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COMMUNICATIONS

THE INFLUENCE OF PROLONGED MONOCULAR OCCLUSION IN REVEALING ERRORS OF THE MUSCLE BALANCE.

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Neither in text-books of ophthalmology nor in monographs upon anomalies of the ocular muscles is any reference made to, much less is any emphasis laid upon, the importance of the duration of the tests of heterophoria. I recall only two brief references to it in the literature of the subject. As I have been unable to find the original papers I can only state from memory that one, by a London ophthalmologist, dealt with the effect of holding the screen for a definite period, ten seconds, I think, before the eyes before shifting it, instead of momentarily; and the other by Posey, of Philadelphia, who drew attention to the advantage of taking the trouble not to remove the screen from the covered eye at the end of the refraction tests before placing in front of the uncovered eye a Maddox rod or whatever device was to be used for testing the muscle balance, thus taking advantage of the relaxation which might have occurred during the tests for refraction. But a little consideration of facts of common clinical observation, namely, that a squint is very apt to
develop in children, the subject of any condition, such as ulceration of the cornea, temporarily annulling binocular vision, that it develops not infrequently in patients who have had one eye bandaged for any length of time, and that a divergence or other deviation develops after a longer or shorter period in eyes which have become blind or very defective from any cause would lead to the inference that the duration of annulment of the binocular function is a very important factor in the detection of faults of muscle balance.

Another common clinical observation—which makes the fore-

Mrs. H. D. D., aet. 52.

Asthenopia.

Above O° line.
X=Exophoria.
O=R. hyperphoria.

Orthophoria.

Below O° line.
X=Esophoria.
O=L. hyperphoria.

Refraction:
R. -0.25 s.
+0.50 c. 40°.

L. +0.25c. 110°.

going inference of practical importance—is that there are a great many patients, the character of whose symptoms leaves no doubt that they are the subjects of some kind of eye-strain, who fail more or less completely to receive benefit from an apparently accurate correction of their manifest refractive and muscle errors, or are made worse by such correction. I wish to submit that in a large number of these cases the failure to relieve is due to the inefficient manner in which the tests for muscle imbalance are made, in respect merely of the length of time for which the binocular function is annulled.
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I have assumed that the so-called cover or screen test, with its related subjective parallax test, is the most valuable of all tests for muscle imbalance, because it is objective and passive, making binocular fusion impossible in the most complete and simple manner, and I have further assumed that the more thoroughly the test is applied the more accurately the result will represent the truth.

The prolonged occlusion test is applied practically—in cases in which the refraction has been carefully estimated, and demonstrable errors of the muscle balance determined and recorded—by having one lens replaced by a ground glass, the other eye being furnished with its full refractive correction. The patient is directed to put the glasses on in the morning before opening the eyes, not to look over or under them, not to remove them for any purpose without closing at least one eye, and to wear them until the eyes are closed at night, keeping this up for seven days. At the end of this time the muscle test is made. A full refractive correction is placed in a trial frame with a Maddox rod in front of one eye: the patient is directed to close his eyes, his glasses are then removed and the trial frame, etc., substituted for them. He then opens his eyes and the tests are made. (My usual
practice is to use the Maddox rod for the vertical and the vertical diplopia test for the lateral deviations, using the screen and parallax tests as confirmatory.)

It must be admitted at once that this test is not suitable for universal use. Only patients of intelligence to whom the nature and object of the test are thoroughly explained, and who also realize, usually by much suffering and many failures in the past, that there has been some hitherto undiscovered factor in their cases, and who are also willing to submit to some inconvenience in order to obtain relief, are really fit subjects for it. But it has been my experience that there are a great many patients of this class, and I have rarely been disappointed in the thoroughness with which the test has been carried out by the patient.

The accompanying charts illustrate more strikingly than a written description the actual results of the tests, and are self-explanatory.

No. 1 shows that a week's occlusion may bring out practically no change.

Nos. 2, 3, and 4 show daily observations and an approximation to stability at the end of a week.
Miss M. M.

Above O° line.
$X = \text{Exophoria.}$
$O = \text{R. Hyperphoria.}$

Below O° line.
$X = \text{Esophoria.}$
$O = \text{L. Hyperphoria.}$

Mrs. L. J. D., aet. 29.
6223.

Above O° line.
$X = \text{Exophoria.}$
$O = \text{R. Hyperphoria.}$

Below O° line.
$X = \text{Esophoria.}$
$O = \text{L. Hyperphoria.}$
In the remaining cases the observations were made only at the beginning and the end of the test, showing varying degrees of increase in the amount of error, and in some, reversal of the direction of deviation.

Case 7 is of particular interest on account of the high degrees of the errors, especially of the hyperphoria, which were entirely latent before the test. This patient was referred on account of severe neurasthenic symptoms, all causes other than ocular having been apparently excluded by her medical adviser. In view of the extremely low degree of refractive error and the perfect orthophoria, I was on the point of giving the opinion that ocular causes could also be counted out, but as some of the symptoms seemed to be closely related to the use of the eyes, I first advised the occlusion test. The chart shows the result: exophoria eight degrees and hyperphoria seven degrees, and the subsequent history of the patient confirmed the importance of the findings.

Cases 8 and 9 are of interest because they are those of mother and son, both having been under my own observation and that of other
Mrs. E.P.S., aet. 28. 6927.

Above O\(^\circ\) line:
X = Exophoria.
O = R. hyperphoria.

Orthophoria.

Below O\(^\circ\) line:
X = Esophoria.
O = L. hyperphoria.

Refration under scopolamine:
R. +0.75 s.
L. +0.50 s.

Mrs. L.K., aet. 46. 77.51.

Above O\(^\circ\) line:
X = Exophoria.
O = R. hyperphoria.

Orthophoria.

Below O\(^\circ\) line:
X = Esophoria.
O = L. hyperphoria.

Refraction:
R. +0.62 c. 160\(^\circ\).
L. +0.62 c. 25\(^\circ\).
ophthalmologists for ten or twelve years without satisfactory improvement being obtained.

Case 10 shows reversal of both vertical and lateral deviations. Case 11 shows exophoria after the occlusion period, greatly exceeding the abduction as measured previously.

Experience with this test in a considerable number of cases suggests the following conclusions:

First: That the length of time ordinarily devoted to tests for the muscle balance is insufficient for the purpose. It is difficult to say how long a period of occlusion is necessary to bring out the total error, for there is obviously a limit to the length of time for which a patient can be subjected to the test. Some of the charts shown seem to indicate that a week is sufficient to arrive at stability, but in other cases successive tests have brought out more error. Thus, in one (Mrs. J. L. H.), the first period of seven days brought out an exophoria of four degrees, the second of fourteen days six degrees, the third of seven days, after an interval in which prisms had been omitted, six degrees, and a fourth of seven days...
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ten degrees. In some cases in which marked relief has been experienced by the patient during occlusion, no error has been found at the end of the period, suggesting as one possible explanation that the period has been too short to bring about relaxation of the muscles.

Second: That the results obtained by the usual brief manner of applying the test may be misleading not only as to the degree but also as to the kind of error present. One of the most striking phenomena seen is the reversal of the direction of deviation. Thus

Mrs. H. W. S., aet. 43.
6573.

Above O° line:
X = Exophoria.
O = R. Hyperphoria.
Orthophoria.

Below O° line:
O = L. Hyperphoria.

Wearing:
R. + 1°25 s.; + 1°00 c. 60°.
L. + 1°25 s.; + 1°25 c. 95°.
Refraction without cycloplegia:
R. + 1°50 s.; + 1°00 c. 60°.
L. + 1°50 s.; + 0°62 c. 70°.

a right hyperphoria before the test may become a left hyperphoria afterwards or vice versa, the change commonly being accompanied by the development of exophoria; or, less commonly, an esophoria changes to an exophoria, or both these changes may be seen in the same case. The most frequent change seen, however, is an increase, often very great, in the amount of deviation.

Third: That the prism duction gives no reliable indication of the presence or amount of a deviation. Previous to my experience with this test I had been under the impression that the prism abduction was to some extent a guide to the amount of possible
exophoria, and that the degree of the latter could not exceed the former. Numerous observations by the occlusion test completely disprove any constant relation between the two. The exophoria, after prolonged occlusion, often exceeds, sometimes very greatly, the abduction as measured before the test. The same may be said of hyperphoria in relation to sursumduction, though observations on this point are not as numerous as those on exophoria.

_Fourth:_ That the effect of an operation on the muscle balance cannot be determined with any certainty without an occlusion test.

F. K., aet. 13—20.

425.

Above O° line: X = Exophoria.
O = R. Hyperphoria.

Orthophoria.
Below O° line:
X = Esophoria; O = L. Hyperphoria.

Refraction:
R. - 0.25 s.; - 0’87 c. 20°
L. - 0.75 s.; + 0’87 c. 70°

The cause of failure of operative measures to relieve symptoms may be shown by an occlusion test, bringing out the fact that the operative effect has been too small or too great.

_Fifth:_ That the effect of prism exercises is to obscure or render latent an error previously manifest, such latent error being easily made manifest again by an occlusion test.

_Sixth:_ That the test brings out conditions which make it unnecessary to assume that the constant use of prisms tends to increase an error, far greater and more rapid change being produced by the passive relaxation of the occlusion test.
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Seventh: That the paralytic or non-paralytic character of a hyperphoria can be determined with much greater ease and certainty after than before the test.

Eighth: That the theory held by some that the lateral deviations are secondary to the vertical receives no support from this test so far as exophoria is concerned. If the latter were due to efforts to overcome hyperphoria, it would diminish when these efforts cease, as during an occlusion test. But this is contrary to the facts. It usually increases. In some cases of esophoria, however, the convergence diminishes, disappears, or is converted into divergence co-incidentally with increase in the degree or change in the form of hyperphoria.

A DISCUSSION UPON THE ILLUMINATION OF MINES, WITH PARTICULAR REFERENCE TO MINERS' NYSTAGMUS*

The Chairman (Mr. J. Herbert Parsons): I do not think I need introduce to you, who are interested in this subject, Dr. Lister Llewellyn. It was an extremely fortunate event when he was chosen first Tyndall Scholar, and he has very fully justified his election. He has produced an enormous amount of evidence in support of the view that the essential cause of miners' nystagmus is deficient illumination, and, at least in the opinion of most of us, he has thoroughly established that view.

Without further preamble, therefore, I will call upon Dr. Lister Llewellyn to read his paper.

a—LIGHTING CONDITIONS IN MINES WITH SPECIAL REFERENCE TO THE EYESIGHT OF MINERS

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Synopsis of Contents

I. Lighting conditions in mines—
   General remarks.
   Photometric measurements.

II. Physiological considerations of the effects of dull illumination on the eye.

III. The effect of dull illumination on the eyesight of miners—
   Injury.
   Disease.

*This discussion took place at a meeting of the Illuminating Engineering Society, on February 24, 1920, and is now published by kind permission of that Society.
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