIGHT ON AN INTENSE WHITE BACKGROUND IN GLAUCOMA.

H.Gunji, K. Kitahara, and G.Takahashi Department of Ophthalmology
The Jikei University School of Medicine, Tokyo, Japan

The usefulness of so called the blue-on-yellow perimetry for detecting early visual field changes in glaucoma has been reported. However, it is difficult to obtain the necessary intensity of the yellow background in order to detect the S-cone pathway sensitivity. In this study, we applied the procedures for a blue test light on an intense white background with automated perimetry for early diagnosis of glaucoma. The necessary intensity of the white background for detecting the S-cone pathway sensitivity was determined by measuring the extra-foveal spectral sensitivities on various intensities of white backgrounds. Thirty patients with ocular hypertension or early glaucoma were studied. We found that the sensitivity in 10-20' area of visual field is significantly lower than that of conventional white-on-white automated perimetric procedures. As a result, it was suggested that this method might be useful for early diagnosis of glaucoma.

5)

GLAUCOMATOUS VISUAL FIELD LOSS DETECTED BY THRESHOLD LIGHT OFFSET STIMULI

Erkan Mutlukan, Barry Skarf
Henry Ford Health System, Detroit

The visual system has differential sensitivity to both light onsets and light offsets. It is possible that testing with light offset (dark-on-bright) stimuli may facilitate the diagnosis of visual field loss in glaucoma. Twenty-one primary open angle glaucoma (POAG) patients (mean age 63 y; range: 37-76 y), 21 ocular hypertensive (OHT) patients (mean age 61 y; range: 39-75 y) and 13 normal individuals (mean age 60 y; range 40-84 y) were tested with full threshold test program 24-2 of the Humphrey Visual Field Analyser, using conventional light onset stimuli. The same eyes were also tested with offset stimuli created on a video-display unit (VDU), using an ascending staircase single crossing threshold combined with a computerised moving fixation method. The test grid for light offsets was identical to that of 24-2 program and consisted of 54 test locations. Both onset and offset stimuli were of 16 mm² (size IV) and presented for 0.2 seconds on 10 cd/m² background. The threshold 95% confidence interval (CI) levels were calculated at each test location for both types of stimuli in the control group. Test locations with decreased sensitivity outside the 95% CI were determined in the POAG and OHT groups and global field indices of 'Mean Defect' (MD) and 'Loss Variance' (LV) were calculated for each eye. The offset stimuli had 95% (20/21) sensitivity in the POAG group and 77% (10/13) specificity in the control group. In the OHT group, offset stimuli indicated field abnormality in 62% (13/21) of the eyes which tended to be the ones with higher risk of developing glaucoma. The topographical distribution of the field defects to light offset stimuli in the POAG and OHT groups was found to be nerve fiber layer type and similar to that revealed by light onset stimuli in the POAG group. The results suggest that light offset stimuli indicate glaucomatous damage satisfactorily and may also reveal early visual field loss.

6)

DIAGNOSTIC VALUE OF ASYMMETRIC OPTIC DISC PARAMETERS IN PATIENTS WITH UNILATERAL GLAUCOMA.

J. H. Meyer, J. Funk; Univ.-Augenklinik, Killianstr. 5, 79106 Freiburg/Brsg., Germany

We wanted to know how well intra-individual asymmetries in optic disc parameters can indicate glaucomatous damage. 45 patients with unilateral or highly asymmetric glaucoma (Octopus G1: $\Delta MD > 2dB$, $\Delta IOP > 5mmHg$, asymmetrically cupped discs, no other ocular disease) were examined with the Rodenstock optic nerve head analyzer and the Heidelberg retina tomograph. 28 healthy volunteers served as controls. **Results:**

Parameter	Mean \pm SD		t-test	Sensitivity	Specificity
ONHA:	glaucoma	normal			
Δ rim area	0,31 \pm 0,13 mm ²	0,01 \pm 0,17 mm ²	p=0,0001	84%	86%
Δ cup disc ratio	-0,14 \pm 0,09	0,02 \pm 0,1	p=0,0001	80%	86%
HRT					
Δ vol. bel. surface	-0,25 \pm 0,26 mm ³	-0,04 \pm 0,18 mm ³	p=0,0049	75%	80%
Δ max. depth	-0,09 \pm 0,15 mm	-0,003 \pm 0,21 mm	p=0,0972	-	-
Δ area	-0,06 \pm 0,21 mm ²	0,08 \pm 0,14 mm ²	p=0,0155	-	-
Δ effective area	-0,19 \pm 0,37 mm ²	-0,08 \pm 0,14 mm ²	p=0,2811	-	-

Conclusions: Intra-individual differences (healthy-glaucoma eye) in rim area and cup disc ratio, obtained with the ONHA, were best suited to differentiate between unilateral glaucoma and normal. Of HRT parameters only " Δ volume below surface" reaches the diagnostic value of the two ONHA parameters. The diagnostic value of the other HRT parameters is worse in this regard.

7)

CORRELATION BETWEEN VISUAL FIELD AND OPTIC DISK IN
CONGENITAL GLAUCOMA

Roberto Sampaolesi, University of Buenos Aires

The population presented at the 1990 IPS Meeting was further studied by performing visual field examinations with Octopus 1-2-3 and High-pass resolution perimetry and confocal tomography with the Heidelberg Retina Tomograph, with which the optic disk parameters were assessed.

The population was divided into 3 groups: G1: congenital glaucomas operated once before 6 months of age; G2: congenital glaucomas reoperated once or more times and G3: late congenital glaucomas, Rieger's syndromes and juvenile open angle glaucomas.

These new examinations were performed after a follow-up ranging between 10 and 28 years. G2 presents severer damage of optic disk and visual field.

WEDNESDAY, JULY 6, 1994

13:30 PM - 14:45 PM

PAPER SESSION VII

Chairperson: L. Frisen

Moderator: P. Brusini

- 1) Perimetric Learning in Glaucoma
A. Heijl, B. Bengtsson
- 2) The Feasibility of Automated Visual Field Examination in Children Between 5 and 8 Years of Age
A. Safran, G. Laffi, A. Bullinger, P. Viviani, C. de Weisse, D. Désangles, C. Mermoud
- 3) Is There an accelerated Loss at Older Age for Normal Sensitivity in the central Visual Field?
B. Lachenmayr, S. Kojetinsky, P. Vivell
- 4) Multi-Dimensional Colour, Flicker and Increment Perimetry
A. Vingrys, S. Demirel, M. Kalloniatis
- 5) High-Pass Resolution Perimetry: Central-Field Neuroretinal Correlates
L. Frisen

1)

PERIMETRIC LEARNING IN GLAUCOMA.

Anders Heijl and Boel Bengtsson
Dept. of Ophthalmology in Malmö, University of Lund, Sweden

The influence of perimetric experience was prospectively studied in 37 glaucomatous eyes of 25 patients, who had not undergone any kind of perimetry prior to inclusion. Each patient underwent 10 field examinations divided between 5 test sessions; inter-test intervals were approximately one week. The 30-2 Full Threshold program of the Humphrey perimeter was used.

Improvement was obvious in greyscales in 57% of glaucomatous eyes. Average improvement of MD in these eyes was 5.03 dB. The number of normal points increased with learning. Average Mean Deviation (MD) improved significantly ($p < 0.001$) between the first and second sessions. Visual fields with a moderate field loss showed larger improvements of sensitivity than fields with severe or mild loss. Learning effects were more pronounced in the periphery than paracentrally. The regular and large effect of perimetric learning in glaucomatous eye demonstrated here, has obvious clinical implications.

2)

**THE FEASIBILITY OF AUTOMATED VISUAL FIELD EXAMINATION
IN CHILDREN BETWEEN 5 AND 8 YEARS OF AGE**

Avinoam B. Safran, Gian Luca Laffi, André Bullinger, Paolo Viviani, Catherine de Weisse, Dominique Désangles, and Christophe Mermoud.
Neuro-Ophthalmology Unit, Geneva University Hospital, Geneva, Switzerland.

To investigate how young children develop the ability to undergo a visual field evaluation using regular automated perimetry, 42 normal girls, aged 5, 6, 7, and 8 years, were tested. Twelve locations in the central 15-degree area were tested three times in succession, using the Octopus 2000R with a 2-level strategy. False-positive and false-negative catch trials were presented. Before the examination, a specially designed program was conducted for familiarization.

With the exception of only one 5-year-old child, all tested subjects were able to complete the planned procedure. The proportion of false-negative answers in the catch trials was negligible. The overall proportion of false-positive answers was 17.9 % (0 - 75%) during the first examination, and 7.4% (0 - 51%) during the third examination.

Children did remarkably well regarding both the duration of the examination and the reliability of the answers. A preliminary familiarization phase with a specially-designed adaptation program was found to be mandatory with children aged seven or under. To our knowledge, this is the first time that such an investigation has been performed with children under seven years of age.

3)

IS THERE AN ACCELERATED LOSS AT OLDER AGE FOR NORMAL SENSITIVITY IN THE CENTRAL VISUAL FIELD?

Lachenmayr BJ, Kojetinsky S, Vivell PM

University Eye Hospital, Section of Psychophysics and Physiological Optics

Aim of the present study was to verify whether or not an accelerated loss at older age is present for normal subjects in the central visual field. 117 eyes of 117 subjects aged 9 to 86 years (exclusion criteria [1]) were tested with the Humphrey-Field-Analyzer 640, program 30-2, the Rodenstock Peristat 433 PRT, program GL1, the Octopus 1-2-3, program G1, our automated flicker perimeter [2,3] and the resolution perimeter of Frisén [4]. Global indices were calculated as follows: mean light-difference sensitivity MS for the various light-sense perimeters, mean flicker fusion frequency MF for the flicker perimeter and mean ring score MR for the resolution perimeter. For all procedures global sensitivity decreases with increasing age. In order to verify whether or not a linear or bilinear model is appropriate for the description of the data, the statistical approach of Owsley et al [5] was used. Both for the various light-sense perimeters and the resolution perimeter a statistically significant accelerated loss of sensitivity at older age is present. This is not the case for flicker perimetry, however. A possible explanation could be the stimulus configuration of flicker perimetry which is largely independent from preretinal factors.

[1] Lachenmayr BJ et al. Invest Ophthalmol Vis Sci 33:3010, 1992. [2] Lachenmayr B et al. Perimetry Update 1988/1989, pp 359-368, 1989. [3] Lachenmayr BJ et al. Graefe's Arch Clin Exp Ophthalmol 229:267-273, 1991. [4] Frisén L. Doc Ophthalmol Proc Ser 49:441-446, 1987. [5] Owsley C et al. Invest Ophthalmol Vis Sci 33(suppl.):1414, 1992.

4)

MULTI-DIMENSIONAL COLOUR, FLICKER AND INCREMENT PERIMETRY.

Algis J Vingrys, Shaban Demirel and Michael Kalloniatis.

Department of Optometry, University of Melbourne, Parkville Victoria, Australia 3052.

Isolating colour or flicker mechanisms may help identify early visual loss. We consider whether a multi-dimensional stimulus (simultaneously containing a luminance increment, colour and flicker) can be used to isolate such mechanisms. For this study we used an LED perimeter which presents green LEDs (0.43° , $\lambda_{\max}=565\text{nm}$) on a white background ($\text{Lum}=10\text{ cd/m}^2$). The LEDs were flickered with a 50% duty cycle at 0-36 Hz. Thresholds were obtained with a 6/3dB staircase with subjects responding to different detection criteria (increment, flicker or colour). Stimulus duration was 1 sec. We tested 4 experienced observers (aged 24-42) at $0-22^\circ$ along a single meridian (45°); 2 extensively and 2 with a reduced protocol. The means and SDs of multiple thresholds (at least 6) were analysed.

The colour, flicker and increment hills of vision differed and could be modelled using power functions with flicker and increment functions coinciding for frequencies ≤ 9 Hz. We propose that two detection mechanisms can be isolated using multi-dimensional stimuli and criteria priming. One is sensitive to fast flicker and the other is sensitive to low frequency (static) increments: both have colour and achromatic components. Differentiation between these temporal filters is complete using an 18 Hz flicker rate. We suggest a protocol for clinical application that taps the fast flicker mechanism.

5)

HIGH-PASS RESOLUTION PERIMETRY:
CENTRAL-FIELD NEURORETINAL CORRELATES

Lars Frisén, Dept Ophthalmology, University of Göteborg, Sweden

Minimum angles of resolution (MAR) were measured at 0 - 10 degrees horizontal eccentricity in three normal subjects, using high-pass spatial frequency filtered ring targets, at four different contrast levels.

Results were correlated with recent data on human cone and ganglion cell separations in corresponding retinal locations. MARs and cone separations showed a close proportionality through the origin for all contrast levels. Ganglion cell correlates were more difficult to elucidate as the cell bodies are displaced from their input cones.

Taking a functional estimate of the displacement into account, the number of ganglion cells appeared to be large enough to uphold an "effective" distribution that obeys the same proportional relationship to MAR that previously has been demonstrated outside 10 degrees. Analysis of the nature of age effects provided support for this model.

WEDNESDAY, JULY 6, 1994

15:05 PM - 16:35 PM

POSTER SESSION III

Chairperson: J. Wild

Moderator: A. Safran

- 1) Influence of Carteolol on the Visual Fields of Patients with Normal Tension Glaucoma (a preliminary report)
N. Oku, Y. Tanaka, K. Mizokami
- 2) The Acute and Chronic Effect of B1-Selective and Non-Selective B-Blockers on Macular Blood Flow and Contrast Sensitivity in Glaucoma
J. Piltz, S. Bose
- 3) Correlation Between Intraocular Circulatory Dynamics and Visual Field Defect in Normal-Tension Glaucoma
Y. Yamazaki, S. Miyamoto, F. Hayamizu
- 4) Correlation Between IOP Changes and Deterioration of the Visual Field According to Nerve Fibre Bundle Map
I. Ugi, A. Wegner, R. Wertheimer, R. Lehr
- 5) Fastpac Error is Within Long-Term Fluctuation of Humphrey Statpac Field Analyses
N. O'Donnell, M. Birch, P. Wishart
- 6) Evaluation of the Repeatability of Fastpac in Glaucoma
W. Hatch, J. Flanagan, G. Trope
- 7) Test Time and efficiency of the Dynamic Strategy in Glaucoma Perimetry
T. Klimaschka, J. Weber
- 8) The Effect of Audio and Visual Cueing on Automated Visual Field Testing
R. Mills, T. Yang, Y. Li,
- 9) The Influence of the Stimulus Duration on Perimetric Thresholds in the Central 30° Visual Field
S. Okuyama, C. Matsumoto, K. Uyama, O. Otsuji, T. Otori
- 10) Pericecal Sensitivity Studies by Means of Scanning Laser Ophthalmoscope
G. Panta, D. Randazzo, J. Ott, G. Nicoletti, A. Reibaldi

POSTER SESSION III, continued

- 11) Evaluation of the difference in Sensitivity Between the Upper and Lower Visual Field by Computerized Perimetry and Event Related Potentials
M. Fioretto, M. Zingirian, E. Gandolfo, G. Fava, C. Burtolo, C. Orione
- 12) Resolution Perimetry in Glaucoma Follow-up
L. Martin-Boglund, P. Wanger
- 13) Computerized Automated Perimetry (CAP) and High-Pass Resolution Perimetry in Diabetic Patients
P. Brusini, F. Barosco
- 14) Influence on the Visual Field after Photocoagulation or Cryotherapy in Children with Retinopathy of Prematurity
Y. Nakamachi, Y. Tanaka, H. Mitani, M. Oike
- 15) Short Wavelength Automated Perimetry (SWAP) in Optic Neuritis
C. Johnson, J. Keltner
- 16) Age-Related Cataract in Blue-on-Yellow Perimetry
I. Moss, J. Wild, D. Whitaker

1) **Influence of Carteolol on the Visual fields of Patients
with Normal Tension Glaucoma (a preliminary report)**

Naoko Oku M.D., Yoshiaki Tanaka M.D. and Kuniyosi Mizokami M.D.

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In a age matched case-control prospective study, 20 patients with Normal-tension glaucoma were randomly assigned to treatment of Carteolol 2% twice a day or none at all. Visual fields and intraocular pressure were studied. Static perimetry were performed with the Humphrey central 30-2 Program two weeks after washout period and every 3 monthperiod after initiation of follow up. Average follow up period is 8.5 months. Intraocular pressure were lowered in Carteolol treated group. At the end of follow up, the visual fields tended to remain stable in Carteolol treated group, on the other hand, the group without treatment tend to progress the loss of visual field at the end of follow up . The difference, however, was not significant statistically. These results will be preliminary analysed in this study. Further follow up is undergoing.

2) **THE ACUTE AND CHRONIC EFFECT OF B₁-SELECTIVE AND NON-SELECTIVE B-BLOCKERS ON MACULAR BLOOD FLOW AND CONTRAST SENSITIVITY IN GLAUCOMA**

J.R. PILTZ AND S. BOSE, Scheie Eye Institute, University of Pennsylvania, Philadelphia

Macular blood flow (blue field entoptic simulation technique), contrast sensitivity (Pelli-Robson) and intraocular pressure were measured in twenty patients with primary open angle glaucoma in a double-masked, crossover protocol. Measurements were performed after a three week washout period (baseline), and after two hours and three weeks of topical timolol or betaxolol administration in two treatment arms. Repeated measures analysis of variance and two-tailed paired t-test were used to assess statistical significance.

As expected, IOP was significantly lower after a single dose and after three weeks of timolol compared to betaxolol ($p=0.009$ and $p=0.035$, respectively). Leukocyte velocity (vel) was significantly greater after three weeks of timolol ($.81 \pm .24$ mm/sec) compared to two hours after the initial dose ($.72 \pm .14$ mm/sec); however it was not significantly greater than the baseline measurement ($.75 \pm .22$ mm/sec). There was no significant change in vel or leukocyte density (den) with betaxolol. There was a small improvement in contrast sensitivity (cs) after acute and chronic dosing of betaxolol ($p=.065$) but not after timolol ($p=.377$). There was no significant difference in the change from baseline in vel, den or cs after three weeks of timolol versus betaxolol ($p>0.05$).

B₁-selective and non-selective topical B-blockers did not have a significant effect on macular blood flow in glaucomatous eyes. Betaxolol exerted a small favorable effect on cs.

3) CORRELATION BETWEEN INTRAOCULAR CIRCULATORY DYNAMICS AND VISUAL FIELD DEFECT IN NORMAL-TENSION GLAUCOMA

Yoshio Yamazaki, Satoshi Miyamoto and Fukuko Hayamizu
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Tokyo, Japan

The blood flow velocity of the ophthalmic artery was analyzed in normal subjects and patients with normal-tension glaucoma (NTG) to investigate the correlation between the changes of intraocular circulatory dynamics and visual field defects. Thirty normal subjects (mean age; 59.3 ± 13.8 years) and 20 NTG patients (58.8 ± 14.1 years) with asymmetric visual field defects were examined using color Doppler imaging (SSA-160^R, TOSHIBA). Visual field with a Goldmann Perimeter, intraocular pressure with a Goldmann applanation tonometer, resting systemic blood pressure and pulse rate were determined prior to the measurement of the blood flow velocity of the ophthalmic artery. There were no significant differences in systemic blood pressure, pulse rate, intraocular pressure between normal subjects and NTG patients. The NTG patients showed a significant reduction in the blood flow velocities ($P < 0.01$) and a significant increase in resistivity index ($P < 0.05$) compared with normal subjects. In 12 of 20 patients with NTG, the eyes with advanced visual field defects had slower flow velocities than the fellow eyes. This finding indicates that circulatory dynamics of ophthalmic artery is related to the visual field defect in normal-tension glaucoma.

4)

Correlation between IOP changes and deterioration of the visual field according to nerve fibre bundle map
Ian A. Ugi, Aharon Wegner, Richard Wertheimer and Regina Lehr/ Augenklinik rechts der Isar, Technical University of Munich, 22 Ismaninger St., 81657 Munich, Germany.

Purpose: To evaluate whether the rate of change in intraocular pressure influences the deterioration rate of the visual field in glaucomatous eyes and which nerve fiber bundles show the highest deterioration rate we performed a retrospective study including all our COAG out patients receiving topical β -blocker monotherapy for more than 4 years.

Method: 287 visual fields and the corresponding 287 diurnal intraocular pressure curves of 47 patients with COAG were evaluated retrospectively. All patients had no additional corneal, retinal or optic nerve disease and were treated with a non-selective β -blocker for at least four and up to ten years. 18 (32%) patients had systemic hypertension, 29 (68%) patients had no further vascular disease. A regression curve was calculated for every single group of perimetric points in the visual fields (Octopus 201 Program 31, worse eye approach) representing a nerve fibre bundle (according to the map of Weber and Ulrich). A correlation was calculated between the regression curve of the diurnal intraocular pressures and the regression curve of each nerve fibre bundle of every patient.

Results: In the group of patients with systemic hypertension a statistically significant ($p < 0.05$) inverse correlation between IOP change and visual field deterioration was found in 5 nerve fiber bundles. No such correlation was observed in the group without systemic hypertension. There was no statistically significant difference in age, mean follow-up time, mean IOP and regression coefficient of IOP between the two groups.

Discussion: A possible effect of systemic hypertension on visual field development has been observed in previous studies. We found that in patients with systemic hypertension the visual field development is more predictable and specific regions are more prone to nerve fiber damage. A reason for this might be found in the reduced autoregulating ability of hypertensive retinal vessels.

5)

FASTPAC ERROR IS WITHIN LONG-TERM FLUCTUATION OF HUMPHREY STATPAC FIELD ANALYSES.

NP O'Donnell, MK Birch, PK Wishart.

Royal Liverpool University Hospital, Liverpool

The long-term fluctuation evident on Humphrey Visual Field Analysis of 24 patients (37 eyes) with a diagnosis of ocular hypertension and 17 patients (24 eyes) with stable glaucoma was calculated from the global indices of serial 24-2 Statpac tests. Each eye had a minimum of 4 Statpac and 1 Fastpac 24-2 tests. Statpac and Fastpac agreed on the presence or absence of field loss in all 61 eyes. Fastpac consistently under-estimated mean deviation and CPSD by an average of 1dB in glaucomatous eyes, but this difference was within the range of the long-term fluctuation evident with Statpac examinations. Fastpac significantly reduced test time for both OH and most glaucomatous eyes by approximately 30%, but in eyes with advanced glaucoma the time saving was minimal.

6)

EVALUATION OF THE REPEATABILITY OF FASTPAC IN GLAUCOMA

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² University of Manchester, Manchester, ³ University of Toronto, Toronto

PURPOSE: To evaluate the repeatability of FASTPAC in a glaucomatous population.

METHOD: 60 glaucoma patients (mean age 66.9 years) with repeatable glaucomatous visual field abnormality and previous experience in automated perimetry were examined on 3 separate occasions, 2 weeks apart, with both Standard full threshold and FASTPAC strategies using Programme 30-2 of the HFA 630. Examination strategy was randomized across the sample and maintained at each session. **RESULTS:** Concordant with previous studies there was a small decrease in MD, PSD and CPSD, but an increase in the SF when FASTPAC was used. There was a small increase in the FN and FP catch trials along with the expected reduction in examination time and number of questions asked. However there was a remarkable similarity between the repeatability of the 2 Strategies. When considering the 95% Confidence Limits for Change the resulting limits were identical. **CONCLUSIONS:** In spite of the increased intra-test variance FASTPAC was as repeatable as the standard strategy for threshold estimation in an elderly, glaucomatous population. This was considered mainly due to a reduction in fatigue.

7)

TEST TIME AND EFFICIENCY OF THE DYNAMIC STRATEGY IN GLAUCOMA PERIMETRY

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The dynamic strategy is a perimetric staircase procedure, where the step sizes were adapted to the gradients of the frequency-of-seeing curves. Because the gradients vary depending on the sensitivity, the 'dynamic' step sizes also vary between 2 dB to 10 dB according to the decibel range. We examined 40 glaucoma patients with both the traditional and the dynamic strategy using a modified Octopus 1-2-3. Sixteen visual field locations were examined alternately with both strategies, 3 times each. The order of the initial strategy was randomised. The variance of the 3 measurements was calculated as a measure of reproducibility. Results of 27 cases without progression:

DLS	Presentations		Variance		cost/benefit		c/b ratio
	DYN	TRAD	DYN	TRAD	DYN	TRAD	
1 - 10	2.09	6.12	17.75	29.54	0.02696	0.00553	4.87
11 - 20	2.45	5.80	20.73	13.29	0.01969	0.01297	1.52
21 - 25	2.50	5.08	6.18	4.37	0.06472	0.04505	1.44
26 - 30	2.39	4.20	2.08	3.60	0.20116	0.06614	3.04

Conclusions. The number of stimulus presentations per test point as a measure of test time was about half for the DYN. The relation of variances depended on the DLS classes. Cost/benefit = test time/reproducibility = presentations / (1/variance) was always better for the dynamic strategy.

8)

The Effect of Audio and Visual Cueing on Visual Field Testing

**Richard P. Mills, Thomas Yang, Yi Li
University of Washington, Seattle**

A Humphrey perimeter was modified to give audio or visual cues before each test stimulus to see if subject test performance could be improved.

37 patients and 42 normals were each given a custom visual field test in one eye once with audio cueing (frequency=1000 Hz, duration=100 ms, 300 ms before stimulus), once with visual cueing (red light at fixation point 300 ms before stimulus) and once with no cueing.

There was a trend for normal subjects and possibly patients to have a better visual threshold and a smaller short-term fluctuation with cueing than without cueing. However, normal subjects were seen to have a significantly higher percentage of fixation losses with audio cueing than with no cueing.

We concluded that the improved visual threshold and decrease in short-term fluctuation associated with cueing represent improved subject performance, but at a cost of increased fixation losses.

9)

**THE INFLUENCE OF THE STIMULUS DURATION
ON PERIMETRIC THRESHOLDS IN THE CENTRAL 30° VISUAL FIELD**

S. Okuyama, C. Matsumoto, K. Uyama, O. Otsuji and T. Otori

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The influence of the stimulus duration on the perimetric thresholds was studied in normal subjects and early glaucoma patients using the Octopus 1-2-3 and its remote software package. A custom program was developed by the authors in order to test the influence of various stimulus durations on the perimetric thresholds. First, as preliminary experiments, the differential light sensitivity of the upper nasal profile on the 135 degree meridian was measured in 2 normal subjects using stimulus durations of 5, 10, 20, 50, 100, 200, 500, 1000, 2000 and 3000 and target sizes of -2, -1, 0, 1, 2, 3, 4 and 5. Studies were then made of the influence of the temporal and spatial summation on perimetric thresholds by analyzing the threshold-duration curves and the threshold-area curves in normal subjects. Secondly, the same test points of Octopus program No.38 were measured using the stimulus durations of 10, 50, 100 and 500 msec and the target size 3 in both 49 eyes of 49 normal subjects and 36 eyes of 24 early glaucoma patients. It was suggested that the use of shorter stimulus duration than the critical time of temporal summation might provide us with a more sensitive method to detect early glaucomatous visual field defects.

10)

PERICECAL SENSITIVITY STUDIED BY MEANS OF SCANNING LASER
OPHTHALMOSCOPE

PANTA G., RANDAZZO D.A., OTT J.P., NICOLETTI G.A., REIBALDI A.
Ophthalmology Institute University of Catania, Italy

The Authors studied the variations of pericecal sensitivity of 10 points surrounding the optic disk in 20 glaucoma suspect subjects, age range 40-55, with slight visual field damages (group A), and in 20 normal subjects of equivalent age, with no visual field defects (group B), by means of Scanning Laser Ophthalmoscope that allows a precise point to point correspondence between fundus image and perimetric results. The values obtained in both groups were compared by means of paired T-test. The difference was statistically significant. The Authors compared the values of 5 points in the upper field with those ones of 5 control points located in the lower field at the same eccentricity, in glaucoma patients and in the normal group. Results are reported.

11)

EVALUATION OF THE DIFFERENCE IN SENSITIVITY BETWEEN THE UPPER AND LOWER VISUAL FIELD BY COMPUTERIZED PERIMETRY AND EVENT RELATED POTENTIALS

M. Fioretto, M Zingirian, E. Gandolfo, G.P. Fava, C. Burtolo, C. Orione
University Eye Clinic - Genoa - Italy (Head: Prof. M. Zingirian)

The Authors carried out a study on 12 healthy subjects to evaluate the threshold's differences between the upper and lower hemifields by automatic perimetry (Octopus 2000 R) and event related potentials (ERP) recorded in O₂ and C₂ (10-20 International System) by a random presentation of a checkerboard at two spatial frequencies. The perimetric results showed significantly higher threshold values in the upper visual field compared to the lower one. The ERP obtained by means of visual stimuli in the primary position and at various degrees of eccentricity in the two hemifields showed a higher amplitude ($p < 0.001$) when recorded by the stimulation of the lower visual field in comparison with the upper one. These results could indicate that the difference in sensitivity is not only due to the perceptive but also to the cognitive functions and it is probably linked to our life-experience.

12)

RESOLUTION PERIMETRY IN GLAUCOMA FOLLOW-UP

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In order to find out to which extent high-pass resolution perimetry would detect any changes in patients treated for glaucoma, resolution perimetry results were evaluated from 56 glaucoma patients and 15 untreated ocular hypertensive patients followed for two to three years.

Sixty of the 71 examined patients showed decrease in resolution thresholds, i.e. increased sensitivity, between the first examination and the third, two years later. The median of the threshold decrease was significantly larger in the treated glaucoma patients (median 1.22 dB) than in the untreated ocular hypertensive patients (0.48 dB).

The threshold decrease in the untreated ocular hypertensive group corresponds to the previously described learning effect. The larger threshold decrease in the treated glaucoma group is assumed to reflect a beneficial effect of the anti-glaucoma therapy. Since the threshold decrease was not significantly related to initial resolution threshold, the difference between the groups can not be explained by a 'sorting' effect.

The finding indicates that measurable improvement in visual function can be detected in many patients, treated for early glaucoma, at least during the first two years of treatment.

13)

COMPUTERIZED AUTOMATED PERIMETRY (CAP) AND HIGH-PASS RESOLUTION PERIMETRY IN DIABETIC PATIENTS.

Paolo Brusini and Franco Barosco

Department of Ophthalmology - Hospital of San Donà di Piave , Venice, Italy

Seventy patients suffering from diabetes underwent a visual field test, using both Computerized Automated Perimetry (CAP) and High-pass Resolution Perimetry (HRP). Thirty five had an early background retinopathy with good visual acuity, and the other 35 showed no retinal lesions.

A high percentage of significant defects was found with both methods. In patients with background retinopathy HRP seems to be more sensitive than CAP in picking up early visual field damage. This technique, quicker and less tiring for patients, is a useful and reliable method for functional testing of diabetic patients too.

14) **INFLUENCE ON THE VISUAL FIELD AFTER PHOTOCOAGULATION OR CRYOTHERAPY IN CHILDREN WITH RETINOPATHY OF PREMATURITY**Y.NAKAMACHI*, Y.TANAKA *, H.MITANI *, M.OIKE *,
M.YAMAMOTO* and K.NOMURA**

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Many investigator reported the visual function after retinopathy of prematurity, but the development of central visual field was not well reported previously. We retrospectively studied the visual field within central 30degrees of 23eyes of 12 children , who had a history of retinopathy of prematurity. Seventeen eyes were treated with photocoagulation and/or cryotherapy (treated group), the other 6 eyes had no therapy (untreated group). Perimetry was performed with the Octopus 31 program at average 11.9 years' old and total loss of the visual field were studied. The total loss of the treated group was $441.2 \text{ dB} \pm 364.5$ (mean \pm S.D) and that of untreated group was $202.1 \text{ dB} \pm 144.5$. The total loss of the treated group was larger than untreated group; the difference, however , not statistically significant ($P=0.16$). These results not only suggest the direct influence of photocoagulation and/or cryotherapy to the visual field, but also of the baseline prematurity of retinal development.

15)

SHORT WAVELENGTH AUTOMATED PERIMETRY (SWAP) IN OPTIC NEURITISChris A Johnson and John L. Keltner

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Purpose: Longitudinal investigations of Short Wavelength Automated Perimetry (SWAP) in ocular hypertensive and glaucoma patients have shown it to be an effective procedure for detecting early glaucomatous damage and progression of glaucomatous loss. The purpose of the present study was to determine the efficacy of SWAP for evaluation of early deficits in patients with optic neuritis.

Methods: Conventional automated perimetry (Size III target, 31.5 asb background) and SWAP testing (Size V blue target, 635 asb yellow background) were performed with Program 30-2 on a modified Humphrey Field Analyzer. Fifteen patients with optic neuritis were evaluated in this study.

Results: Except for a few eyes with normal results for both conventional automated perimetry and SWAP testing, the deficits noted for SWAP were approximately 1.5 to 2 times larger than those observed for conventional perimetry. In some cases, SWAP results revealed an abnormality when conventional automated perimetry results were normal. The most dramatic comparison involved a 49 year old female with multiple sclerosis who demonstrated normal visual fields for conventional automated perimetry and a homonymous hemianopsia for SWAP testing.

Conclusions: In most cases, SWAP deficits in optic neuritis were larger and more severe than those found with conventional automated perimetry. SWAP thus also appears to be useful in early detection of visual field loss in optic neuropathies other than glaucoma. The results are consistent with the hypothesis that SWAP deficits are due to reduced redundancy (undersampling) in the short wavelength pathways.

16)

AGE-RELATED CATARACT IN BLUE-ON-YELLOW PERIMETRYI D Moss, J M Wild and D WhitakerDepartment of Vision Sciences, Aston University, Birmingham, UK.

Purpose To compare the effect of age-related cataract on the normal Blue-on-Yellow (B-Y), Yellow-on-Yellow (Y-Y) and White-on-White (W-W) visual field.

Methods. Twenty cataract patients (Age range 60-82 years) underwent B-Y (size V, blue OCLI dichroic filter, Schott OG530 yellow filter, bowl luminance 330cdm^{-2}) the control Y-Y (size V, Schott OG530 yellow filter, bowl luminance 330cdm^{-2}) and standard W-W (size III) perimetry using Program 24-2 of a modified Humphrey Field Analyser 640 (HFA). Cataract was classified using LOCS II. Forty age matched normal subjects served as the control. B-Y sensitivity was corrected for individual ocular media absorption using the standard technique of Sample et al (IOVS 29: 1989). Forward light scatter was measured by the direct compensation technique of van den Berg (Vision Res 31: 1991). The visual field indices Mean deviation (MD) and corrected pattern standard deviation (CPSD) indices were derived for the cataract patients for the various stimulus combinations.

Results. The cataract patients exhibited a negative MD, ie a reduced perimetric sensitivity for the three stimulus combinations. The extent of the reduction varied with the type and severity of the cataract. Group mean MD was greatest for the W-W (-0.50 log unit SD 0.31) and B-Y (-0.48 log unit SD 0.30) stimulus combinations; the B-Y field was preferentially affected by posterior subcapsular cataract and the W-W field by cortical cataract. The degree of forward light scatter showed a good relationship with the B-Y MD ($R=0.84$).

Conclusions. Cataract produces a diffuse reduction in B-Y sensitivity, the extent of which is dependent upon the type and severity of the cataract. Caution needs to be exercised in the interpretation of the Blue-on-Yellow visual field in cases where glaucoma and cataract co-exist.

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1ST AUTHOR INDEX

	Page No.
Asman, P.	36, 38
Austin, M.	46
Bechetoille, A.	46
Bergamin, O.	27
Birch, M.	46
Brigatti, L.	31
Brusini, P.	37, 66
Capris, P.	46
Casson, E.	47
Chauhan, B.	13, 46
Coman, L.	47
Corallo, G.	36
Crabb, D.	36
Dannheim, F.	31
Demirel, S.	22
Enoch, J.	47
Fechtner, R.	31
Fioretto, M.	66
Flanagan, J.	13, 37
Frisen, L.	61
Funk, J.	36
Gandolfo, E.	22
Gaspar, A.	36
Gunji, H.	56
Haas, A.	22
Harris, M.	36
Hatch, W.	65
Heijl, A.	61
Henricsson, M.	18
Henson, D.	36
Iester, M.	46
Iwase, A.	27
Jankenecht, P.	31
Johnson, C.	18, 66
Kardon, R.	27
Kitazawa, Y.	13
Klimaschka, T.	65

1ST AUTHOR INDEX

	Page No.
Kono, Y.	46
Lachenmayr, B.	61
Laffi, G.	27
Langerhorst, C.	31, 47
Lindblom, B.	22
Martin-Boglund, L.	66
Matsumoto, C.	46
Meyer, J.	56
Mills, R.	37, 65
Mizokami, K.	56
Moss, I.	56, 66
Mutlukan, E.	56
Nakamachi, Y.	66
O'Brien, C.	31
O'Donnell, N.	65
Ogawa, T.	37
Oku, N.	65
Okuyama, S.	65
Olsson, J.	22, 36
Panta, G.	65
Piltz, J.	65
Poinoosawmy, D.	13
Polizzi, A.	18, 47
Safran, A.	61
Sampaolesi, R.	56
Schiefer, U.	47
Schwartz, B.	13
Suzumura, H.	13
Swanson, W.	31
Takashima, M.	27
Tosoni, C.	37
Traverso, C.	13
Ugi, I.	65
Van de Velde, F.	37
Vingrys, A.	61
Wall, M.	18
Weber, J.	22

1ST AUTHOR INDEX

	Page No.
Weitzman, M.	56
Wild, J.	18
Williams-Lyn, D.	46
Wright, L.	27
Wu, J.	22
Yamada, S.	37
Yamazaki, Y.	65
Zulauf, M.	46

EXHIBITORS

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