COMMUNICATIONS

STRABISMIC AMBLYOPIA*

BY

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NOTWITHSTANDING the vast literature, a complete and satisfactory definition of the clinical picture of amblyopia in strabismus has not yet been produced, and some symptoms are often confused with those of other forms of functional amblyopia. Bangerter (1953) and many other authors embrace in the term “amblyopia ex anopsia” the amblyopia observed in anisometropia, in high ametropia, and in nystagmus, as well as the true strabismic amblyopia. There are, however, certain clinical symptoms which seem to be characteristic of strabismic amblyopia, and the treatment of these symptoms by pleoptics appears to be fundamental for the recovery of the visual acuity in the amblyopic eye and, following this, for the final cure of the squint.

In persons affected by concomitant squint, particularly in its convergent form, the amblyopia is not limited to the functional reduction of the vision of one eye, but is accompanied by other symptoms which are no less important in prognosis and in choice of therapy. Apart from the deficiency in the perception of shape (the morphoscopic acuity of vom Hofe, 1930), the existence of which needs further confirmation, the phenomena which have recently attracted attention are the deficiency of fixation in the amblyopic eye, and the so-called difficulty of separation.

To these symptoms must be added the lack of motor coordination observed in amblyopic persons when they try to localize a point in space by following the lead of the amblyopic eye. This disturbance has been pointed out by a few authors, but has not yet been studied sufficiently, although some of the pleoptic exercises described by Bangerter seem to be based on the re-education of the motor coordination. The most important discoveries regarding fixation deficiency are of very recent date, and it is now generally agreed that eccentric fixation may occur in strabismic amblyopia, as suggested by von Graefe in 1881. Apart from those cases with a fixed and constant eccentric fixation, there are many others in which the fixation is unstable (Ehrich, 1955, 1956, 1958; Brook and Givner, 1952; Urist, 1955; Lazich, 1948); moreover recent researches in electro-oculography (Mackensen, 1957; von Noorden and Burian, 1958) have demonstrated the instability of fixation in amblyopic eyes.

Böhme (1957) and Pouliquen (1958) describe motor disturbances in amblyopia leading to a difficulty in fixation in abduction and to differences

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between the visual acuity in adduction and abduction. This phenomenon was described earlier by Pugh (1954).

We have studied this aspect of the question because of the great importance of fixation in the prognosis and therapy of this condition. By means of electro-oculography we have observed fixation by amblyopic and anisometropic non-squinting eyes as well as that by amblyopic squinting eyes, in order to compare amblyopia of an exclusively sensory character with that in which eccentric fixation seems to be due to motor disturbance. The results do not permit a hard and fast differentiation between the two forms of amblyopia, but confirm the suggestion that in concomitant squint fixation in the amblyopic eye is unstable.

Fig. 1 shows four illustrative oculograms:

(a) Amblyopia without strabismus,
(b) Strabismic amblyopia,
(c) Eccentric fixation,
(d) Central fixation.
The technique of recording is that described by Pasino (1959), Pasino and Cordella (1959), and Pasino, Pagni, Pisano, and Cordella (1959).

The observation that fixation may vary according to the direction of the gaze and after surgical intervention is a sufficiently strong reason for us to revise some of the usual theoretical assumptions regarding the purely sensory character of amblyopia. As in strabismus, there is a deficiency in the binocular sensory-motor coordination, that is to say, a deficiency of binocular vision as well as of fusion. A defect of the retino-cortical relations may ultimately result in abnormal retinal correspondence as it does in strabismic amblyopia. This unstable fixation may develop into a permanent eccentric fixation which may be termed "abnormal fixation" (Fig. 2).

**Fig. 2.—Sensory and motor coordination in uniolocular vision.**

(A) Normal. F–P. Normal projection.
(B) Amblyopia with unstable fixation.
   F'–P' Doubtful projection.
(C) Amblyopia with eccentric fixation.
   F''–P'' Anomalous projection.

c visual cortex.
r retina.
x diagram of retino-cortical relations.

Fixation deficiency is important clinically because any improvement in visual acuity which may be brought about by pleoptic treatment depends upon the attainment of central fixation.
It is now generally recognized that difficulty of separation is a frequent symptom in cases of functional amblyopia. The angular visual acuity in the amblyopic eye (examined by separate distinct symbols) is usually better than the cortical visual acuity.

Fig. 3 shows the average values for angular and cortical visual acuity in a certain number of patients with strabismic amblyopia. The difficulty of separation was scarcely distinguishable at the beginning of the pleoptic treatment, but it later increased so rapidly that after twenty sessions of pleoptic treatment the separate or angular visual acuity was nearly normal while the cortical (morphoscopic) visual acuity did not reach 7/10. This phenomenon, which was described by Ehrich (1956) and also by Thomas and Gabenisch (1958), cannot easily be explained. Further observations are being undertaken with the object of establishing whether this deficiency of separation is present also in cases of non-strabismic functional amblyopia.

Fig. 3.—Improvement in angular and cortical visual acuity during twenty treatment pleoptic sessions (average of several patients).

From a therapeutic point of view this symptom requires early and prolonged treatment because only when the deficiency of separation is overcome will correction of the amblyopia be possible.

Persons affected by strabismus may also show symptoms of motor incoordination in other parts of the body. Disturbances of localization and
failure in projection have been observed by Starkiewicz (1954) in patients with strabismus with abnormal retinal correspondence, and also by Lazich (1948) and Guibor (1953) in patients with strabismic amblyopia with eccentric fixation.

We have found varying symptoms of disturbance of the basic eye-hand coordination during unicoular vision in amblyopic patients with definite eccentric fixation and also in other patients with apparent central fixation.

Fig. 4 illustrates disturbances in localization which were seen in twenty patients with strabismic amblyopia in the course of pleoptic treatment. In all cases the in-coordination was reduced and in some it completely disappeared. Changes in eye-hand coordination did not always parallel those in visual acuity, and it was noted that difficulty in separation and unstable fixation may persist even when the visual acuity of the amblyopic eye has been brought up to normal.

The problem that remains is whether the clinical picture of strabismic amblyopia is caused by inhibitory sensory phenomena or by motor disturbances.

Our own conclusions, based on recent publications and on the results of our own research and clinical observations, is that strabismic amblyopia
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represents a genuine syndrome of sensory-motor in-coordination, and thus differs from other forms of functional amblyopia. The sensory disturbance represented by deficiency of binocular vision, deficiency of visual acuity, and difficulty of separation, is closely related to the motor disturbance represented by strabismic deviation, deficiency of fixation, and motor in-coordination involving other parts of the body.

The strabismic subject, by reason of the ocular deviation and the deficiency of binocular vision, fails to fuse the images because of an alteration in the retino-cortical relations and also because of a secondary uniocular sensory-motor in-coordination. He is unable to use the fovea of the amblyopic eye because he cannot coordinate the movements of the eye in such a way as to make the point of fixation correspond with the retinal zone of greatest resolving power. On the other hand, in patients suffering from non-strabismic amblyopia, the uniocular fixation is central, and because there is no sensory-motor in-coordination the power of localization is unaffected.

Summary

The clinical picture of strabismic amblyopia is described, and is interpreted as a syndrome of sensory-motor in-coordination. Apart from the ocular deviation, the symptoms include deficiency of fixation and motor in-coordination of spatial orientation; this may be the direct cause of a low degree of visual acuity and of a lack of binocular vision, as well as of a deficiency of separation.

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