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MUSCULAR ASTHENOPIA AND ITS TREATMENT
BY GRADUATED TENOTOMY.

BY

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MUSCULAR ASTHENOPIA AND ITS TREATMENT BY GRADUATED TENOTOMY.

By CHAS. HERMON THOMAS, M. D.,

PHILADELPHIA.

During the past decade a great advance has taken place in our knowledge of the anomalies of the ocular muscles. Until well within that time, the standard text-books on ophthalmology, so far as I am aware, recognized the so-called insufficiency of the internal recti only, as the cause of muscular asthenopia; affections of the remaining muscles being treated solely in their relations to diplopia and strabismus. It is now almost universally conceded that the opposing and vertical muscles are subject to like defects, with corresponding symptoms of equal or even greater importance. Recent editions of systematic treatises show that most writers now give to the whole range of muscular anomalies the prominence which their importance demands. Among these may be mentioned the latest edition the work of Noyes, which treats the subject elaborately, and also the works of de Schweinitz and of Norris and Oliver, both of which latter deal with it at considerable length. The increased interest and scope which the subject has acquired has resulted in the very general adoption of a new and systematic nomenclature—that originally proposed by Stevens. This improved terminology is employed by the authorities just named and is also introduced in the recent American editions of the works of Fuchs and Juler. As showing the increased importance accorded to the subject, it is worthy to be mentioned that at the meeting of the Pan-American Medical Congress, held in Washington within the past year, one day out of four was allotted by the Ophthalmic Section to the discussion of disorders of the ocular muscles.

The form of asthenopia under consideration results from disturbance in the normal use of the eyes as a pair—in effect acting as one single and not two separate organs—*œil cyclopienne*. The uncontrollable impulse to secure binocular vision, throws upon the extrinsic muscles of the eye a constant and delicate service during the continuous effort to maintain accurate adjustment in the fixation of objects viewed. Interference with the movements of the eyes by disturbance of the normal relations of their muscular components, calls for an excessive expenditure of nervo-muscular energy, to secure compensation and maintain the eyes in the proper position to secure single binocular vision. Exophoria—divergence defect—may demand the utmost exercise of the power of convergence, constantly applied; esophoria—convergence defect—on the contrary, that of an excess of abduction, involving the development of an unusual and abnormal innervation and muscular action. Such efforts may prove exhausting and are frequently the cause of disturbances which manifest themselves in a series of symptoms more or less marked and important.

The symptoms most frequently observed are, a sense of fatigue in the eyes, more or less constant and usually aggravated by definite use; objects viewed become indistinct and sometimes double, with occasional transient strabismus; headache; photophobia; dizziness; great discomfort while looking at moving objects, and when the patient is himself in rapid motion, as in looking out of a moving railway train; pain in using the eyes for definite fixation, which pain is frequently referred not to the eyes alone, but to the frontal, temporal or occipital regions, rarely to the vertex. Indeed, a large proportion of cases of headache, whatever the special variety, are symptomatic of eye-strain due to ocular defects and, many of them, to disturbances of the ocular muscles. Headache may supervene at once upon use of the eyes or it may be delayed.

The following conditions, alone or variously combined, are frequently present:—pain in the back; drowsiness in some, insomnia in others; a variety of reflex neuroses; mild

blepherospasm, involving a few fibres only of the orbicularis; twitching of the eye-lids; palpitation of the heart; night terrors; nausea; indigestion; constipation and a host of other symptoms.

These symptoms and such as these, however, it will be seen, are often associated with accommodative asthenopia as well; excepting only the transient diplopia or strabismus mentioned, and which is of infrequent occurrence.

On the whole, it may be said that the subjective symptoms of asthenopia as elicited in the consulting room, show almost no distinctive characteristics pointing to their especial origin, whether refractive or muscular; the same headaches and the same sense of eye-strain are complained of under both conditions. The test which has been given as differentiating the two disorders, namely, the use of one eye, the other being excluded from the act of vision for a time by covering it, has, in my experience, usually proven inefficacious.

Practically then, though the subjective symptoms alone are often inadequate to show the existence of muscular defect, objective investigation usually yields definite and uniform results, often indeed showing an exactness scarcely inferior to those obtainable in refractive determinations. Sometimes, but very rarely, the conditions found are inconstant or even erratic, and then great care is required in the estimation of their value.

As regards objective tests, the so-called cover test is the most readily applicable and is deserving of much confidence; it should not be omitted in any case. The diplopia tests such as vertical prisms, Maddox rod, etc., and the determination of abduction, adduction and sursumduction are indispensable in reaching a reliable conclusion.

It should be a fixed rule of practice to eliminate first the refractive and accommodative elements in any case under examination, by the proper glasses, leaving the muscular conditions to be dealt with at the last. Under these circumstances, it will be found occasionally, though not as frequently as could be wished, that the muscular anomalies vanish after correction of errors of refraction and accommodation; the final test

as to which of these may be the active disturbing agent in any particular case, must frequently be the therapeutic test.

The following cases selected from my case books are presented as illustrative of the clinical history, treatment and its results in patients, the subjects of disorders of the ocular muscles :—

I.—T. H. L., mechanical engineer, aged 42, referred to me by Dr. W. H. H. Githens, June, 1891. Wearing high hyperopic correction combined with prism before each eye, 4 degrees, base in. Divergent squint, right eye deviating, except when attention is fixed. Diplopia except on great and tiresome effort, notwithstanding the prisms worn; much headache, confined mostly to the region of the brow. Reading and other definite and constant use of the eyes always at the expense of fatigue, which is only partially relieved by covering one eye; a page of ordinary size often overlaps one-half. Is particularly disturbed by sounds which are slight and not ordinarily noticed. Has multiple false images, monocular. Exophoria 14° . Operation, right externus, complete section, immediate result, Orthophoria. Two weeks later, Exophoria 8° , operation, complete, retrenched with suture, result, Orthophoria. One month later, Exophoria of 3° , reasserted. Exophoria in accommodation 20° .

Expresses much satisfaction in the comfort derived from the operation. Has no tendency to diplopia for distant, but somewhat for near vision. Has a new sense of solidity in objects viewed; is conscious of definite binocular vision. There is also relief of the headache and of the abnormal sensitiveness to sounds. Finds that the use of eyes, as in accurate examinations of instruments and drawings, is now possible where it was not before. The false images, monocular, noted at the first visit, have almost entirely vanished.

Three years later, there is an Exophoria of 2° , Exophoria accommodation 26° , and an Ab. of 4° , and an Add. of 11° . Has passed the intervening time since the operation in occupations involving much use of the eyes, but in entire comfort.

II.—H. R. S., aged 48, master builder. A man of great physical strength and endurance; suffers severe pain localized in the eyes; complains particularly of the right eye feeling as "if it were drawn out by a corkscrew." This is accompanied by general nervousness and irritability with a prickling sensation over the whole body, after reading for a comparatively short time. Eyes feel dry and uncomfortable. All discomforts vanish to a great degree when away on vacation and the eyes are resting, except a severe headache which has been habitual and almost constant for years. Has high hyperopia, R 5, D. L 4, D.

Convergence defect; Es. 5° . Tenotomy right internus, result, Orthophoria. Four months later reported no headache since the operation and

that relief occurred within 24 hours. All the symptoms before described have vanished. Patient highly appreciative of the change for the better which has taken place.

III.—H.W.P., retired merchant, aged 64; makes no complaint of pain or sense of strain, but only of some annoyance or inconvenience in the use of his eyes. He has a hyperopia of 1D, which corrected, gives him full vision in both eyes. He is able to fix distant and near objects with both eyes and at no time is there any manifest strabismus. He has a habit of opening and closing his eyes alternately every few seconds, during which act he elevates and corrugates the brow of the open eye excessively. This he does both in reading and in conversation, producing a very grotesque appearance, and, which being much remarked by his friends is, perhaps, the principal reason why he seeks advice.

A muscular test shows a divergence error, exophoria 20° , with a left hyperphoria of 2° . After wearing correcting prisms for a few days, the Ex. increased to 25° and the Hy. vanished. An operation was then performed, a complete section of the right externus, resulting in a reduction of the Ex. to 13° ; and two days later a tenotomy was made on the right externus, not entirely complete, leaving an Ex. of 6° . Six months later there remained an Ex. of 5° . The habit of opening and closing his eyes alternately which was plainly an instinctive movement to avoid diplopia, had ceased with the operation and he expressed himself as entirely comfortable. His appearance is greatly improved. The small amount of exophoria remaining I deemed it conservative, under the circumstances, to leave uncorrected.

IV.—R. P. B. referred to me by Dr. Stubbs of Wilmington. Suffers from intense nervousness, extreme insomnia with mental depression, accompanied by suicidal fears. Close application to her work, (that of painting fine decorations on silk) causes distress of a grave character in the forehead near the eyes, sometimes running down the nose and extending to the face. Has had headache only recently. Uncontrollable winking at times, very troublesome, frowns habitually. Eyes not pained by use. Prickling sensation over the whole body, at all times, but mostly at night. Refraction normal, Es. 1° , Hy. 1° . Prescribed vertical prism correcting hyperphoria which gave immediate relief, frowning ceased. Much irregularity of reaction of vertical and lateral muscles, but Es. of 10° proving very constant tenotomy of right internus was performed. Great improvement and abolition of all symptoms followed immediately. Three months later, orthophoria was established. Insomnia and nervous symptoms entirely abolished. Patient describing her condition said she was now entirely comfortable.

V.—W.J.D., aged 35, book-keeper, referred to me by Dr. E. J. Nolan. Has high compound hyperopic astigmatism, for which he wears the correcting glasses, but complains of pain around the eyes with dull pains in the occi-

put. Symptoms aggravated by use of eyes for near work, interfering with regular duties. Has manifest Es. 12° – 15° . Ordered prisms aggregating 10° , base out which were worn for a week with comfort. Es. advanced meantime to 22° . Tenotomy, right internus, complete section, result, Es. 4° . A week later 12° was manifested with marked recovery from convergence under cover test. A second operation, left internus, section almost complete; result, orthophoria when his sphero-cylinders are worn, though there is recovery from convergence, Es. 6° , when glasses are removed. Reports entire comfort and ability to use his eyes to an unlimited amount.

Considerable discussion has taken place as to the relative frequency of esophoria and exophoria, and different writers have asserted a marked preponderance on either side. A review of my cases for the last nine years shows that in the operative cases, as between esophoria and exophoria, these are almost exactly equally divided; and while there has been a certain variation on one side or the other from year to year, a close parallelism has been maintained in the main throughout the whole period. This examination also shows, as regards the refraction in both these forms of heterophoria, that hypermetropia predominated. The predominance of hypermetropia was more marked in the cases of esophoria than in those of exophoria, as the following figures show:—

In esophoria the relative frequency of H. over M. was in the proportion of $3\frac{3}{4}$ to 1; in exophoria the relation of H. to M. was as $2\frac{1}{2}$ to 1. Thus, while the most of the cases of heterophoria show hyperopic refraction—as is to be expected considering the greater frequency of this condition over myopia; when the static refraction is viewed in its relation to the accompanying heterophoria, we find that hypermetropia is usually accompanied by esophoria and myopia is most frequently associated with exophoria.

There is still to be found occasionally one who maintains the opinion that a complete tenotomy is required in every case of heterophoria calling for operation, on the assumption that no gain whatever is to be derived from partial severance of the tendon. My experience leads me to a directly opposite conclusion.

In my first paper on this subject, written six years ago,¹ I stated in effect that the fan-shaped expansions of the tendons of the recti at their insertion into the sclerotic are wider and thinner and their margins more elastic than is generally appreciated; and, that the elasticity of the margins is an influential factor in the production of a relaxation of tension in the tendon, graduated and definite in amount and permanent in character, permitting the effectual central portions of the tendon to retract and form a new attachment to the globe further back. This I desire at this time especially to reaffirm and to add that graduated tenotomy is practicable and effective, only because of the elasticity of the margins of the tendons. No attempt is here made to distinguish between the tendon and its immediate covering derived from Tenon's capsule; for distinct as they are anatomically, they are one surgically, for the purposes of this operation, at least, and are to be treated as one.

It is true that occasionally a case is found in which no appreciable change in position occurs until complete severance has been accomplished, but such cases are altogether rare and exceptional. *In the great majority of cases a gain graduated from 1° to 8° may be made without complete severance.* In those exceptional cases referred to, the tendon is thick and narrow at its insertion, and the elastic margins are either deficient or absent.

The technique of graduated tenotomy involves considerable difficulty and complication at times, and the performance of the operation is not to be looked upon as in any sense a trivial procedure. It is an altogether more delicate and difficult operation than that for strabismus; and not less so indeed than any other operation done upon the eye-ball, not excepting that for cataract: but, when skillfully performed, it may be expected to yield definite and satisfactory results. It cannot be successfully undertaken without special instruments. Those devised by Dr. Stevens leave little to be desired. The ordinary strabis-

¹Graduated Tenotomy in the Treatment of Insufficiencies of the Ocular Muscles, by C. H. Thomas, M. D. *Trans. Philadelphia County Medical Society*, March, 1888.

mus instruments are altogether unsuitable by reason of their coarseness and clumsiness and should never be employed.

A study of nearly ten years faithfully pursued in all cases of asthenopia coming under my care has lead me to the following conclusions:—

Muscular asthenopia may present symptoms of all grades of importance, from the slightest to the most serious.

The muscular conditions in every case should, as a matter of routine, be as carefully investigated as are the media, eye-ground, refraction and amplitude of accommodation.

As in refractive, so in muscular asthenopia the gravity of the symptoms bears no constant relation to the amount of the physical defect. It is impossible to predict with any considerable degree of definiteness, the result of correction of either refractive or muscular error. As much and very much the same kind of relief is to be expected from the correction of the muscular anomalies as from the correction of errors of refraction and accommodation, as might be expected from the similarity in the symptoms which these conditions respectively cause.

During the earlier years of my study of these cases, I gave considerable attention to the graver neuroses—especially epilepsy—in connection with muscular anomalies; continuing the observation of a series of epileptic cases throughout a period of about five years. The results obtained in this series were altogether negative, not one recovering. With expectations of cure of epilepsy greatly abated, I nevertheless consider it proper to remove eye-strain of muscular origin in this affection as I would in any other condition; and for the additional sufficient reason that sound conservatism in the management of epilepsy calls for the removal of all possible sources of peripheral irritation.



