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THE USE OF THE PLANIMETER TO MEASURE FIELDS OF BINOCULAR FIXATION

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Abstract

The fields of binocular fixation of 20 normal subjects were plotted on an arc perimeter and the area of the fields was then measured with a planimeter. A planimeter is a cartographic device used to measure areas of two dimensional closed, irregular areas. The results showed that the planimeter gave an accurate quantifiable measure of fields of binocular fixation in normal subjects.

Key words: *Fields of binocular fixation, fields of binocular single vision, planimeter.*

INTRODUCTION

In Lyle and Wybar's "Practical Orthoptics in the Treatment of Squint" the average size of the binocular field of fixation (field of binocular single vision) is described as 50 degrees in up gaze, 50 degrees in direct down gaze with a reduction of approximately 15 degrees in dextro and laevodepression because of the nose, and 100 degrees in lateral gaze.[1] However, it has been generally accepted that irregularities of facial features, eg a large nose or deeply set eyes may alter the standard size of the binocular field. Consequently, quantifying the extent of a field of fixation has not been possible. The measurement has simply described a reduction of the field of fixation by comparing it to the "normal" or by a comparison made from one visit to another. In order to accurately obtain a quantitative measure of the size of a field of fixation, a cartographic device called a planimeter was used to measure the area as plotted by a perimeter. The planimeter is used by surveyors to measure areas of two dimensional, closed, irregular shapes. It consists of a base, a pole arm and a tracing arm on which is a clear plastic magnifying cylinder through which the outline can be viewed and traced. On the other end of the tracing arm is the scale which records the area traced as shown in Figure 1. The area is measured in either units of 0.1 cm^2 or .01 $inches^2$. To measure the area, the planimeter is set up on the recording chart, the outline of the field is traced and the area read directly from the vernier unit on the tracing arm, as shown in Figure 2.

The use of a planimeter in ophthalmology is not new.[2] It has been employed mainly in the quantitative analysis of sizes of scotomata in visual field testing both with patients with glau-

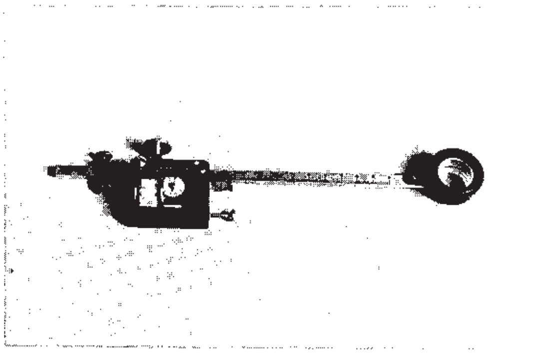

Figure 1: The planimeter, an instrument used by surveyors to measure areas of two dimensional, closed, irregular shapes.

coma and retinitis pigmentosa.[3-6] Those in favour of measuring field loss in terms of area, have argued that irregularities of some types of field loss can be accurately calculated and a quantitative measure of progression is then possible.[7]

To the authors' knowledge, planimetry has not been used to calculate areas of fields of fixation. The aim of this pilot project was to evaluate the cartographic method of obtaining a quantitative measure of the size of binocular fields of fixation.

SUBJECTS

Twenty normal subjects were chosen all with uncorrected right and left visual acuity of not less than 6/9, as measured on a standard Snellens chart at six metres; N5 each eye as tested with the Moorfields Bar Reading book at one-third metre; a full range of ocular movements; near stereopsis as evidenced by gaining 80 seconds of arc on the Titmus Test and full visual fields. None had any history of ocular problems.

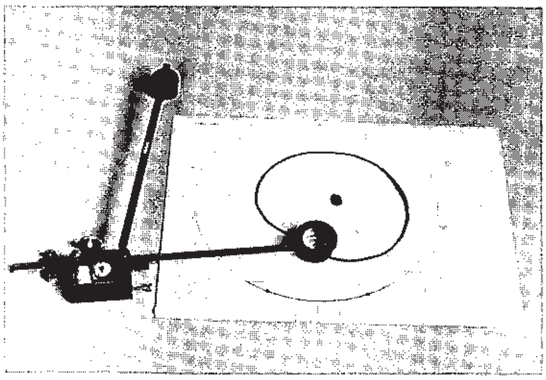

Figure 2: Use of the planimeter to measure the area of the binocular field of fixation.

METHOD

The authors have noted that it is possible to confuse the limits of the field of fixation with a field of vision. This can occur when the subject loses fixation but can still "see" the target while it remains within the visual field. Therefore to minimise this possibility, the Ellis (arc) perimeter was used with an accommodative target equal to Snellens N12 attached to the white 5 mm moving target. Three letters of N12 size were placed on the target of the perimeter. The rationale for using the accommodative target was that a blurred image would indicate the exact position when foveal fixation was lost and therefore the limit of movement. The subjects were instructed to place the chin centrally on the chin rest, with both eyes to follow the target from the central position without moving the head. The subject was asked to indicate at what point blurred vision or diplopia of the target occurred. This information was charted on the relevant binocular field of fixation chart. The planimeter was then set on the chart, the outline of the field was traced and a reading in square centimetres was taken.

RESULTS

The extent of the normal binocular field of fixation as described by Lyle and Wybar[1] is 50 degrees in elevation, 50 degrees in depression and 100 degrees laterally. When the contours of this field are measured by the planimeter, the area is 34.20 square centimetres.

The frequency distribution of fields of binocular fixation for the subjects in this study is shown in Figure 3 and as can be seen, there is a range of normal fields of fixation.

The mean, standard deviation and standard error are shown in Table 1. While the mean of 34.26 is almost exactly that of Lyle and Wybar, it has a negative skew, and so the median (36.45) more closely represents the obvious middle of the distribution. The negative skew is caused by the extreme values of this sample. No record was kept which could explain these extremes and so

TABLE
Range of Area of Fields of Binocular Fixation

Mean	Standard Deviation	Standard Error
34.26	7.40	1.64
Minimum	**Maximum**	**Range**
18.50	46.50	28.00

more subjects need to be examined to ascertain whether the skew is real in the sense that it represents the state of the population of fields of fixation, or merely measurement/sampling error.

DISCUSSION

The advantage of more accurate measurement in orthoptic investigation eliminates errors of clinical judgement and resultant variations between different clinicians. The monitoring of recovery of extra-ocular muscle paralysis, it is postulated, may be better carried out through this method than other methods, eg Hess Charts which the authors have noted frequently do not correlate with patient symptoms and clinical findings. This is a preliminary investigation to evaluate the use of the planimeter as a quantitative measure of the binocular field of fixation. The authors will now proceed to investigate the binocular field of fixation in subjects with known extra-ocular muscle paralysis, in order to assess its value in measurement of progressive recovery.

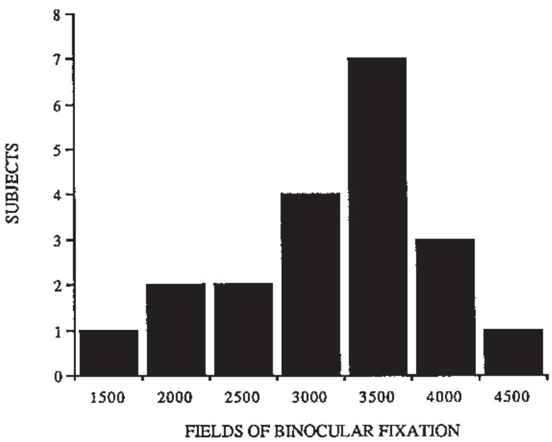

Figure 3: Frequency distribution of fields of binocular fixation.

The fact that some subjects fall outside the "normal" field of fixation is well known clinically and has been shown in this study. Because there is a range of apparently normal fields of fixation, the results should perhaps be compared intra subject rather than inter subject over a period of time.

CONCLUSION

The measure of the field of fixation by planimetry is a quick and easy measure, providing a numerical value which closely relates to the accepted standard normal field of binocular fixation. Clearly this has uses in measurement of both uniocular and binocular fields of fixation.

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