surgeons in the treatment of these cases, classified according to their cause.

Not until we have a fuller knowledge of their aetiology can we reasonably hope either to advise rationally or to devise a more successful procedure in the treatment of these difficult cases.

THE RELATION OF EXOPHORIA IN EARLY PRESBYOPIA TO REFRACTIVE ERRORS*

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ROUTINE studies in any particular line of cases are rewarded by the uncovering of many unsuspected, but none the less prevalent, conditions. The practice of routine muscle studies in refraction is no exception to the rule. One of the outstanding facts in this special line of investigation is the gradual increase in the number of exophorias encountered from the age of thirty to that of forty-five or fifty. Two distinct types of cases are to be found in this period. First are those which simply represent a carry-over, as it were, of an aggravated condition which has its inception in early adult life and increases with the added strain of waning accommodation in the presbyopic period. These fortunately make up the smaller group. From an aetiological standpoint, as well as from the standpoint of possibilities in treatment, they furnish a fascinating field for study. The second or larger group are those which one may appropriately call "accommodative exophorias"—exophorias which have as their basis failing accommodation. This group includes so many cases which need our careful consideration, that they alone will be discussed.

The underlying factor is failing accommodation. A summary, however, of case records seems to point to one fact especially significant, a majority of these patients have never worn glasses or have been improperly glassed until the age of thirty-five or later. If glasses are properly prescribed in early adult life, and again as the presbyopic age creeps on, this type of exophoria is comparatively infrequent in occurrence and is easily managed. In the writer's experience, those, who have most symptoms, have the greatest degrees of exophoria, and are the most difficult to handle, are the hypermetropes who have failed to wear suitable glasses until the early presbyopic period.

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Two or three dioptries of hyperopia with low grades of astigmatism may cause little trouble before the patient is 37 years of age. At this period, however, even a moderate degree of hyperopia begins to inconvenience the patient in close work and he looks for help. Still unwilling to wear glasses constantly or possibly uncomfortable with a full correction because of an overacting ciliary muscle, a full correction is usually prescribed for near work and distance glasses are not worn. The consequence of this method of handling or indulging the patient is a disturbance of the relation between accommodation and convergence.

There is a temporary period in most cases, even if properly glassed with a far and near correction, when exophoria may appear as the result of the sudden relaxation in accommodation incident to the wearing of the near correction. In the average individual this readily adjusts itself or may only be present in fatigue. In the patients, however, just referred to, it becomes necessary at all times to utilize an excess of their reserve accommodation for distance alone. The normal relation of the metre angle of convergence to the dioptrie of accommodation is not maintained at infinity and is not observed at the working near point. Convergence is repressed in the interest of single binocular vision.

It is generally assumed that convergence excess is the rule when an excess call is made upon the accommodation for clear distant vision, and on this belief is based the accommodative theory of the aetiology of convergent squint. Donders, however, has clearly shown (*Accommodation and Refraction of the Eye*, 1864, pp. 110-111), that each may work independently of the other in the interests of clear binocular vision. Operating over a period of many years, a new relation, therefore, may be established between accommodation and convergence for a given patient with two or more dioptries of uncorrected hypermetropia.

At this period of disturbance, the optician prescribes rest glasses; the careless oculist prescribes without drops; or because the patient objects to glasses for constant use, or the ciliary muscle rebels, a two or three dioptrie reading glass is prescribed and the distant vision is uncorrected. Convergence, which is already repressed, fails to respond normally, with a total relaxation of accommodation, and exophoria, often of ten to fifteen degrees, develops.

A fair statement of the aetiological factors must necessarily include a small group of patients properly glassed throughout, who, temporarily, or when fatigued, or when somewhat below normal in health, may show moderate degrees of exophoria for the near point, especially when wearing their first presbyopic glasses. It is a form of exophoria which responds readily to proper therapeutic measures.

The symptoms complained of by these patients, aside from the difficulty of seeing clearly at the near point, are headache, usually

supraorbital and temporal, but often occipital, after doing close work; drowsiness on the slightest attempt at reading; redness of lids, vague gastro-intestinal disturbances, and nervous conditions usually attributed to other causes. Reading, which to the average man becomes more and more a habit and a source of pleasure and occupation as the years multiply, becomes intolerable. To the man whose work requires close application at the desk work becomes a burden. These patients are apt to go the rounds in an effort to obtain relief. Some are successful; others accept what they believe to be the inevitable and shun close work as much as possible, and may even change their occupations.

What can be done to correct the condition? The answer is not a simple one.

The first step is careful refraction, with a cycloplegic in all cases in which it can be safely used. To discuss the cycloplegic best suited would take us too far afield. Unfortunately, homatropin is now generally used as the drug for this period. There are cases, however, uncorrected throughout life, in which homatropin will be found to be inadequate to control properly an unequally developed ciliary muscle. In these cases, scopolamin should be used without stint for the double purpose of properly controlling the ciliary muscle during the examination, and in order to keep the muscle relaxed for a longer period than is our custom.

If exophoria is marked at this early period, a full distance correction, even if tolerated, should not be given at once. In most instances this advice is unnecessary, as few will accept two or three dioptres of correction immediately. Two pairs of glasses should be prescribed—a full correction for close work and a weaker correction for constant use. In many instances, the weaker correction can be discarded in a month or two, and the full correction will be accepted. In other instances, a second or a third change may be necessary before the full correction will be accepted. The wearing of a full correction will be determined largely by the patient's tolerance and by the results obtained by prismatic and stereoscopic exercises.

Some years ago, when inspired by the excellent work and teaching of the late Wendell Reber, the writer began to use prism exercises; either because the cases were poorly selected or the exercises were improperly conducted, the results obtained were rather discouraging. Necessity, however, is the mother of invention, and the number of these cases which make up an average clientele compelled more assiduous study with gratifying results.

The cases fall into two groups. Those most suitable for prism exercises alone usually manifest exophoria for distance and a greater degree of exophoria for the near point. Adduction is below normal. Those in which stereoscopic exercises, combined with prism exercises,

are best adapted have an esophoria for distance and exophoria for the near point. In the latter group both adduction and abduction may be above normal but improperly balanced.

The first object of prism exercises at six metres is to restore a normal relation between the dioptré of accommodation and the metre angle of convergence which has become viciously disturbed by the necessity of using too much accommodative effort at infinity. This is especially imperative in those individuals who are able to obtain normal visual acuity at infinity in spite of the presence of three and even four dioptrés of hypermetropia. It is not easy to accomplish this, especially in patients who have gone uncorrected until they reach the age of thirty-five. Much time must be spent, and patient and doctor should have considerable patience, therefore, when treatment is instituted. A normal balance can be restored in most cases, if the technique is good and the exercises are continued sufficiently long.

The technique is so important that a brief enumeration of the important steps should not be amiss.

1. All exercises should be conducted at six metres with the light at proper level—not above the patient's eyes.

2. A full correction should be worn during the exercises.

3. Prisms should not be tilted up or down, but with bases out held perfectly level before the patient's eyes. It may be impossible to fuse if the vertical displacement of the light is even one degree.

4. The increase in prism strength should be very gradual at first, two or three prism dioptrés at a time, until the patient has caught the knack of fusing.

5. *The patient must see the two images fuse into one.* One of the causes of failure is due to non-observance of this rule. Patients will return with a report of being able to practise with 70° and even 90° prisms at home, when actual experiment in the office may show a possibility of but 15 prism dioptrés. The second light deviates so far to the right or left that they fail to recognize its presence.

6. Minute instruction must be given in the office, two or three times. The actual work is then conducted at home daily for a week when the patient should return and have any errors in technique corrected. Return visits after the first week should be made in two weeks and later once monthly.

7. Home practice should be conducted every day for 15-minute periods until satisfactory results are obtained.

8. If several months of treatment bring about satisfactory results, two 20° and two 15° prisms should be purchased by the patient and a few moments of practice should be indulged in at intervals.

The degree of exophoria which may be overcome by this method averages from two to seven degrees at infinity with a corresponding

seven to twelve for the near point. Long before the Maddox rod shows a normal or nearly normal balance the patient will report relief from the symptoms which led him to consult the oculist. Those who have high degrees of exophoria will also report comfort in close work in spite of a residual degree of exophoria, amounting to as much as seven or eight degrees for the near point as shown by the Maddox rod test. The explanation of the relief from asthenopic symptoms, even though the Maddox rod registers so much exophoria for the near point, lies in the fact that the nearness of the images and their similarity enable fusion to accomplish its work. Failure cannot be entirely determined by the Maddox rod. The patient's comfort must be the deciding factor in high and sometimes even in low degrees.

Improvement in abducting and adducting power and their relation are important, but, after all, their relation is disturbed primarily by the vicious interference referred to early in the discussion. The first object, therefore, is to correct, not an inherent duction weakness, but an unbalanced relation which has been brought about by failure to correct hyperopic defects early in life.

The role of the stereoscope is also important. It is too intricate, however, to discuss in detail in this communication. It is sufficient to say that it is a most excellent instrument with which to supplement prism exercises as a stabilizer, especially when both adduction and abduction are well developed but are not well balanced. It is of greatest help in those cases in which there is an esophoria for distance and an exophoria for the near point. Its proper technique is as intricate as prism exercises and deserves a separate communication for its proper presentation.

The writer cannot close this discussion without a final word to those who refract without routine muscle studies and to those who have tried prism exercises and have failed to obtain satisfactory results. Those who refract without routine muscle studies, whether in private practice or in the hospital clinic, are not doing justice either to themselves or to their patients. In private practice there can be no excuse for this omission. In hospital work there should be no excuse. The taking of muscle balance does not require an expensive equipment, nor does it require much time. In hospital work, if muscle defects are found and their importance is explained to the patient, most patients will be willing to find the means for private office training. Or, failing in this, the responsibility rests with them. Prism training is too time-consuming for dispensary application.

Those, on the other hand, who have practised prism training and have failed to obtain results should try again, with a change in technique. The results which the writer of this paper has obtained are being duplicated by many. They are offered only after having been thoroughly tried and not found wanting.