New visual field-testing devices: accuracy and use in assessing disability

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Is what you’re doing going to get you the result you want?

Outline:

What result do you want?

Reasons to test visual field test; (VF tests do not assess “function;” they study a surrogate for function);

My experience with vision testing -- clinical, investigative;

Relationship between Quality of Life, Ability to Act, and vision;

Conclusions.

Selected publications.

What is the desired result?

The primary purpose of assessing a person's vision is for that assessment to be useful to that person, that is, part of a strategy designed

to help that person feel healthy (QoL) and

to be able do what he/she/they wishes to do,

at an affordable cost.

The purpose is **not** to get a score or a printout or determine if "normal" or "abnormal."

A secondary reason is

for that assessment to be useful to the **community** by reducing the burden on the person's community due to the decreased productivity, and increased costs of care and supportive services caused by a person losing enough vision to become disabled. (A public health purpose)

Other purposes for assessing vision:

Charge a fee,

Assess the usefulness of a product,

Build a practice by appearing to be “state of the art,”

Fill out a record,

Help avoid being convicted of malpractice,

Practice the “standard of care,”

Illustrate reality to a patient,

As part of an investigative study,

Increase understanding of pathophysiology.

2 truths ----------

Doctors love visual field testing:

it is financially profitable (?$500 M /year),
loss of field ‘justifies’ doing something that generates a fee,
often the results are shown in a “print out” (a fiction ---
the “hard, allegedly objective” printout is a fantasy)
the results are often analyzed statistically (a fiction),
provides security re: diagnosis and treatment (a fiction).

Patients hate visual field tests:

they know they’re not giving accurate answers,
they know the printout does not represent what they see,
they know the doctor will “believe” the results of the test.

3 reasons for assessing the visual field: a) diagnose, b) monitor change, c) evaluate an attribute of importance: QoL, ability to perform actions, etc.

a) Diagnosis: patterns of field loss can be diagnostically useful. Different methodologies are differentially useful.

simultaneous confrontation --- certain types of stroke;

motion (kinetic) --- define boundaries: tumors, strokes, likelihood of wipeout associated with surgery etc.;

localized luminance --- find isolated defects, ? Glaucoma defects, etc.

Desired purpose of test:

b) Quantitate amount and nature of **Change**: this a tremendously underappreciated useful aspect, but **only** if assessment of the visual field is accurate.

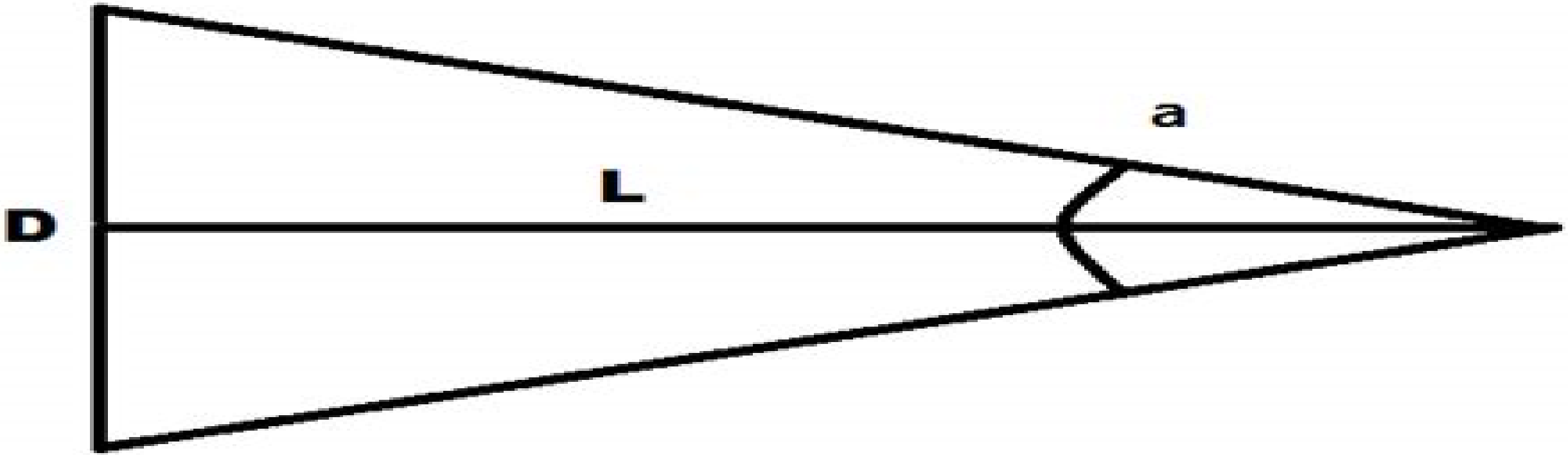
Ways to increase accuracy: instruct well; retest; have optimal duration of the test; assure patient is looking centrally when stimulus shown.

Monitoring fixation allows deleting unreliable results.

It is not possible to have constant fixation; the eye is in constant motion (saccades).

Monitoring also is a help in interpreting the amount of inaccuracy.

Accuracy can be increased by increasing the distance from the observer to the test stimulus, so the “blind” areas have a larger linear width. The smaller the device the less accurate the field.



Desired purpose of test

c) Evaluate an **attribute important to that specific patient**:
assess a specific disability or ability –

driving,
stereopsis,
peripheral vision (ice hockey players),
detect motion,
mobility,
various aspects of quality of life.

Other important considerations:

?

How accessible is the test? (compare Amsler Grid to Bell Perimeter)

Able to self test?

How expensive? (time and money)?

So, What is the result that is wanted?

To obtain an adequately **accurate** reflection of an aspect of that field. Accuracy is vital for detecting change;

To evaluate a particular **aspect** of the field: patterns of luminance, boundaries especially horizontal and vertical, motion, flicker.

To assess a specific **clinical ability:** QoL, athletic skills, detect motion, find objects, be mobile.

My early experience (focusing on vision testing):

1960 Residency: (Wills Hospital) much attention to visual acuity; selective interest in VF -- confrontation, tangent screen -- used primarily for diagnosis;

1963 Glaucoma Fellowship: (NINDB) further reading; Goldmann perimetry, dark adaptation, ERG;

1965 Practice, comprehensive: realization I was not a competent clinician, but rather a well-trained automaton (Yale, Harvard, U Michigan, U Penn, Wills Eye, NIH); I started becoming aware of the poor overlap between academic and clinical skills.

1968 -2024 Faculty at Wills Eye Hospital:

Had papers published in refereed journals regarding vision tests ,especially how they relate to quality of life and the ability to perform visually related tasks;

Fields: Goldmann, Tuebingen, Octopus, Frequency Doubling, Humphrey; Octopus, Virtual Goggles; various soft ware (not short-wave length perimetry);

Color: Farnsworth-Munsell Color;

Contrast Sensitivity: Pelle-Robson, SPARCS;

Performance based tests: AFREV, ADREV, CAARV;

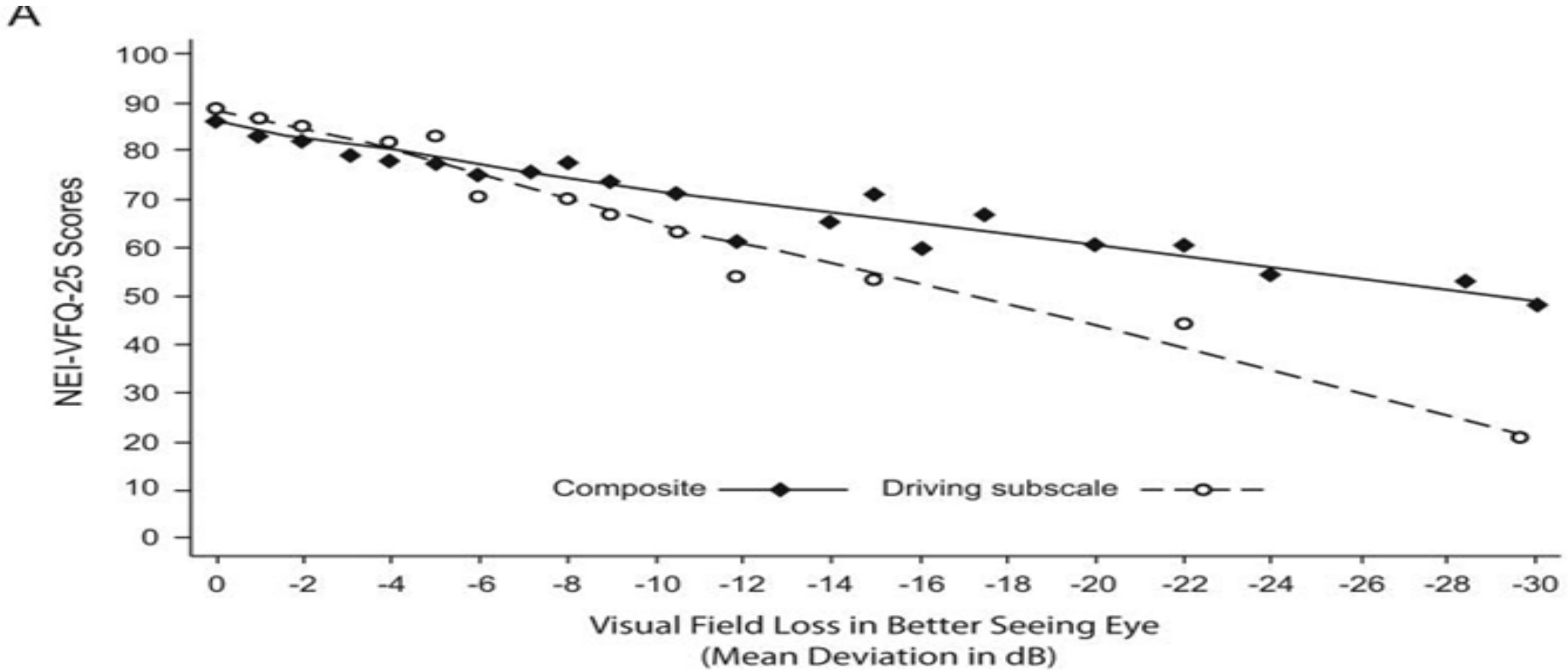
Collaborations -- NEI studies, U Michigan, U Penn, Aravind, Chandigarh, Kolkata , FDA – PROM

1968 –present

I am the author of over 400 articles in refereed journals, 200+ editorials, 22 books (one on standard automated perimetry). But my primary interests were mentoring and patient care.

Initially I relied largely on tests, both "functional" and structural (*VA and VF do **not** test function but only the ability to take a test related to an aspect of vision)*. I gradually became aware that much in refereed journals was either error or irrelevant to the well-being of patients (BMJ editor - "trash"), that products were developed primarily for the benefit of academics and industry, that so-called objective tests were just covert algorithmic subjective tests, and that few physicians in any medical field were primarily interested in how **specific people** felt **or what a specific person could do.** The investigators' emphasis was on *group means*, and not on individuals. (Consider how rarely research data show the results in individuals).

Roberta McKeanCowdin, · Rohit Varma, Joanne Wu, · Ron D. Hays, Stanley P. Azen



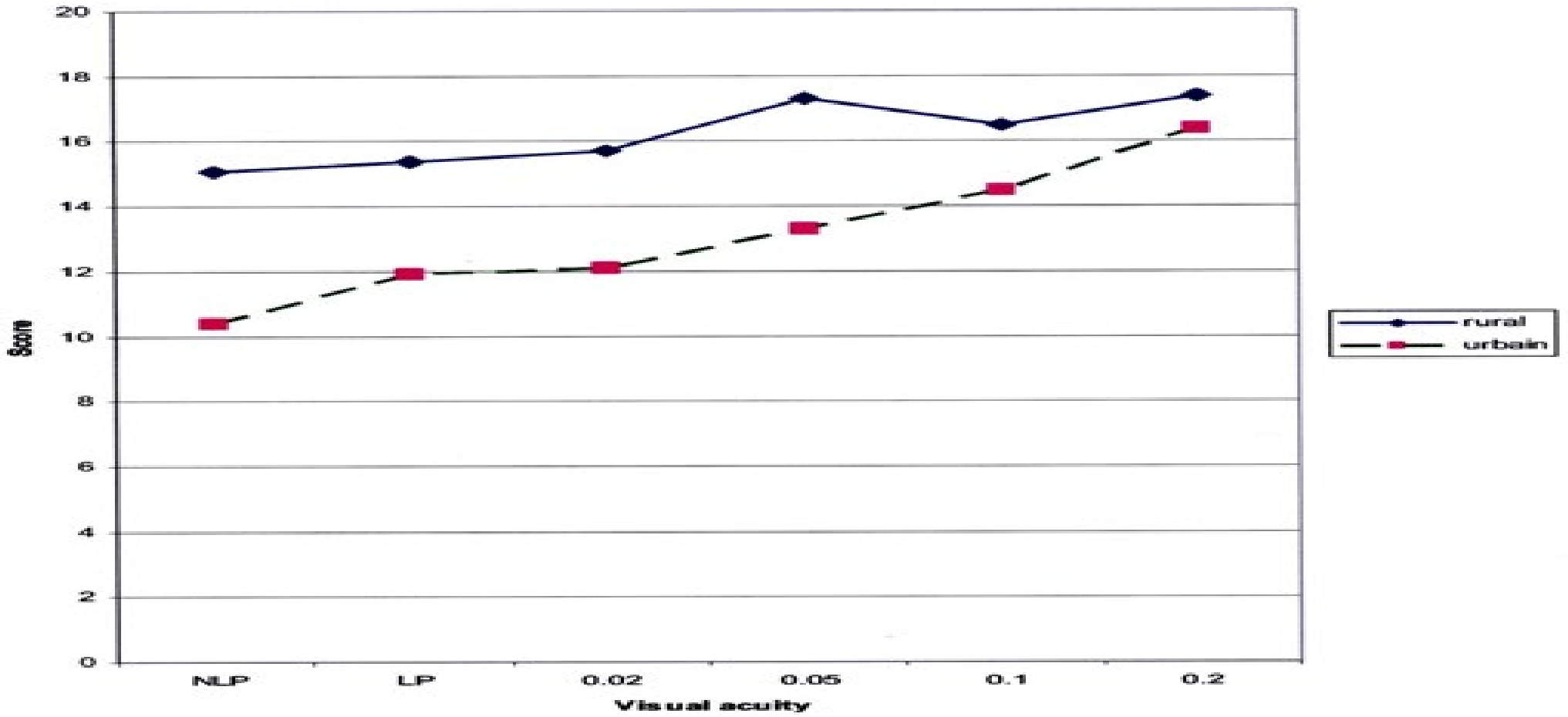
Published interpretation:

“HRQOL is diminished even in persons with relatively mild VFL on the basis of MD scores”.

“Four- to 5-dB differences in VFL were associated with a five-point difference in the NEI-VFQ-25 composite and most subscale scores.”

Severity of Visual Field Loss and Health-related Quality of Life. *Am. J. Ophthal* Volume 143:6;1013-1023,June 2007

VA 0.05 = 20/400 1 = 20/20



QoL survey developed for Mali –urban and rural populations

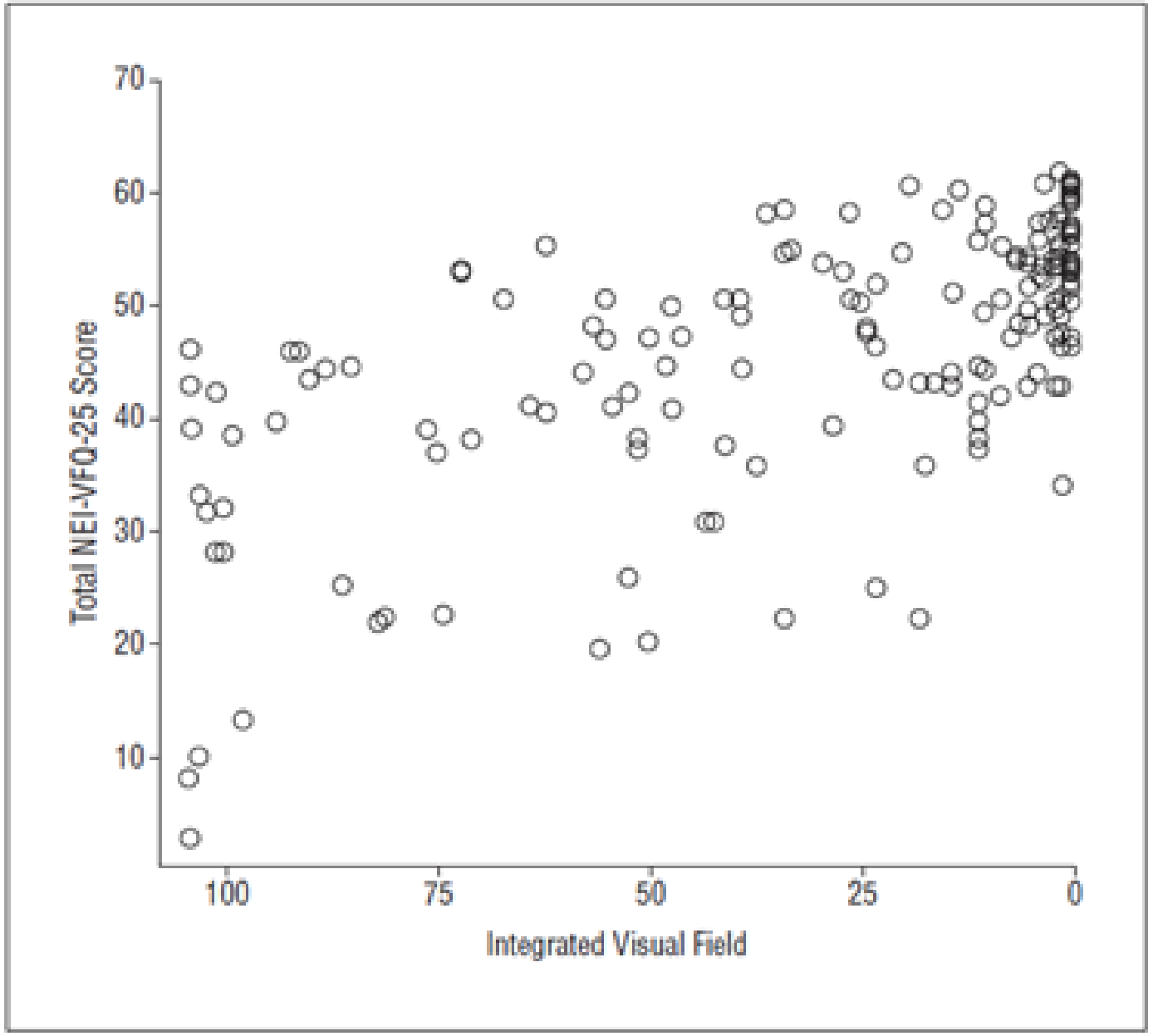
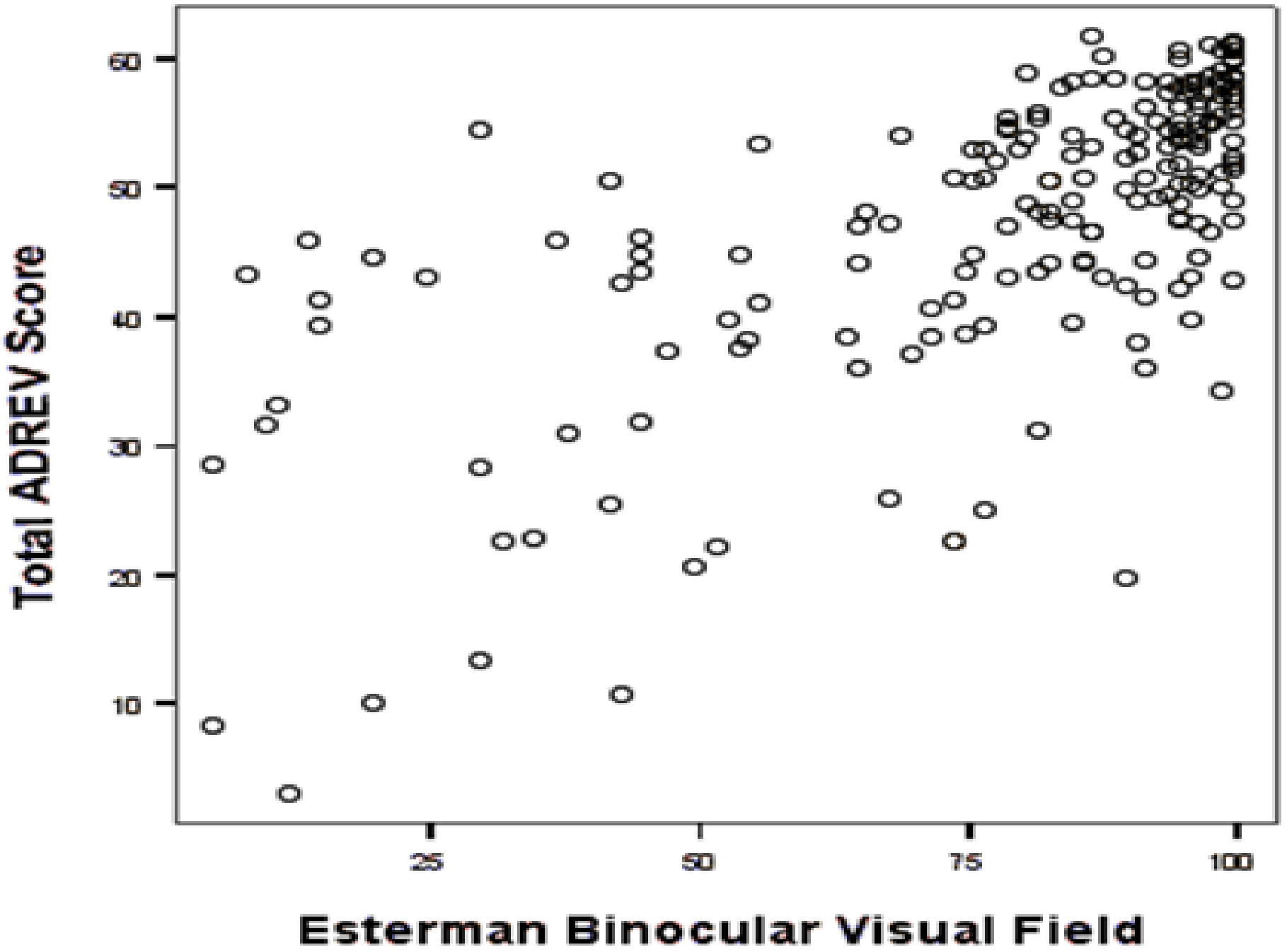


Figure 3. Scatterplot of the relationship between integrated visual field and total 25-item National Eye Institute Visual Function Questionnaire (NEI–VFQ-25) score ($r = -0.53$; $P < .001$).


Total ADREV Score
60
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40
30
20
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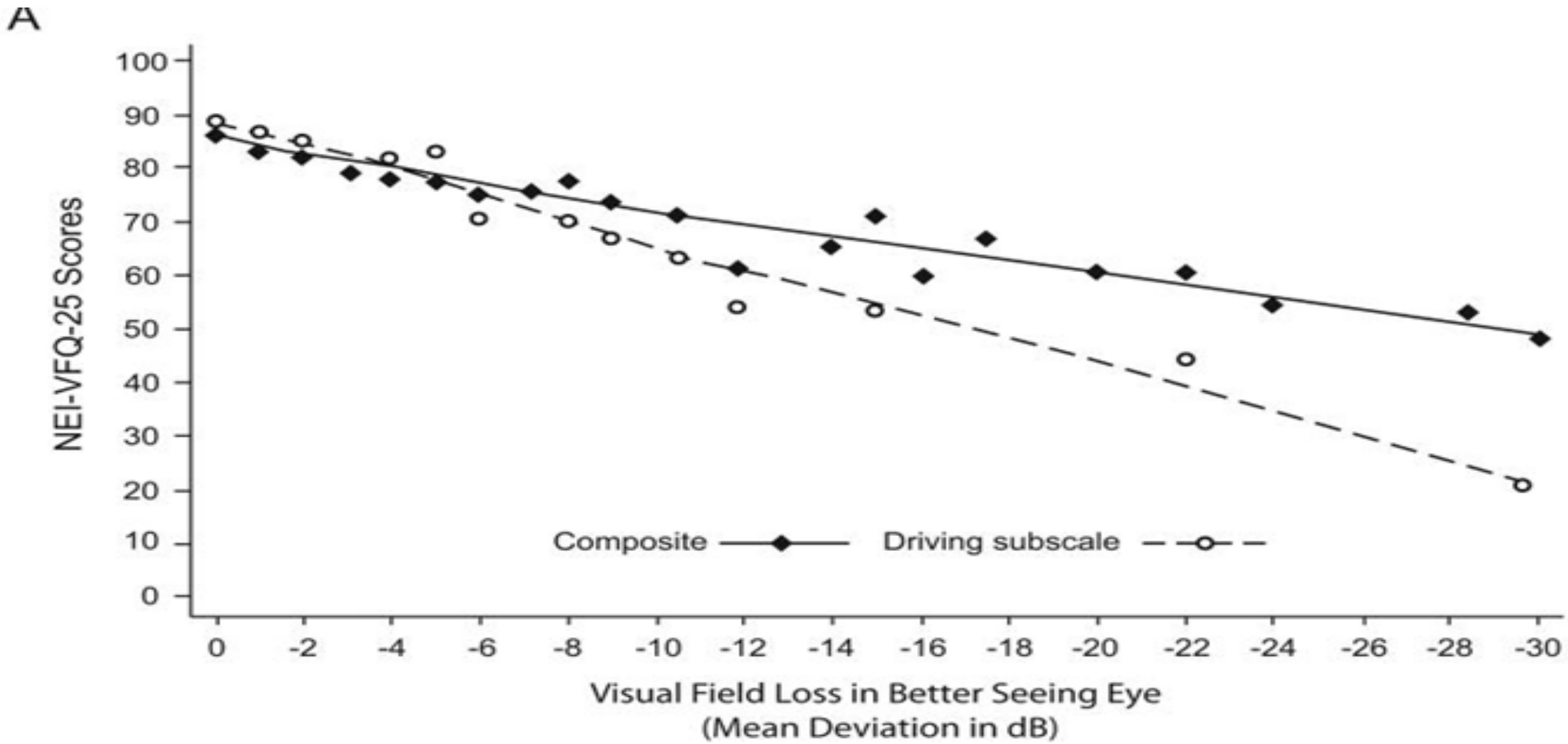
25
50
75
100
Esterman Binocular Visual Field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NEI-VFQ-25 Scores
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90
80
70
60
50
40
30
20
10
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Driving subscale
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-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
Visual Field Loss in Better Seeing Eye
(Mean Deviation in dB)

That graph is a lie: an intent to deceive --

as is much that is presented and published medically.

Conflict of interest issues are huge.

Problems with testing visual fields; noisy, focal, expensive.

In my practice I used the clinical examination and test results to determine who would be tested with fields:

my purpose: diagnostic baseline, monitor change in those able to take test well (VERY valuable);

used in those able to fixate; with satisfactory prior test.

Fields were not used to assess disability (generalizations from group to an individual are just guesses).

--monocular fields misleading (*Ophthalmology Glaucoma* 7:401-404, 2024).

Conclusions: re accuracy:

The major factor affecting the accuracy of visual field testing is the person being tested. The technician's role is highly influential (e.g., how to distinguish between entoptic phenomena and a test stimulus): proper refraction, correcting lens, lens placement, instruction, monitoring during the test. The hardware and software may not be the primary determinants of accuracy.

The smaller the device, the less the accuracy. The greater the distance between the person being tested and the testing "surface" the greater the accuracy of the test.

Conclusions re accuracy

Within limits, the longer the test the greater the accuracy.

Present methodologies may have already exceeded the ability of patients to respond accurately.

Consider blue/yellow, short wavelength perimetry. It is useless because so noisy – yet was strongly promoted. Doctors were delighted because almost everyone had a field defect.

Conclusions re: Disability

Visual loss affects visually-related quality of life and ability to perform visually related tasks, but the extent to which it does that in a specific individual can not be accurately predicted, and varies markedly.

Assessment of contrast sensitivity relates to QoL and ability to perform visually-related tasks better than assessment of VF.

The best way to estimate the effect of a disability on an individual (such as the effect of loss of visual field) is to discuss this with the person.

Conclusions: re disability: Truths, not Lies:

Disability in an individual cannot be tightly tied to a surrogate for disability (such a visual field).

Quality of life in an individual cannot be tightly tied to a surrogate for QoL (such as visual field).

To study amount and nature of disability well one needs to use a performance-based measure.

Subjective disability (Quality of Life) is best assessed subjectively through the history. There is often a vast difference between QoL and measured disability.

Two 30-yr-olds: hand movements BE vs 20/20R, 20/30LE.

Access to testing, self testing, accuracy and costs of testing are issues of importance.

On a list of issues important to patients and the community, refining field testing is low. Improving how field testing is done and interpreted is high on the list.

Valid relevant evidence that devices actually benefit patients and/or the community should be required.

At present this is not the case.

Selected, related citations are on the next slides

- Spaeth GL. A new management system for glaucoma based on improvement of the appearance of the optic disc or visual field. *Fortschr Ophthalmol.* 1988;85:614-619.

Spaeth GL. Reversibility of optic disc cupping. A phenomenon that may change the management of glaucoma. *Arch Ophthalmol.* 1989;107:1583-1584.

Katz LJ, Spaeth GL, Cantor LB, Poryzees EM, Steinmann WC. Reversible optic disk cupping and visual field improvement in adults with glaucoma. *Am J Ophthalmol.* 1989;107:485-492.

Gliklich RE, Steinmann WC, Spaeth GL. Visual field change in low-tension glaucoma over a five-year follow-up. *Ophthalmology.* 1989;96:316-320.

Breton ME, Wilson TW, Wilson R, Spaeth GL, Krupin T. Temporal contrast sensitivity loss in primary open-angle glaucoma and glaucoma suspects. *Invest Ophthalmol Vis Sci.* 1991;32:2931-2941.

Samuelson TW, Spaeth GL. Focal and diffuse visual field defects: their relationship to intraocular pressure. *Ophthalmic Surg.* 1993;24:519-525.

Lu DW, Azuara-Blanco A, Spaeth G, Collur S, Speicher MA, Araujo S. Visual limitations assessment in patients with glaucoma. *Br J Ophthalmol.* 1998;82:1347.

Spaeth GL. Mapping the visual field. *Ophthalmology.* 2001;108:1714.

Bayer A, Harasymowycz P, Henderer JD, Steinmann WG, Spaeth GL. Validity of a new disk grading scale for estimating glaucomatous damage: correlation with visual field damage. *Am J Ophthalmol.* 2002;133:758-763.

Altangerel U, Spaeth GL, Rhee DJ: Visual function, disability, and psychological impact of glaucoma. *Curr Opinion Ophthalmol* 2003 Apr;14(2):100-5.

Lin JC, Samuel F, Katz LJ, Spaeth GL, Hoop J, Cantor LB. The effect of topical glaucoma medications evaluated by perimetry. Br J Ophthalmol 2003 ;87:792.

Kim J, Dally LG, Ederer F, Gaasterland DE, VanVeldhuisen PC, Blackwell B, Sullivan EK, Prum B, Shafranov G, Beck A, Spaeth GL, AGIS Investigators. The Advanced Glaucoma Intervention Study (AGIS): 14. Distinguishing progression of glaucoma from visual field fluctuations. Ophthalmology 2004;111:2109-2116.

Altangerel, U, Spaeth, GL, Steinmann, WC. Assessment of Function Related to Vision (AFREV). *Ophthalmic Epidemiology*. 2006;13:67-80.

Spaeth G, Walt, J, Keener, J. Evaluation of Quality of Life for Patients with Glaucoma. *Amer J Glaucoma*, 2006; Vol. 141, No. 1, S3 – S13

Magacho L, Henderer JD, Lankaranian D, Steinmann WC, Spaeth GL. Improvement in colour vision parameters following successful trabeculectomy. *Acta Ophthalmologica Scandinavica*. 2006;84(2):201-205.

Spaeth GL. Prognostic factors for progression of visual field damage in patients with normal-tension glaucoma. *Jpn J Ophthalmol*. 2007 Mar-Apr;51(2):156.

Warrian K, Lorenzana LL, Lankaranian D, Dugar J, Wizov S, Spaeth GL. Assessing Age-Related Macular Degeneration with the ADREV Performance-Based Measure. January 2009;29:80-90

Lorenzana L, Lankaranian D, Spaeth G, et al. A New Method of Assessing Ability to Perform Activities of Daily Living: Design, Methods and Baseline Data *Ophthalmic Epidemiol.* 2009 RetinaMar-Apr;16(2):107-14.

Warrian KJ, Altangerel U, Spaeth GL. Performance-based measures of visual function. *Surv Ophthalmol*. 2010 Mar-Apr;55(2):146-61.

Warrian KJ, Lorenzana LL, Lankaranian D, Dugar J, Wizov SS, Spaeth GL. The Assessment of Disability Related to Vision Performance-Based Measure in Diabetic Retinopathy. *American Journal of Ophthalmology.* May, 2010; 149(5): 852-60.e1.

Richman J, Lorenzana LL, Lankaranian D, Dugar J, Mayer JR, Wizov SS, Spaeth GL. Relationships in glaucoma patients between standard vision tests, quality of life, and ability to perform daily activities. *Ophthalmic Epidemiol*. 2010 June;17(3):144-51.

Richman J, Lorenzana LL, Lankaranian D, Dugar J, Mayer J, Wizov SS, Spaeth GL. Acuity and Contrast Sensitivity in Patients with Glaucoma. *Archives of Ophthalmology*. 2010;128(12):1576-1582.

Spaeth GL. Visual field loss. *Ophthalmology*. 2012 Jan;119(1):203-4.

Spaeth GL, Lopes JF, Junk AK, Grigorian AP, Henderer J. Systems for staging the amount of optic nerve damage in glaucoma: a critical review and new material. Survey of Ophthal 2006;51:293-315.

Altangerel, U, Spaeth, GL, Steinmann, WC. Assessment of Function Related to Vision (AFREV). *Ophthalmic Epidemiology*. 2006;13:67-80.

Kulkarni KM, Mayer JR, Lorenzana LL, Myers JS, Spaeth GL. Visual Field Staging Systems in Glaucoma and the Activities of Daily Living. *Amer J Ophthal*. Sept 2012;154(3):445-451.e.3.

Wei H, Sawchyn AK, Myers JS, Moster MR, Wizov SS, Steele M, Lo D, Spaeth GL. A clinical method to assess the effect of visual loss on the ability to perform activities of daily living. *Br J Ophthalmol*. 2012 May;96(5):735-41.

Richman J, Spaeth GL, Wirostko B. Contrast sensitivity basics and a critique of currently available tests. *J Cataract Refract Surg*

Richman J, C, Lu L, Wizov SS, Spaeth E, Spaeth GL. The Spaeth/Richman contrast sensitivity test (SPARCS): design, reproducibility and ability to identify patients with glaucoma. *Br J Ophthalmol*. 2014 July 22.

Warrian KJ, Katz, LJ, Myers J, Moster M, Pro MJ, Wizov SS, Spaeth GL. A Comparison of Methods Used to Evaluate Mobility Performance in the Visually Impaired. *Brit J of Ophthal*. 2014

Faria B, Duman F, Zheng CX, Waisbourd M, Gupta L, Zangalli C, Lu L, Wizov SS, Spaeth E, Richman J, Spaeth GL. Evaluating contrast sensitivity in age-related macular degeneration using a novel computer-based test, the Spaeth/Richman Contrast Sensitivity Test (SPARCS). *Retina*. 201535(7):1465-73.

Hu CX, Zangalli C, Hsieh M, Gupta L, Williams AL, Richman J, Spaeth GL. What do patients with glaucoma see? Visual symptoms reported by patients with glaucoma. *Am J Med Sci*. 2014 Nov;348(5):403-9.

Musch DC, Gillespie BW, Palmberg PF, Spaeth G, Niziol LM, Lichter PR. Visual field improvement in the collaborative initial glaucoma treatment study. *Am J Ophthalmol*. 2014 Jul;158(1):96-104.e2.

Erdem E, Williams A, Kuchar SD, Waisbourd M, Spaeth GL. Long-term (>8 years) evaluation of progression in patients with low-pressure glaucoma. *Eur J Ophthalmol* 2015 Nov-Dec;25(6):490-5.

Ichhpujani P, Lo DC, Cvintal V, Waisbourd M, Averbuch A, Leiby BE, Myers JS, Spaeth GL, Katz LJ. Flicker defined form, standard perimetry and Heidelberg retinal tomography: structure-function relationships. *Can J Ophthalmol* 2015 Aug;50(4):290-6.

Waisbourd M, Parker S, Ekici F, Martinez P, Murphy R, Scully K, Wizov SS, Hark LA, Spaeth GL. A prospective, longitudinal, observational cohort study examining how glaucoma affects quality of life and visually-related function over 4 years: design and methodology. *BMC Ophthalmol*. 2015 Aug 1;15:91

Ekici F, Loh R, Waisbourd M, Sun Y, Martinez P, Nayak N, Wizov SS, Hegarty S, Hark LA, Spaeth GL. Relationships between measures of the ability to perform vision-related activities, vision-related quality of life, and clinical findings in patients with glaucoma. *JAMA Ophthal.* 2015 Dec;133(12):1377-85.

Sun Y, Erdem E, Lyu A, Zangalli C, Wizov SS, Lo D, Spaeth EE, Richman J, Spaeth GL. The SPARCS: a novel assessment of contrast sensitivity and its reliability in patients with corrected refractive error. Br J Ophthalmol. 2016 Jan 12.

Sun Y, Lin C, Waisbourd M, Ekici F, Erdem E, Wizov SS, Harl LA, Spaeth GL. The impact of visual field clusters on performance-based measures and vision-related quality of life in patients with glaucoma. *Am J Ophthalmol.* 2016 Mar;163:45-52.

Waisbourd M, Ahmed OM, Molineaux J, Gonzalez A, Spaeth GL, Katz LJ. Reversible structural and functional changes after intraocular pressure reduction in patients with glaucoma. *Graefes Arch Clin Exp Ophthalmol*. 2016 Jun;254(6):1159-66.

Gupta L, Cvintal V, Delvadia R, Sun Y, Erdem E, Zangalli C, Lu L, Wizov SS, Richman J, Spaeth E, Spaeth GL. SPARCS and Pelli-Robson contrast sensitivity testing in normal controls and patients with cataract. *Eye* (Lond). 2017 May;31(5):753-761.

Amanullah S, Okudolo J, Rahmatnejad K, Lin SC, Wizov SS, Manzi Muhire RS, Hark LA, Zheng CX, Zhan T, Spaeth GL. The relationship between contrast sensitivity and retinal nerve fiber layer thickness in patients with glaucoma. *Graefes Arch Clin Exp Ophthalmol.* 2017 Sep 5. doi: 10.1007/s00417-017-3789-4. [Epub ahead of print]

Reighard CL, Pillai MR, Shroff S, Spaeth GL, Schilling SG, Wizov SS, Stein JD, Robin AL, Raja V, Ehrlich Jr. Glaucoma-Associated Visual Task Performance and Vision-Related Quality of Life in South India. *Ophthalmol Glaucoma.* 2019 Sep-Oct;2(5):357-363.

Eshraghi H, Sanvicente CT, Gogte P, Waisbourd M, Lee D, Manzi RRS, Leiby BE, Richman J, Wizov SS, Spaeth GL. Measuring Contrast Sensitivity in Specific Areas of Vision – A Meaningful Way to Assess Quality of Life and Ability to Perform Daily Activities in Glaucoma. *Ophthalmic Epidemiol.* 2019 Oct;26(5):301-310.

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Gupta L, Waisbourd M, Sanvicente CT, Hsieh M, Wizov SS, Spaeth EE, Richman J, Spaeth GL. Establishment of a normative database and evaluation of the test-retest repeatability of the Spaeth/Richman contrast sensitivity test. *Jpn J Ophthalmol*. 2019 Jan;63(1):73-81. doi: 10.1007/s10384-018-0640-3.

Ichhpujani P, Thakur S, Spaeth GL. Contrast Sensitivity and Glaucoma. *J Glaucoma*. 2020 Jan;29(1)71-75.

Osama M. Ahmed, Michael Waisbourd, George L. Spaeth, L. Jay Katz Improvement in structure and visual function in patients with glaucoma: the possible key to better treatment? Survey of OphthalmologyPublication stage: In Press Corrected ProofPublished online: December 11, 2020

Anastasia Tsiogka, Efthymios Karmiris, Evangelia Samoli, George L. Spaeth, Comparison of Central and Peripheral Contrast Sensitivity Between Healthy and Refractive Surgery Patients Using the Spaeth/Richman Contrast Sensitivity (SPARCS) Test,February 2022, Journal of refractive surgery,38(2):128-133, Feb 2022

Tsiogka, A., Moster M.L.. Chatzistefanou, K.I., Karmiris, E., Samoli, E., Giachos, I. Droutsas, K., Papaconstantinou, D and Spaeth, G.L. The TsiogkaSpaeth grid for detection of neurological visual field defects: a validation study *Neurological Sc*i (2024) https://doi.org/10.1007/s100172-024-07305-1

End of presentation

Slides tht may be used in the discussion

The primary purpose for assessing vision:

Your thoughts?

Focus on “primary,” please, because there are various purposes.

Proper Objectives of caring for a patient with glaucoma: please answer “yes” or “no” to each;

Reduce IOP to Target IOP,

Reduce IOP to measured value of < 21,reduc mmHg (or 24 mm Hg),

Reduce IOP to measured value of 12 mm Hg,

Prevent loss of any visual field,

Prevent progression os visu loss,

Prevent and Retinal Nerve Fiber Layer al field Fiber loss,

Prevent any damage to the optic nerve,

Present progressive damage to the optic nerve,

Prevent symptoms caused by visual loss,

Prevent troublesome symptoms caused by visual loss

Relieve troublesome symptoms caused by visual loss.

To assist in caring for patients well.

To assist in care for a specific patient well.

The desired outcomes of a patient can only be accurately and relevantly answered by the specific patient and

before that patient has been *indoctrinated* by the doctor or other “authority..”

Desired patint aoutcomes are routinely different from those of the doctor or the profession.

This is the most important message of this presentation.

What hopes and concerns of patients should be listened to and which paid for?

The hopes and concerns important to the patient should be heard by the patient's doctor.

However, as the health of the patient is a consequence of more than the patient's life style, some issues related to that patient are the responsibility of the community of the patient.

Which of those hopes and concerns are the responsibility of the patient, and which of the community of the patient are not decisions for the patient or the doctor, but for the community.

An enlightened community presumably spends money related to patients on what is important to the patients and the community.

Consequently, tests that measure what is important to patients and the community take precedence over those of less importance to patients and the community.

Relative value related to people with or suspected of glaucoma:

The History;

Ability to discern dark/light borders (contrast sensitivity);

Visual acuity;

Appearance of the optic disc;

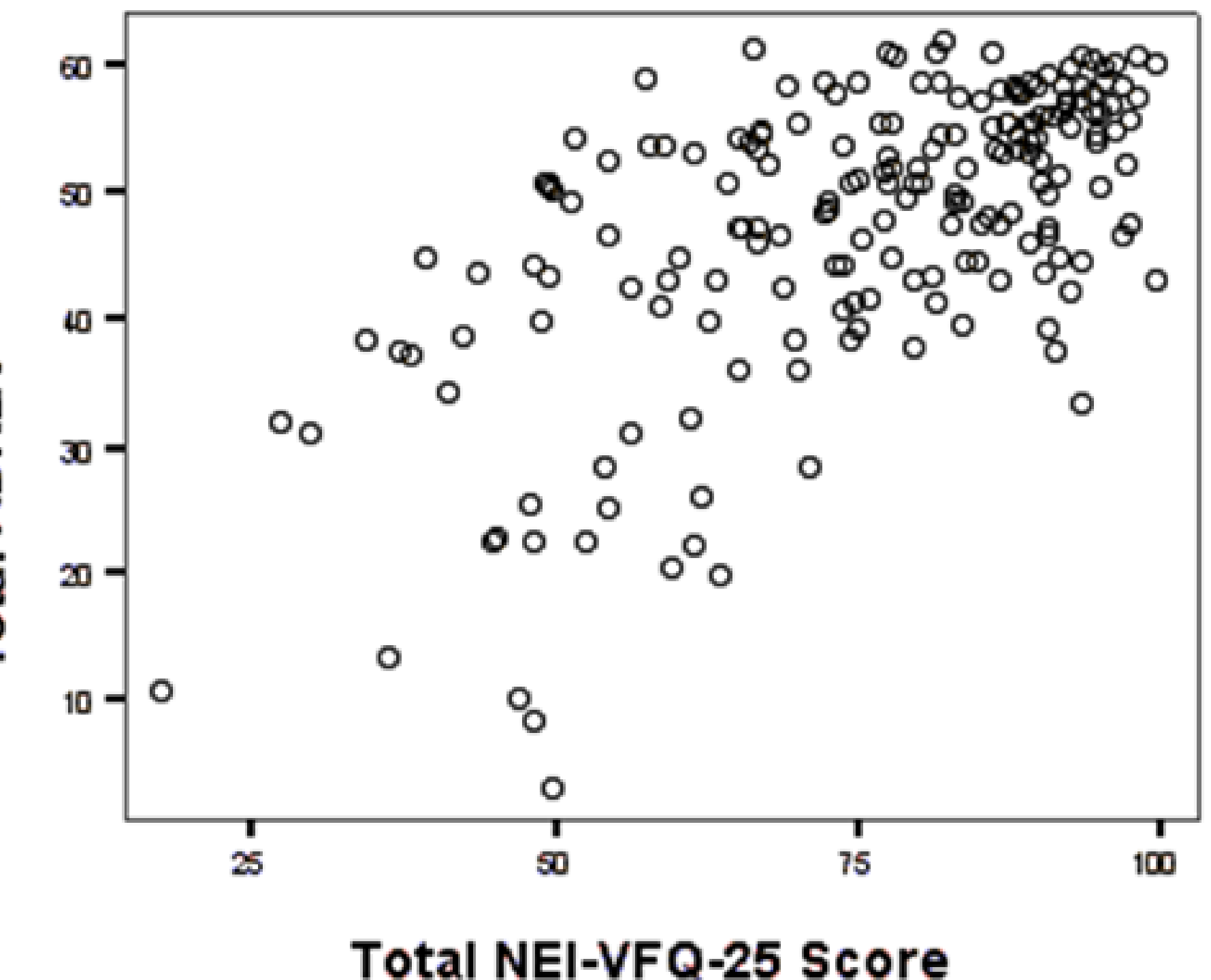
Appearance of the anterior chamber angle;

The visual field

The retinal nerve fiber layer,

The intraocular pressure,

The thickness of the cornea centrally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