STRABISMUS CONVERGENS AND ITS TREATMENT.

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OUR first real knowledge of the cause or causes of this affection we owe to Donders, whose book on the “ Accommodation and Refraction of the Eye ” appeared in an English translation (by our late fellow townsman, Dr. Moore) in 1864. Donders laid down that hypermetropia is the cause of converging strabismus, and its action is aided by the following conditions :— (1) Circumstances diminishing the value of binocular vision, such as defective sight in one eye from any cause ; and (2) circumstances rendering convergence easier, such as peculiar structure or innervation of the muscles, or an abnormally large angle alpha. In the higher degrees of hypermetropia strabismus is not so frequent as in the lower degrees, because difficulty of obtaining an accurately focussed image in either eye enhances the value of the probably more imperfect image obtained by binocular fixation.

This theory of Donders, after some forty years, still holds the field, expressed nowadays, of course, in terms somewhat different from those used by Donders, but essentially the same theory.

For instance, Hansen Grut, who made strabismus the subject of his Bowman Lecture to the Ophthalmological Society in 1890, regards strabismus convergens as due to an abnormal innervation of the internal recti. (Strabismus divergens, on the contrary, he regards as due to a relaxation

of convergence innervation permitting the eye to assume its position of rest.)

Hansen Grut lays great stress upon HABIT, which he considers an unconscious innervation, which in time produces a new functional position of rest.

In investigating the subject of strabismus in general, he starts from the anatomical position of rest. This, he states, is divergent ; for

(1) In regarding distant objects, if one eye be occluded it much more frequently diverges than converges, though it remains more frequently parallel than either divergent or convergent.

(2) Divergence is more common in deep sleep and profound narcosis than any other position.

(3) After death and before rigor mortis divergence is the rule.

(4) The orbital cavities diverge.

(5) A blind eye as a rule diverges.

He regards therefore much of the parallelism found in testing as the expression of a functional and not of an anatomical position of rest, a portion of the convergence, namely, from the divergent anatomical position of rest to parallelism, being latent, just as some hypermetropia is commonly also latent.

In convergent strabismus then the HABIT of convergence leads to the withdrawal of a large portion of the amplitude of convergence from the voluntary control of the individual, or in other words the constant habit of convergence displaces the functional position of rest more and more inwards.

As proof that strabismus convergens is an innervation Grut adduces the occasional disappearance of it under chloroform, and the constant parallelism or divergence observed under chloroform the moment the internal rectus is divided, while convergence returns on recovery of consciousness. No

such phenomenon is observed in operating on external strabismus. He also states that after tenotomy of the internal rectus when some convergence still is left the secondary angle of squint becomes greater than the primary, the latter now lessened by the operation. This can only be accounted for by assuming that the strabismus is an innervation.

Other views than these are held by some ophthalmologists. According to Schweigger, the essential cause of squint is not to be found in anomalies of refraction, but in an elastic shortening of the muscles with insufficiency of their antagonists.

Alfred Graefe also believes there is a state of passive anatomical shortening of the muscle, but he thinks this is consecutive to the squint. All these theories which assume a shortening of the muscle from any anatomical condition are objected to by Hansen Grut, for the following reasons :—

(1) The assumed anatomical shortening has never been demonstrated.

(2) It is not in accordance with the fundamental laws of squinting, inasmuch as the limitation of the movement of the squinting eye in the direction opposite to that of the squint is always considerably less than the angle of the squint.

(3) It is not in accordance with the temporary cessation of squint in narcosis, &c.

(4) The spontaneous disappearance of squint renders it improbable.

Schneller again finds the essential cause of squint in an abnormal relation between the adductors and abductors. To this Grut replies the abnormality is the result and not the cause of the squint.

In his Bowman Lecture on the “ Etiology and Educative Treatment of Convergent Strabismus ” Priestley Smith takes up the same position as Hansen Grut. His conclusions are :—

(1) That strabismus convergens is a disease of innerva-

tion, the visual centres failing to control the act of convergence, which consequently becomes degraded or purposeless, the act is excessive because uncontrolled.

(2) Failure of control depends on faulty development of visual apparatus, peripheral or central.

(3) Hypermetropia predisposes.

(4) The disorder is confirmed by suppression of retinal impressions in squinting eye.

The one essential cause of squint then is a defective development of the fusion faculty, and without the fusion faculty binocular vision is impossible.

The faculty of binocular vision may exist without being perfect. There are found, according to Worth, three different grades of the faculty existent: (1) Simultaneous macular perception. (2) True fusion with some amplitude. (3) The sense of perspective. It is generally allowed that the power of fusion is not congenital, but is a function acquired after birth by experience. The ocular movements of the new-born infant cannot be described as anything else than purposeless, and even the power of macular perception is probably imperfectly developed at birth.

It is only by use (the habit of Hansen Grut) that the child develops the functions of its retina, and its central visual apparatus, with the various centres connected with the eyes both sensory and motor. At birth the visual apparatus, both peripheral and central, is even anatomically an imperfect structure. Very probably of the various ocular functions that of fusion is the last to be fully developed. According to Worth its full development is reached normally before the end of the sixth year of life.

Before adopting treatment of any kind, the following points should be accurately noted:—

(1) The kind of strabismus.

(2) Unilateral or alternating.

(3) Continuous or periodic, and if continuous, whether constant in amount or varying.

(4) Duration and mode of onset.

(5) Physical condition of each eye.

(6) Functional condition of each eye, viz., vision, field of vision, refraction, fixation power of crooked eye, binocular vision ; *i.e.*, if diplopia exists, or is to be elicited by prisms, coloured glasses, or fusion tubes, &c., determine the suppression area.

(7) Degree of strabismus, by which I mean the angular measurement of the deviation, for no approximation to accuracy can be made by linear measurement. There are several methods of measuring the angle of squint, subjectively by observation of double images when this is possible, or objectively by the arc of the perimeter, or by Wecker and Masselon's "keratoscope," or by the simple tape measure proposed by Priestley Smith. The latter method can only apply when the primary and secondary angles of squint are equal in amount, but as this is substantially true of the ordinary cases of convergent strabismus, the method for practical purposes is sufficiently accurate. For perfect accuracy in all methods of objective measurement the value of the angle α , or rather of the angle γ , or better still κ , should be ascertained. The angle should be determined for near objects as well as for objects at a distance, which require parallelism of the visual lines.

(8) The power of the muscles, viz., their lateral excursions should be noted, also by angular measurement, and

(9) The possible excursions of the punctum proximum of convergence. (Knapp lays down that after an operation for convergent strabismus the punctum proximum of convergence should not be farther from the eye than 5 c.m. Otherwise divergence may arise later.)

As strabismus convergens is an affection of early childhood, and as the younger the child is when brought for treatment the better the ultimate result, it is probable that many of the patients will be too young to admit of examination into all these points. We must be content to determine as many of them as the age and intelligence of the patient allows.

The measures adopted for the cure of strabismus are of three kinds. (1) Optical ; viz., correcting whatever errors of refraction exist. (2) Operative, either tenotomy or advancement of the insertion of a tendon or both combined or folding of a tendon on itself, or partial tenotomy, or advancement, or division of the capsule of Tenon. (3) Orthoptic, or, as Priestley Smith prefers to term it, educative.

There is no need to dwell on the optical treatment. No rational man neglects to correct any anomalies of refraction present in cases of squint.

Operations, in my opinion, should only be undertaken when optical and educative treatment has failed, and the decision upon this point must be left to the discretion of the medical man in charge of the case. Great difference of opinion exists among ophthalmic surgeons as to what operations should be done in strabismus cases. Whether one or both eyes should be operated on, and whether advancement should be the rule or the exception. And also as to what particular method of "advancement" should be performed. There is so much to be said on these points that I shall not attempt to enter upon the arguments in support of the various opinions, as it would unduly lengthen this communication.

From what has been stated, it is evident that as the cause of strabismus convergens is a defective fusion faculty the cure of strabismus must consist in establishing or re-establishing a fusion faculty. Without this faculty a permanent cure cannot be guaranteed, but the eyes will sooner or later assume

their anatomical or functional position of rest. The earlier the treatment is begun the better. No infant is too young to be treated, and it is only in the first years of life that we can expect to develop the fusion faculty. If children are left untreated (as is not uncommon) till they are supposed to be old enough to be proper subjects for an operation, at the age of six or so, all hopes of obtaining fusion are destroyed, and a permanent cure of the squint cannot be depended upon.

If the deviating eye has not the power of fixation, *i.e.*, central fixation, our first effort must be directed to this point, and we must endeavour to make the child use this eye to the exclusion of the other. This we do by covering the straight eye for a certain period of the day for as long a time as possible, so that the child has to pay attention to the visual sensations of the defective eye. In children whose power of fixation is absent at the first visit, it will often be found that the power is present after this treatment has been adopted for some weeks. The treatment can be assisted by instilling atropine into the straight eye, to lessen the optical value of that eye and thereby increase, if possible, the value of the crooked eye. In cases where there is good fixation in the crooked eye we often have the satisfaction of being told after some time that the bad eye is straight, but that the cast is gone into the good eye. This is a proof that good vision can be obtained in the squinting eye. Occasionally we find that atropine in the good eye cures the squint at once, and the cure is usually then permanent if correcting glasses are fitted before the mydriasis has passed off.

If a cure has not been obtained by the above measures, atropine should be put into both eyes, and correcting glasses ordered. The glasses should be worn constantly, and, if necessary, the atropine should be continued for months before recourse is had to operative measures, and meanwhile

the power of binocular vision should be developed by stereoscopic exercises. The great difficulty in these exercises is the habit of suppression of the vision of the squinting eye. This may be got over by making the illumination of the picture exhibited to that eye more intense than that shown to the other eye. We can usually effect this by some little adjustment in any stereoscope, but what is probably the most perfect instrument for educative treatment is the amblyoscope of Worth. It is, however, not an instrument which can be given to patients for home use, and I have no personal experience of it.

The next difficulty is that the angle of deviation is usually so great that no ordinary stereoscope brings the images anywhere near the two maculæ. This is overcome by stereoscopes such as Hallwach's, which can be set at any angle from 0 to 50°. It is the best stereoscope that I am acquainted with for this purpose, and its cost is so little that it is within the means of the majority of those who would take the trouble to employ it—12s. 6d.

The fusion tubes of Priestley Smith, and the heteroscope of the same author, have not very great educative value, but are most useful for ascertaining if simultaneous macular perception is present. When we have found by means of the latter instrument what angle is necessary, we try to elicit fusion of some of the pictures made for that purpose in Hallwach's stereoscope.

CASE 1.—As a sample of "orthoptic" treatment, I may cite the case of Miss E. L., æt. 4, who came to me April, 1902 with history of convergent strabismus of right eye for one year. Angle 14 degrees; V. less than $\frac{6}{60}$, but large letters can be made out. Left V. = $\frac{5}{10}$. Right, H.5., Left H.3., by erect image. Atropine for four days brought the eyes nearly straight, and she was ordered to use the drops every second day. Three weeks later the squint had returned, and I tried atropine

in the left (good) eye only every night, and had this good eye bandaged for some time every day, so as to force the crooked eye to act. After one month of this treatment the eyes were perfectly straight, and the child could fix well with the right eye, and see with it, but imperfectly, and I observed that she projected towards the temporal side. Atropine was constantly used in the left eye only till October, the eyes remaining straight all the time, though I observed that on fixing very near objects the left (good) eye tended to converge. The bandage, too, was used daily. Vision of right rose to $\frac{5}{35}$, that of the left being the same as before (under atropine). In October I ordered +5D right, and +4D left, and gave up the atropine. Six weeks later the eyes were straight with the glasses, and without mydriatic. In May, 1903, eyes quite straight with the glasses, and fusion with heteroscope from parallelism to 15 degrees convergence. By stereoscope excellent simultaneous macular perception, but no definite sense of perspective. Stereoscopic exercises are to be used at home, and I expect in this case to develop full binocular vision.

CASE 2.—Miss E. J., æt. $3\frac{1}{2}$, seen in October, 1902, with left internal periodic strabismus of one year's duration. Angle about 16 degrees H. 2D, or 3D. Atropine in good eye resulted in a temporary cure, and good fixation was obtained in the left eye. After atropine was abandoned, the squint returned, the right eye now converging periodically. Fusion with heteroscope from parallelism to 15 degrees convergence, but with excentric not central fixation. Atropine in both eyes now put them quite straight and simultaneous macular perception was proved to exist. The case is still under observation, and I expect a perfect cure.

CASE 3.—Miss A. A., æt. 11, in 1901. An alternating convergent squint of 18 degrees, with good vision in both eyes. I had seen this child some five years before, but I have lost

my notes. Glasses to correct her hypermetropia (of only 3D) cured the squint, permanently, I believe. In May, 1903, the eyes were straight with the glasses, and the girl possessed perfect binocular vision with true sense of perspective.