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COMMUNICATIONS

ON A METHOD OF EVALUATION OF BINOCULAR
MUSCLE BALANCE*

BY

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IN the pages of this journal (Vol. XXV, Nos. 4 and 5, April and May, 1941) Nigel Cridland fully discussed the academic aspects of orthophoria and heterophoria with a comprehensive bibliography.

The static measurement of the amount by which the visual axes deviate from the truly parallel when deprived of the stimulus of attention, fusion, and ciliary activity is no simple matter; the cadaveric state is as pathological a condition as is that of complete ophthalmoplegia. The position of rest, defined as a function of one or other of these, or in terms of dissociation from all neuromuscular control, is a hypothetical concept which cannot be measured in those alive and healthy. Nor is it particularly relevant to their visual comfort, though some approximate estimate can be made by the use of a Maddox rod, a remote point source of light, and interchangeable prisms in a condition of absolute cycloplegia. It is beginning to be more generally realised, however, that routine cycloplegia for the prescription of spectacles is as little logical as general anaesthesia for fitting shoes or clothes,

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the suitability of which is only remotely influenced by precise static anatomical measurement. The state of emmetropia is well so named; normal binocular balance could better be known as euphoropsia than orthophoria, to convey not only anatomical precision but also the psychological implication of comfort in a dynamic sense. The amounts of "uncorrected" deviation from orthophoria that are tolerable are not exact and invariable for all patients alike.

Each oculist acquires by experience alone an assessment of the personal factor and an opinion on the appropriate measures likely to relieve symptoms of visual discomfort. This experience as it relates to the correction of errors of refraction is gained at first consciously from the painstaking evaluation of each case examined by the post-graduate student. By the everyday routine of his professional life it is subsequently and continually facilitated and refined; experts differ little from a uniform opinion upon the dioptric power of any spectacles necessary to relieve symptoms in a given case.

The subject of muscle balance is one in which the student takes an early interest, involving an expenditure of time and the use of unaccustomed equipment that is not practicable in every case. The discovery that considerable degrees of heterophoria can co-exist with euphoropsia causes him to renounce his interest as unprofitable.

The phoria requirements for comfortable near vision have become in a measure recognised as a result of the simple and speedy tests available. Near point tests give partial information only; the author believes that practical merit attaches to an equally rapid method of estimating, as a part of routine eye examination, the dynamic ocular equilibrium for distance; and that daily familiarity with the variability of these functions and their association with visual comfort will reconcile prevalent exaggerated scepticism and enthusiasm about the whole subject.

Instrumental additions are :—

- (1) A pair of 7 dioptré prisms bases out in a hand spectacle frame (Fig. 1).

FIG. 1.

(2) A spring mount with a thin handle to take a single trial lens (in this instance a 2 dioptre prism as in Fig. 2).

Distance fixation targets are necessary, white on a black ground, at the customary six metres from the patient. They may be contrived very conveniently in conjunction with a scotometry screen of black velours cloth, 54 inches square, before the centre of which a Snellen chart is hung at a suitable height. Above the distance test type a 3 inch square of white card is pinned to hang diagonally by one corner and described as a diamond. On the left, at the

FIG. 2.

horizontal centre, is pinned a ring of white card, of $1\frac{1}{2}$ inch internal and 3 inch external diameter. (This has another use in plotting a central scotoma.) A small white button about $\frac{1}{2}$ inch in diameter is pinned to a corresponding point on the right of the test type. The screen, fixation objects, and test type are illuminated by a single bulb above and in front, in a Holophane reflector fitting with a ventilated "gallery." This has proved as suitable as any more elaborate system, in that it gives an even light of adequate intensity free from disturbing reflections even though the Snellen type be framed under glass (Fig. 3).

(1) *Test for Eso- or Exo-Phoria.*—The patient, wearing a trial frame containing the lenses appropriate for distance, correctly centred, is told to look at the ring. The hand frame is held vertically by the examiner so that one prism is base down before the

FIG. 3.

right eye. If the patient fails to see a second ring displaced above the first, even with repeated removal and replacement of the prism, marked suppression or suspension of vision of one eye can be assumed. If no movement of the fixation object is observed, the right is the suppressing eye. (This can be verified or refuted by repeating the test with the prism before the left eye.) If a second image is seen, the patient states whether the higher image is to the right or left of the lower. The hand frame is tilted in the frontal plane until one image is vertically above the other, the amount of tilt giving an indication of the esophoria or exophoria. (The horizontal effect is $7 \times$ tangent of angle of tilt. 45° is equivalent to 5 dioptres. A greater amount than this is unusual, and further tilting so reduces the vertical separation as to be impracticable, in which case supplementary prisms must be inserted in the trial frame base-apex line horizontal. It would, of course, be possible to elaborate this test by use of a variable prism or by a plumb-bob goniometer calibrated in prism dioptres, but our aim is simplicity.)

(2) *Crude Test for Hyperphoria (and Negative Relative Convergence).*—The patient's attention is next directed to the diamond.

The hand frame is held horizontally, so that one 7 dioptre prism is base in before the right eye. Spontaneous fusion may occur, but if two diamonds are seen, the outer end of the hand frame is raised or lowered in the frontal plane until they are level. The patient is then asked to bring them into one. The ability to overcome 7 dioptres base in from a state of orthophoria and emmetropia (natural or artificial) implies *very full* euphoropsia with ample negative relative convergence at distance. If necessary, fusion may be encouraged by a glance at the test types.

(3) *Test for Positive Relative Convergence*.—The patient continues to look at the diamond, and the hand frame is held before both eyes. This gives an effective 14 dioptres base out. The attainment of fusion now demands fourteen prism dioptres of convergence. It sometimes occurs spontaneously; if not, the examiner's finger may be held erect between patient and fixation object, about a metre from the patient, as a convergence stimulus. When fusion of finger images is effected, the patient may be able at the first or subsequent attempt to transfer his gaze to the diamond, at the same time sustaining fusion. Persistent failure implies that the fusion wish or the power of convergence is weak. Ability to maintain fusion and to read as far as before on the test types will prove that the convergence is "relative." (The hand frame itself is a practicable "home exerciser" whether of convergence or divergence, at a distance or at the near point.)

(4) *Critical Test for Hyperphoria*.—The fixation button and a 2 dioptre prism in the handle mount are used only for the assessment of hyperphoria and of the need for correction. With the handle horizontal, the effect obtained is that of two dioptres of prism base up (or down) before one eye with a corresponding vertical image separation. Spontaneous fusion should be rapid. By a twist of the handle between finger and thumb the examiner creates the opposite state or artificial vertical imbalance and may repeat this manoeuvre several times (not too often if he values the favourable opinion of his patient) observing on each occasion an equal ease of recovery of fusion. Success in this implies that the hyperphoria present, if any, is easily within the patient's tolerance. If fusion in one position of the handled prism is easy but impossible in the obverse position, supplementary prisms of various low powers, base up or down as indicated, are inserted in the trial frame and the test repeated until fusion in either position is equally well achieved, or separation is equal in the two positions. As a rough guide, it may be assumed that a patient can take care of his uncorrected hyperphoria if, from the state of vertical orthophoria created by a supplementary prism, he can recover fusion in each direction when the prism in the handle mount is twice the power of the supplementary prism. If equality of separation

is the best result thus obtainable, and especially if fusion recovery in each direction is only possible when the prism in the handled mount is weaker than the supplementary prism, prismatic spectacles are essential to comfortable binocular vision.*

It is not always possible to achieve a comfortable compromise of prism strength in a case of paralytic vertical diplopia, but it is worth a trial and is successful more often than might be expected. This applies especially to cases due to fracture of the maxilla even when the separation of images is pronounced. Those troublesome defects of eye movement, temporary or permanent, which follow spinal anaesthesia or head injury can often be relieved in this way.

(5) *Subjective Cover Test*.—Miss Margaret Dobson, in this journal (Vol. XXV, No. 2, February, 1941, page 67), describes an objective form of cover test involving polarised red-free light. It is somewhat complicated in application and only grosser amounts of distance heterophoria, amounting almost to heterotropia, can be detected with certainty. Any reasonably intelligent patient, however, can describe the direction in which distant objects appear to "jump," up or down, to right or left, if the examiner covers each eye in turn for one second, passing quickly from one to the other.

(6) *Near-Point Euphoropsia*.—The use of a Maddox Wing Test or some equivalent in the assessment of comfortable binocular vision at reading or working distance is sufficiently common-place to need no urging. The author would like to reiterate the importance of near point esophoria as a cause of frontal headache often situated at the root of the nose, and to advocate as a practical measure of relief in these cases the prescription of such "presbyopic" correction for close work as will establish ortho-, or slight exo-phoria, even in young patients, if the lens power so required does not approximate the punctum remotum and the punctum proximum too closely to each other or to the patient for his convenience. Thus, a man of forty may need the help of spectacles for near work though he can glibly read Jaeger 1, whereas another aged 50, still exophoric by nature at the "near-point," may boast of his ability to read for hours in comfort without glasses, merely cursing the newspapers for being so badly printed in recent years.

Some degree of exophoria at the near point, as measured by Wing Test or convergiometer, is a source of comfort. This amount

* As a standard, a two-dioptre prism should be used in the handled mount. It may be changed for a weaker or stronger one as judgment dictates in any special case. The handled mount was made for me by Messrs. C. W. Dixey some fifteen years ago for a different purpose; a minus cylinder of any power—depending on the visual acuity of the eye under test—can be inserted at 45° to the handle and used as a preferable alternative to a cross cylinder.

has been variously estimated at between two and six prism dioptres. Greater amounts than this *do not necessarily imply* deficient convergence; in the absence of good convergence power symptoms of discomfort may, however, arise. (The author, in hypermetropic enjoyment of full binocular vision, is not inconvenienced by sixteen dioptres of near point exophoria, with one dioptre of hyperphoria.)

Little attempt is made here to indicate the use to which an examiner may put the information obtained. Familiarity with the language and customs of strangers gives mutual benefit by dispelling distrust and misunderstanding; with a wider knowledge of euphoropsia and the factors that disturb it, an ophthalmologist will make his own judgment, critical and reasoned, of the relative values of prismatic spectacles, prism exercises, and the services of the trained orthoptist. All these have suffered some unwarranted neglect in the past from a fear which is bred out of ignorance by suspicion. It is the misfortune of orthoptists to have been associated primarily with the training of squinting children. The spectacular successes sometimes achieved in suitable cases led at first to indiscriminate reference of unsuitable ones, and inevitable disappointment. We do not yet sufficiently appreciate the extent to which they can help *selected* adult patients by "eye exercises" of the right kind.

TRANSIENT SLIT-LAMP APPEARANCES DUE TO CONCUSSION BY SMALL PARTICLES*

BY

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WHEN a "back-fire" occurs from the breech of a service rifle, a part of the exploding gases escapes backwards conveying with it very small particles of foreign matter, mainly fragments of incompletely burnt charge. These impinge upon the right side of the face of the soldier firing the rifle; though the force is considerable, the depth of penetration of skin, conjunctiva, or cornea, is slight owing to the small mass of each particle.

A soldier received an injury of this kind at about two o'clock one afternoon. He was admitted to a Military Hospital the same evening. His face and eye were cleaned superficially, and he was examined more thoroughly the following morning. By slit-lamp microscopy multiple minute foreign bodies of various sizes were

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