COMPARISON OF AUTOMATED KINETIC AND STATIC VISUAL FIELDS IN NEURO-OPHTHALMOLOGY PATIENTS

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Eighty-three patients with various neuro-ophthalmic diseases were submitted to a standard automated protocol including kinetic and static perimetry The kinetic protocol included one peripheral, one intermediate and one central isopter and a blind spot contour determination The static protocol included fast thresholding of 80 points within the pericentral field and a 4-2-2-2 foveolar threshold determination. Discrepancies between the results of the two protocols were found in 24 out of 83 patients. Part of these discrepancies were related to methodological problems: static stimuli provide a more quantitative evaluation of the paracentral scotoma, whereas the kinetic tests appear to be more sensitive for eccentricities exceeding 15 degrees. Statokinetic dissociations were found in 12 subjects with compressive and cortical lesions

Introduction

The development of automated perimetry has mainly been concerned with static perimetry. Considering the number of manual kinetic perimeters still in use in ophthalmology departments equipped with automated static perimeters, it still remains unclear whether this apparent abandonment of kinetic perimetry is due to more stringent requirements in hardware and software or to a definite advance in testing efficiency. The purpose of this study was to compare the performances of the static and kinetic procedures available on the Vision Monitor computer assisted perimeter in the detection, identification and follow-up of deficits.

Methodology

Eighty-three patients with various neuro-ophthalmological disorders were submitted to a standard protocol including kinetic and static perimetry. All examinations were performed on two Vision Monitor computer assisted perimeters manufactured by the METROVISION company. For both examinations, the background luminance was 10 cd/m^2 and the stimulus size 20 minutes of arc. For the kinetic examination, the test luminance of the peripheral isopter was 310 cd/m^2. The test luminances of the intermediate and central isopter are adjusted automatically in order to obtain responses at 30 and 15 degrees of eccentricity. Eight additional measurements are used to determine the blind spot contour (Fig. 1A). The stimulus is displaced at a constant velocity of 10 degrees per second for the peripheral isopter, 5 degrees for the intermediate and 2 degrees for the central isopter and blind spot contour. The static protocol includes the fast thresholding of 80 points within the pericentral field and a 4-2-2-2 foveolar threshold determination (Fig. 1B). Fixation is monitored throughout the examination with a near infrared camera.

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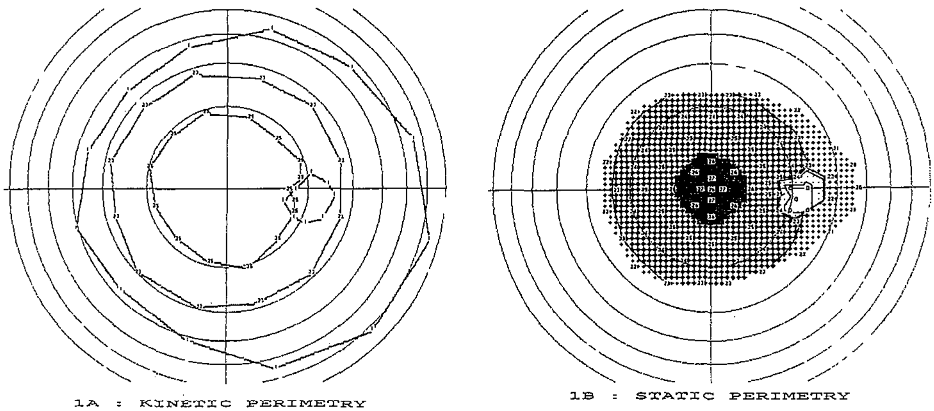

Fig 1 Examination procedures used in this study 1A: kinetic perimetry; 1B: static perimetry. The locations of the responses are shown by figures. The non-linear scale is indicated by reference circles located at every 15 degrees of eccentricity. The gray scale map is obtained by linear interpolation between the measurements All the data in this study are presented as a map of sensitivity so that areas with a total loss of sensitivity like the blind spot appear as white.

Duration of the examination

Fig. 2 shows the histogram of the duration of the examinations for each eye and for kinetic and static examinations. The average duration for the examination of one eye was 7.1 min for kinetic perimetry and 9.7 min for static perimetry. There is no significant influence as to the order in which the examinations are performed (kinetic OD, static OD, kinetic OS, static OS). The 35% shorter testing time is a definite advantage for kinetic perimetry, considering that a shorter duration is better for patient reliability and that automated perimetry is now a bottleneck in many ophthalmology departments.

Deficit detection and evaluation

Out of 83 patients, 59 or 71% showed complete agreement between kinetic and static examinations. The deficits were detected in both cases and their depth and shape were similar. Twenty-four patients or 29% presented noticeable field differences.

Figs. 3A to 3F show the results from six examination sessions performed over two months on the same patient with pituitary adenoma. Both kinetic and static fields show a progressive reduction of deficits, from extensive bitemporal alterations in Fig. 3A to normal fields in Fig. 3F. Fig. 3E shows small relative static defects which might easily be disregarded, whereas the bitemporal kinetic deficits are definitely present.

Kinetic perimetry appears generally more sensitive in detecting small scotomas located over 15 degrees of eccentricity. These differences are related to the threshold measuring technique. The static perimetry protocol uses a fast thresholding technique derived from the one initially proposed by Heijl and Krakau[1]. The threshold is only measured if the deficit is larger than 4 dB with respect to a reference map in the computer memory.

Any relative deficit of less than 4 dB is not taken into account. Even with a full

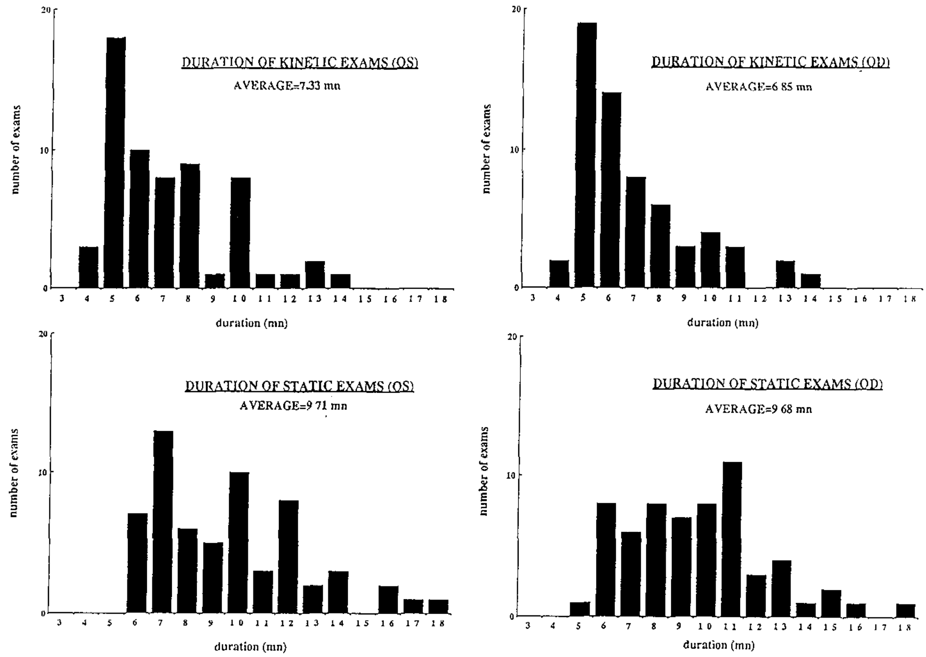

Fig 2 Histograms of duration of kinetic and static examinations.

thresholding procedure which is also available on the Vision Monitor but is also more time consuming, one might miss deficits of 2 dB or less due to the 2 dB steps used in the staircase procedure. The kinetic technique is more sensitive as it approaches the threshold in a continuous manner.

The delay in the patient's response causes an absolute error proportional to the stimulus velocity and response time of the patient[2]. However, the sensitivity for detecting relative defects is limited by relative errors, not absolute errors. This includes the response time fluctuation and the threshold fluctuation. The error due to the response time fluctuation can be estimated to be less than half a degree of eccentricity for a stimulus velocity of 2 degrees per second and a response time variation of 200 ms.

The next example shows deep paracentral scotoma in one patient with optical neuropathy (Fig. 4A) and a second patient with a sellar meningioma (Fig. 4B). The central isopters of kinetic perimetry do not give any information about the depth of scotoma. Such under-estimation of the depth of paracentral scotoma occurred in nine of the 83 patients included in this study. This is really nothing new[3] and it just reminds us that, in perimetry, one only finds what he is looking for.

In some patients, the spread of the central scotoma is greatly under-estimated by the kinetic protocol. Fig. 4C shows the worst cases encountered in this study. However, in all patients, there were small but still noticeable signs of kinetic deficits.

Statokinetic dissociations

Twelve out of the 83 patients presented noticeable differences between the kinetic and static fields which could not be related to the testing procedure. This

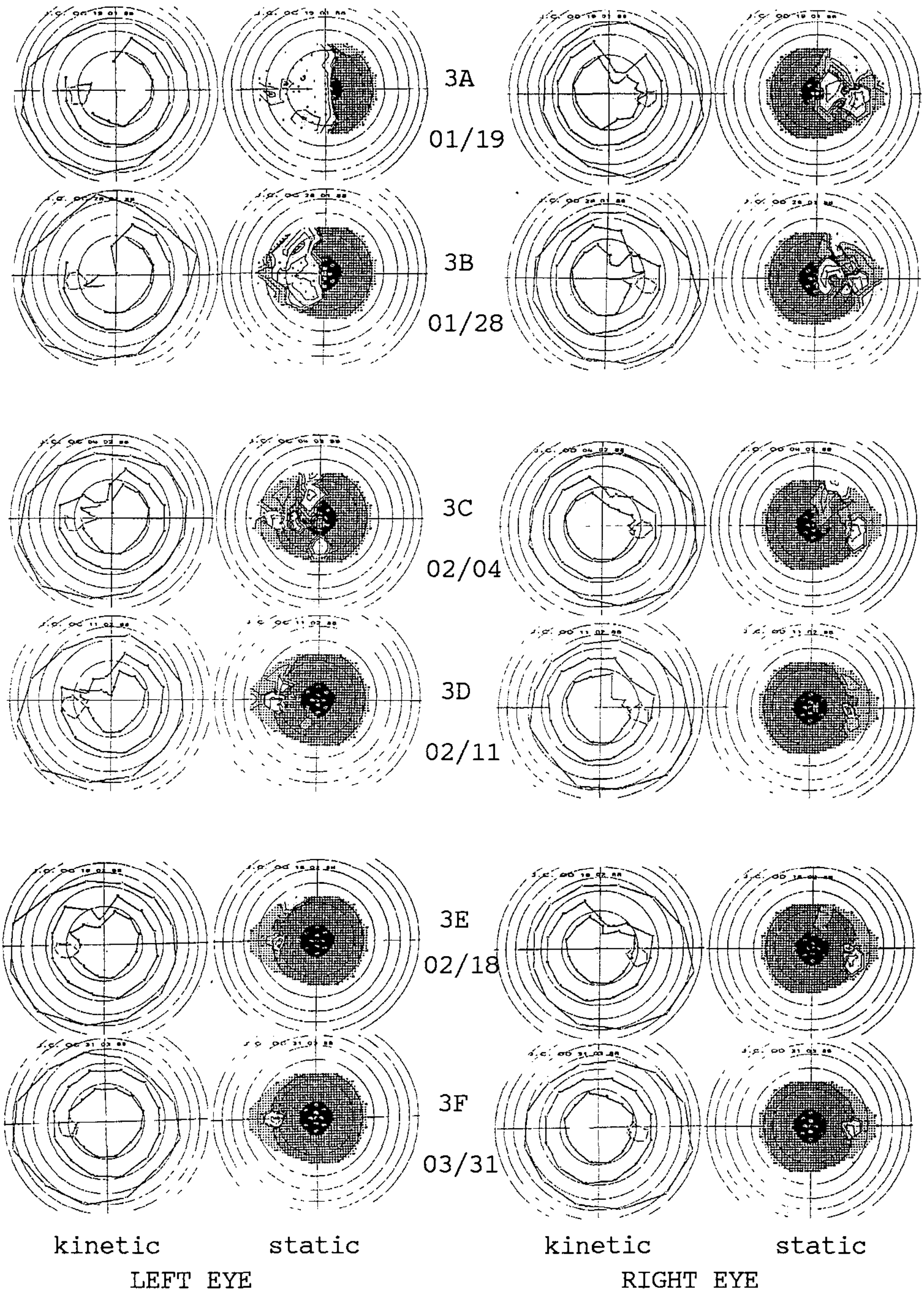

Fig 3 Follow-up of patient with pituitary adenoma

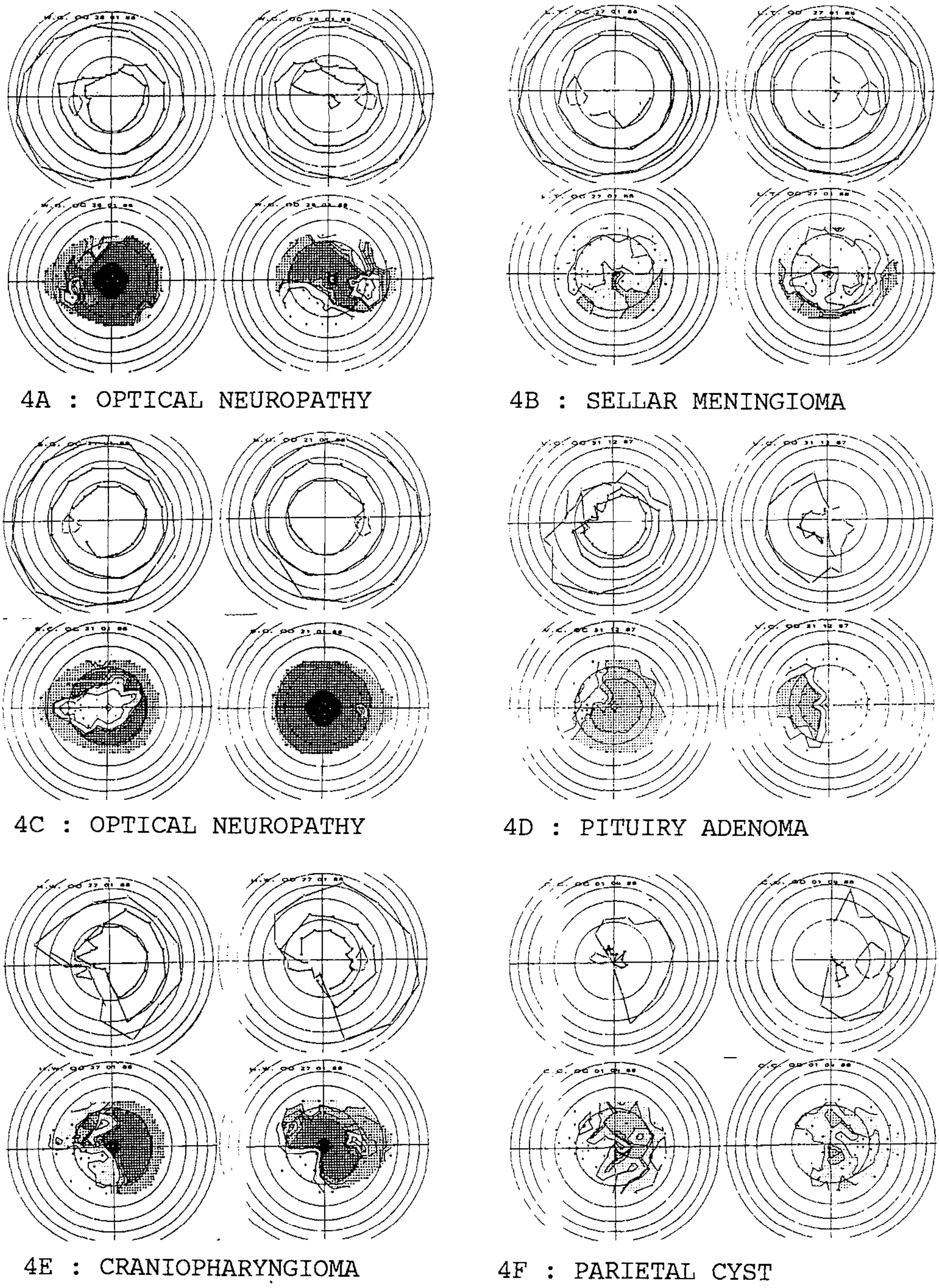

Fig 4 Examples of discrepancies between static and kinetic visual fields in neuro-ophthalmological diseases

group included seven out of 40 patients with pituitary adenoma, one out of four patients with craniopharyngioma, four out of ten patients with cortical lesions. These differences seem to be related to a phenomenon Riddoch described in 1917[4] for cortical lesions. Similar effects have been reported for other lobe lesions[5] and for lesions of the anterior pathways[6].

The results of this study support the existence of different pathways for the information involved in static and kinetic fields. One piece of evidence is that visual acuity is in agreement with the static field when the dissociation occurs over the macular regions (Fig. 4D). Temporal summations at the retina are not likely to cause such dissociations due to the use of 300 ms presentations in static perimetry. The effect of spatial summation would hardly explain that a large number of patients do not present dissociations (Fig. 4E). Furthermore, one of the patients in this study presents less deficit in the static field than in the kinetic field (Fig. 4F). Further interpretation of these dissociations can only be made by speculation. Statokinetic dissociations might be related to mechanisms of selective attention described by Singer[7]. According to this author, such mechanisms involve the control of the geniculate pathway by subcortical circuits and might alter the threshold levels by 5 to 10 dB.

Conclusions

The results of this study indicate that the ideal evaluation of neuro-ophthalmology patients should include complete kinetic and static fields. Both examinations present significant advantages, namely, the static examination assesses more precisely the volume of large paracentral scotomas and the kinetic examination is more sensitive and reliable for the detection of relative scotomas at eccentricities of over 15 degrees. Both examinations provide correlative and complementary information and their confrontation is extremely valuable for the establishment of a diagnosis.

However, if time limitations are taken into account, compromises have to be made, such as combining kinetic and static perimetry within the same protocol. For neuro-ophthalmology patients, a preliminary assessment of the field with kinetic perimetry and a control of the central field with static perimetry seems to be the ideal compromise.

References

1 Heijl A, Krakau CET: An automatic static perimetry. Design and pilot study Arch Ophthalmol 93:293-310, 1975

2 Fankhauser F: Kinetische Perimetrie Ophthalmologica 158:406-418, 1969

3 Drance SM, Wheeler C, Pattullo M: The use of static perimetry in the early detection of glaucoma. Can J Ophthalmol 2:249-258, 1967

4.Riddoch G: Dissociation in visual perception due to occipital injuries, with especial reference to appreciation of movement Brain 40:15-57, 1917

5 Zappia RJ, Enoch JM, Stamper R, Winkelman JZ, Gay AJ: The Riddoch phenomenon revealed in non-occipital lobe lesions. Brit J Ophthalmol 55:416-420, 1971

6 Safran AB, Glaser JS: Statokinetic dissociation in lesions of the anterior visual pathways Arch Ophthalmol 98:291-295, 1980

7 Singer W, Zihl J, Poppel E: Subcortical control of visual thresholds in humans: evidence for modality specific and retinotopically organized mechanisms of selective attention. Exp Brain Res 29:173-190, 1977