

## THE MEASUREMENT AND CORRECTION OF HYPERPHORIA

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I. One of the important considerations in a complete refraction routine is the measurement of hyperphoria. This paper shall describe a clinical method of examination for and measurement of hyperphoria. Discussion of correction will be confined to the consideration of the use of prismatic effect incorporated into ophthalmic lenses. No differentiation of etiology of the vertical phoria will be attempted. The categories of hyperphoria considered will be limited to the static and parietic classes (1). It should be understood, therefore, that no attempt at complete coverage of hyperphoria and its various means of correction is intended.

### II. *Method of Measurement*

The sequence in the total refracting routine, of the measurement of hyperphoria is of significance for properly evaluating the status of the patients binocular functioning. In general the earlier the presence of a hyperphoria is uncovered the greater will be the validity of the other measures of refraction that follow.

A thorough measure of hyperphoria throughout the binocular motor field usually is not routinely done on all patients, so the indications of a thorough examination of the hyperphoria will now be considered.

There are a few cues that indicate the necessity for a complete study. They follow:

1. Presence of prismatic effect in the currently worn spectacles is due either to intent of the previous examiner or to improper vertical decentration of the lenses. In either event a complete vertical phoria investigation is in order to confirm the need for the prismatic effect.

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(1) Sir W. Stewart Duke-Elder, *The Neurology of Vision* (St. Louis, The C. V. Mosby Company, 1949) Text-Book of Ophthalmology Volume IV, pp. 3970-3971.

2. The nature of the case history may directly indicate symptoms of vertical phoria or tropia or may suggest the possibility of their presence. Case history is not characteristically an indication of this defect, however. Specific complaint of vertical diplopia is not anticipated in the categories of vertical deviations under discussion.
3. In the author's refractive routine, ocular motility is measured before the retinoscopy is performed. Careful observation of the Patient's ocular excursions will sometimes indicate the existence of faulty performance of a vertically acting muscle or muscles by overtly observable vertical deviations by one eye from the line of the target used in testing the rotations. The author uses a muscle light as the corneal reflection it produces is of assistance in making this observation. The observation of a vertical phoria in any direction of movement of the extraocular muscles is greatly facilitated by the use of the cover test. The existence of a lateral phoria by itself or accompanying a vertical phoria in any direction of movement of the extraocular muscles is greatly facilitated by the use of the cover test. The existence of a lateral phoria by itself or accompanying a vertical deviation will, of course, render the objective observation more complicated. In any event, even the suspicion of a pure vertical deviation should lead to testing for the error by more definitive methods.
4. Even if failure to uncover a vertical deviation by objective observation occurs, as in the case of small static errors (present throughout the motor field) the measurement of the vertical phoria in the primary position of gaze farther along in the refracting routine through the refraction or trial frame, will indicate that verification should be pursued. The normal routine of refraction may then be interrupted to allow for the thorough investigation of the phoria, or if binocularity is intact and the routine can be completed, the testing can be done following refraction.

Now we shall proceed to consider the means of making a thorough investigation of a vertical phoria. The patient should be seated with his body and head comfortable erect and with the eyes positioned level. The Maddox rod either of red or white glass is used. Light source at 20 feet is a white square or circle of light. A muscle light is used for testing at the near range.

The distance test is made with the Maddox rod before one eye, the other eye viewing the target. When the horizontal line created by the Maddox rod is not vertically bisecting the light target, prism in various gradation are successively held with the rod, the base-apex line of the prism perfectly vertical (base in the indicated direction) until the horizontal line is made to appear to pass through the center of the light target. The cover test should then be performed to ascer-

tain if the line continues to bisect the target. If it does not, it is suspected that the patient has been utilizing some degree of fusion of the similar targets. The Maddox rod should be held before the other eye as the amount of hyperphoria may be variable in a parietic case depending on whether the deviation is primary or secondary.<sup>2</sup>

An advantage of the distance measure is that in hyperphoria subtended angle of separation of the line from the light source is greater at distance than near point and therefore affords a critical measurement of the defect. The distance hyperphoria may be measured throughout the field of motor action by having the position his head as desired.

The near measurement shall be considered only by two significant means. The *first* is with the Maddox rod and a muscle light. Again the line is made, by use of the proper prism, to bisect the light. Again the line is made, by use of the proper prism, to bisect the light bulb. The cover test again guards against fusion attempts. In addition to the measurement in the primary visual position the muscle light is held so that the patient is looking in turn in each of the six positions of maxim action of the extra-ocular muscles, and in the estimated habitual reading position and if needed in the peculiar positions required of the eyes in carrying out the occupational routine.

The Maddox rod must be held so as to be level at all times and so that the line of sight strikes the rod perpendicular to its plane. If these cautions are not observed the horizontal line created by the rod will be curved rather than perfectly straight.

The amount of prism for each direction of gaze is recorded. The findings should be confirmed by repeating the measurements with the Maddox rod before the other eye. The prism base will then be reversed. The degree of hyperphoria may vary depending on primary or secondary deviations.<sup>3</sup>

The *second* method of testing the vertical phoria is with a ruby glass held before one eye. Where diplopia exists in a given position of gaze it may be eliminated by the proper prism. In the event this cannot be accomplished due to a horizontal phoria the red and white images of the muscle light can be made level. The ruby glass test will *not* correspond exactly with the Maddox rod test and in the case of small errors may not produce any diplopia even though the Maddox test gave rise to a phoria measurement. Also, suppression may prevent the response of

(2) Richard G. Scobee, *The Oculo-rotary Muscles*. Second Edition (St. Louis, The C. V. Mosby, Company, 1952) p. 192.

(3) Richard G. Scobee, *The Oculo-rotary Muscles*. Second Edition (St. Louis, The C. V. Mosby, Company, 1952) p. 92.

diplopia of the similarly shaped images of the ruby glass test. For these reasons, the author prefers the Maddox test as a more provocative measure of hyperphoria. The ruby lens test however, is an important adjunct in considering whether prism or how much prism should be prescribed. It is valuable by indicating in which positions fusion of the red and white lights occurs. Where fusion is easily maintained throughout the motor field prism prescription may be contraindicated.

### III. *Advisability of Correction*

As was pointed out in the introduction, considerations is given only to stable and parietic types of hyperphoria.

#### 1. *Stable Hyperphoria*

Where the defect is approximately consistent throughout the motor field and of one prism diopter or more, prism should be considered. There are several factors to evaluate:

##### a) Patients Complaint and Symptoms:

If these are attributable to the phoria, correction should be made. Symptoms may vary from general discomfort of eyes to reports of occasional diplopia or blurring of vision. Other complaints are fatigue with close work and headaches with use of eyes. Greater ease of reading with one eye is diagnostically significant. Compensatory head postures, placing one eye higher than the other are sometimes seen in substantial hyperphorias.

##### b) Presence of Suppression:

As the degree of suppression increases, symptoms usually decrease. Judgment should be used before prescribing for a symptom free hyperphoric patient.

##### c) Associated Lateral Phoria:

Vertical are more difficult to overcome by fusional adjustments than lateral phorias. The presence of a lateral phoria which by itself might not be detrimental to fusion and binocularity can become unmanageable when compounded by the presence of hyperphoria. In a case of this type the correction of the vertical phoria would aid the patient by correcting one barrier to fusion, leaving only the management of the lateral phoria up to the patient.

##### d) Visual Acuity:

In a case where permanent visual acuity of the two eyes is sufficiently different to hamper bi-macular coordination, the presence of small vertical errors may be justifiably overlooked.

##### e) Age:

If the patient is of an age, either young or old, such that the subjective responses are questionable, hyperphoria measurement based on these responses

should be considered of dubious merit. Objective cover tests are of more value. Correction should be based on objective tests if a subjective and objective measurements are different.

f) Occupation:

Generally, the greater the demand for binocular vision of the particular occupation, more seriously should the examiner consider the use of vertical prism.

g) Limit of Correction:

Should the error be extremely gross, for example, over 10 prism diopters, the advisability of correction is questionable. Ordinarily there will be no symptoms, and the decision to prescribe for the error would have to be based on convincing factors.

2. *Paretic Hyperphoria* (hyperphoria variable throughout motor field)

We shall consider under this category patients who manifest at least one-half prism diopter in the field of minimum hyperphoria. The same things evaluated before correcting stable hyperphoria should be considered in this category. But in alleviating hyperphoria of a paretic nature, the correction will be effective maximally in some regions of the motor field and minimally in the regions where the defect is most pronounced. The minimal hyperphoria measured with the habitually fixating eye regarding the muscle light is generally the limiting factor in paretic cases. Exceptions will be considered in the next section.

IV. *Prescribing the Prism*

1. Stable Hyperphoria

Hyperphoria of one prism diopter or less characteristically does not elicit subjective complaints from the patient. Notwithstanding this, if the patient is in need of spectacles for constant wear and the ruby glass test, produces diplopia in significant positions, there are at least two conditions where incorporation of prism in the correction is justified. The first is the occupation as discussed previously. One-half of the error can be corrected to guard against binocular interference and possible future discomfort. The second condition is that of associated lateral phoria. Binocularity is susceptible to stress from lateral phoria and the incorporation of prism into the spectacles will assist the patient to combat weakening of binocularity with accompanying suppression.

In patients with one prism diopter of vertical error or more who show diplopia in the ruby lens test in significant positions of gaze, the correction of the error can be assumed to be of beneficial effect when glasses are to be



worn constantly. Exceptions for use of prism are for patients who prefer not to wear glasses constantly. Also some factors listed in considering advisability of correction, such as gross difference in visual acuity of the two eyes, would make the prescribing of prism ineffectual.

Where prism is used, the power may vary between full correction to within one-half to one diopter of the error depending on pertinent circumstances as discussed earlier.

## 2. Paralytic Hyperphoria

Since the hyperphoria or phoria-tropia varies in the motor field, this fact dictates the amount of prism to be used. The minimum measurement of hyperphoria must be considered first.

- a) If the least error prevails in the primary position of gaze with habitually fixating eye viewing the muscle light, the correction should not exceed that amount of error. This assertion can be seen to apply to a hyperphoria present maximally in one lateral field of movement, as well as one that reverses hyperphoric eyes from one lateral field to the other. In the latter instance probably no correction would result, which indeed should be the proper disposition where the hyperphoria is right looking to one side and left in directing the eyes to the opposite side.
- b) If the minimal hyperphoria exists with the eyes directed to one extreme lateral position, the evaluation of amount of prism to be prescribed must be based on data concerning the patient's visual habits and the spectacle relationship to the patient's eyes.

A. First, in relation to visual habits, the extent of the lateral conjugate movements utilized in the patient's visual routines must be ascertained. The comparison of the difference in lateral conjugate sweep of a bookkeeper and a watch repairman illustrates the problem. If the lateral movement is wide, the maximum prism prescribable is limited by the hyperphoric measurement at the terminus of the lateral excursion. For example, the hyperphoria is zero with eyes looking somewhat to the right of center and a right hyperphoria develops as the eyes move horizontally toward and then into the left field. Further, at the primary position the right hyperphoria is two prism diopters and increases to a maximum of four in extreme levoversion. If the patient in his occupation utilized a lateral excursion extending  $15^{\circ}$  to each side of the primary position, the right hyperphoria should be measured with eyes looking  $15^{\circ}$  to the right side. The right hyperphoria at that point

might be one prism diopter and that would be the limit of the prism prescribable under existing occupational usage of the approximate limit of lateral version before head movement reflexly occurs)<sup>4</sup>.

- B. Secondly, the spectacle measurement is a limiting factor. In the example above if the binocular field of vision through the spectacles exists 25° to the right side, then very conservatively the hyperphoria measurable at this position would be prescribable. Bifocals are obtainable in widely varying dimensions and the limitation of lateral versions imposed by the segment is another consideration. A practical dictum to follow is to limit the prismatic power to the least hyperphoric measurement 15° from the primary position. This would probably be the motility limit but the prism power should preferably be slightly less than the total correcting prism at this 15° position.
- C. If a negligible hyperphoria exists in the primary position of gaze, but hyperphoria is present in the reading position (eyes directed downward), the refractive power of the lenses should be compared before prism in the reading fields is considered. If the resultant power in the vertical meridian is different for the two lenses, the prismatic effect resulting from looking below the optical centers of the lenses (reading position) must be calculated to determine if the effect corrects or exaggerates the hyperphoria. Often the error is nullified to some degree relieving the necessity to prescribe a prismatic correction in the lower part of the lens (slab-off or bifocal prism). If the error is increased by prismatic effect of looking down through the lenses, then prismatic power sufficient to correct the muscle error plus the spectacle error would require consideration.

Under item a) it was stated that the correction should not exceed the error present in the primary position of gaze. If this error is zero or of negligible quantity, but a substantial hyperphoria exists to one side, nothing can be done with prism. However, the patient should be advised to avoid looking to the side of the maximum error or to turn the head so as to avoid the eye position which is apt to place stress on the binocular mechanism.

### 3. Prescribing the Prism

Prismatic effect may be achieved in several ways, some of which are applicable only in special circumstances.

(4) Richard G. Scobee, *The Oculo-rotary Muscles*, Second Edition (St. Louis, The C. V. Mosby Company, 1952) p. 92.

a) Prism incorporated into the lens.

This is the most common form of prism used for vertical hyperphoria. The direction of the base of the prism may be specified by the examiner, commonly the base is placed up before the hyperphoric eye. The prismatic power may be shared between the two eyes in large hyperphorias.

b) Vertical lens decentration

In cases of strong lense correction and small vertical imbalance, the desired amount of prismatic effect may be achieved by decentering the ophthalmic lenses along the vertical meridians. The decentering effect in prism diopters multiplied by the amount of decentration in centimeters.

c) Prism in segment

In presbyopes when the amount of hyperphoria in the reading position differs from that in the primary position, this discrepancy may be corrected by prescribing prismatic power in the segments.

d) Slab-off prism

In single vision lenses, the same kind of adjustment achieved in (c) may be accomplished by the method of slab-off prismatic power. This method produces a base up effect in the lower part of the lens which is ground off.

e) Complicated vertical prisms

Lateral and vertical prismatic power may be incorporated into the same lens.

*V Summary.*

The scope of this paper has been limited to the common types of hyperphoria that are frequently encountered in practice.

Method of measurement of hyperphoria is of great importance if prismatic correction is to be considered. The amount of error in the significant directions of gaze, the reading position, and the habitually usable fields of mobility, should be known.

The presence of a hyperphoria does not always demand its correction. Many factors such as those considered under section III. must be weighed. The single most important factor contraindicating demand for prismatic correction alone is presence of suppression.

The correction of vertical deviations sets the stage for more precise and efficient binocular and bi-macular visual functioning.

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