DECREASING BEHAVIORAL FLEXIBILITY (OF ADJUSTMENT TO STRABISMUS) AS THE CAUSE OF RESISTANCE AGAINST TREATMENT DURING FIRST YEAR OF LIFE

S. Rethy and S. Rethy-Gal

ABSTRACT

Possibly immediate and full conservative treatment (glasses in special baby frame, binasal occlusion, and/or atropine ointment) was given from the 2nd to 10th month of life to babies with convergent strabismic angles from 25 to 60 prism diopters, in order to differentiate between the congenital inherited dispositions of strabismus or the acquired adjustments which become stabilized without treatment. The flexibility of adjustments to strabismus (sensory and motor inhibition, nystagmus, anomaly and overconvergence-Blockierung) was decreasing month after month during first year of life, as was shown by detailed case histories of 22 "congenital" cases becoming parallel without operation. The microstrabismus as an intermediate phase in all cases took longest to completely disappear. Refractive errors corrected were mostly astigmatic, sometimes low grade hyperopic and occasionally myopic. Most durable (therefore deep) adjustment was due to greatest flexibility of behavior patterns at an early start of strabismus. This and the seemingly inevitable period without treatment are analyzed as the factors of quickly developing resistance against treatment.

INTRODUCTION

One aspect that has not been covered in the present papers is the adaptation of the central nervous system to strabismus. Such adaptation stablizes the angle, making changes difficult with belated treatment. We may discover the unknown etiology of congenital strabismus, if we could document of the mechanism creating the resistance to a changed angle. The literature details most organic etiologies.(1,2)

Our hypothesis assumes that the resistance to change of the angle arises in early months of life quickly by developing anomalous retinal correspondence (ARC). The

STRABISMUS II
ISBN 0-8089-1424-3

anomalous movements of Bagolini are well known. They can keep the angle of strabismus stabilized.(3) We wish to pose two questions:

1. Can every functional strabismus acquire the therapeutic resistance during early weeks of life?
2. Can the stabilizing adaptation of early age, (by the initial plasticity of the brain) be responsible for quick development of resistance, a characteristic of every congenital strabismic case?

METHODS

We tried to break up the adaptation and to reverse the process of ARC development by the therapy of binasal occluding segments worn upon the glasses. Slight spherical overcorrection of the refractive errors found in cycloplegia was ordered.(4)

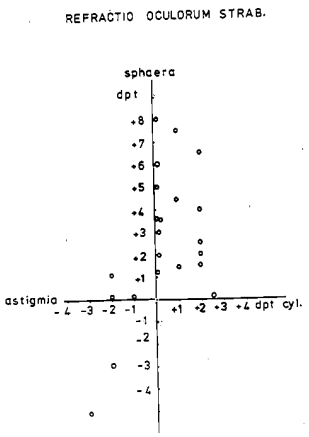

Figure 1. Cycloplegic refractive errors of babies with "congenital" strabismus, which started from 2nd month of life onward. Eight cases had spherical and 14 cases had an astigmatic refraction.

The gradual disappearance of the angle allowed later normal retinal correspondence (NRC) should occur if the plasticity of brain to readapt itselt was still present. We believe that the type of refractive error is not a determining factor as to whether the strabismus is an

irreversible. The therapy resistance depends more on the long duration of adjustment than on the supposed origin of the strabismus. The therapy resistance can be best prevented by possibly immediate full conservative treatment. The prevention of adjustment must include the accepted modalities: motor, sensory and sensorimotor treatment. The patching of the eyes or the binasal segments in babies can eliminate the stimuli for suppression and for ARC.

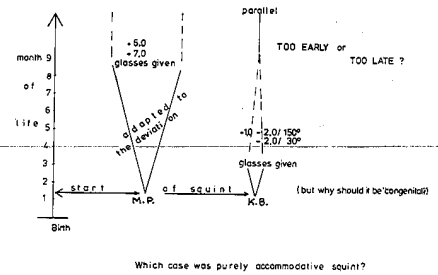

Figure 2. Different delay of treatment cause the difference in therapy-resistance in these 2 cases. Equal early onset was followed in the early case by long interval, until even +6.0 and +7.0 diopters could not remove the angle of strabismus stabilized by long adjustment. In contrast, the astigmatic correction straightened the eyes when only a short interval was allowed for unhindered adjustment in the 2nd case.

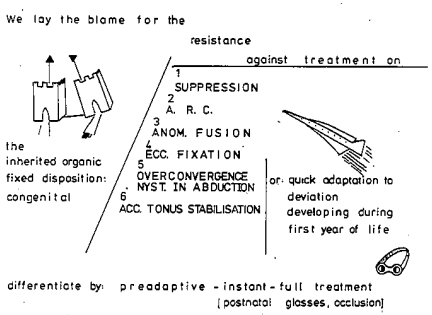

Figure 3. Comparison of the two possible groups of therapy-resistance and failures in strabismic therapy. Immediate treatment can distinguish between acquired adjustment or congenital organic resistance against therapy.

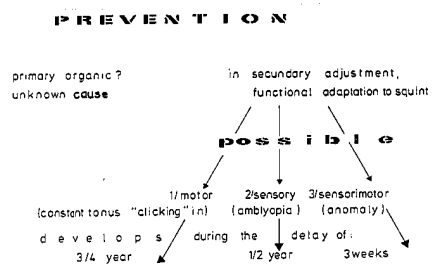

Figure 4. Effective prevention observes the different time factors of strabismic adjustment on motor, sensory and sensorimotor level.

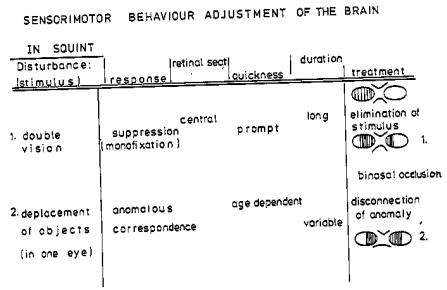

Figure 5. Binasal segments eliminate the disturbing stimuli and stop the adaptation. Dominance can be influenced by the changing size of the segments.

The glasses can achieve two purposes at once:

1. to create sharp images at the fovea
2. to remove the stimulus for overaccommodation and overconvergence

MATERIALS

We report 22 cases treated since 1978, who attained bifoveal fixation and straight eyes after sometimes long, antiadaptive, full conservative therapy. All the cases initially had characteristic signs of congenital strabismus: nystagmus pseudoparesis in abduction, large unilateral or alternating esotropia with "V" or "A" patterns.

The angle was resistant at first. It was not corrected with the first glasses and binasal segments. The size of the binasal segment had to be greater on the dominant eye, smaller on the other eye. The patching segments were changed frequently to achieve alternate fixation.

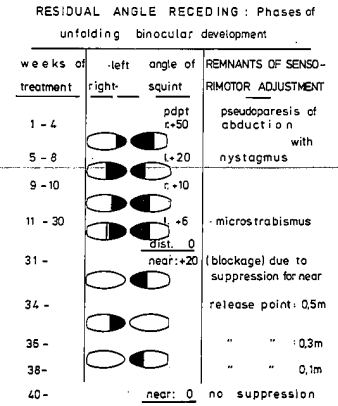

Figure 6. During the 40 weeks duration of segment occlusion the distinct phases of dominance and diminishing angle are shown with the changing pattern of segment-occlusion.

Prolonged atropinization assisted the constant wearing glasses that were frequently removed by the babies. We had better compliance with the glasses given to babies under 5 months of age and the best compliance were with those under 3 months.

All babies with gradually diminishing strabismus went through long phases of micro-strabismus. Later, with straight eyes for distance, they often had "blockage" or overconvergence for near vision. The overconvergence was treated by prescribing the usually one-sided sector on the dominant, not overconvergent eye. The nasal sector covered the pupil of the slowly convergent dominant eye to the moment as the other eye was ready to start the overconvergence. At this moment we could occasionally demonstrate the presence of a sudden suppression in the slave eye. The hologram slides

worn on the eyes showed the suppression in one eye occuring only in binocular vision.(5) The nasal segment of the dominant side eliminated the binocular vision at the moment of overconvergence and thus the active suppression was hindered. Gradually the suppression became less and the overconvergence point came nearer, until the bifoveal fixation could be achieved for near and distance. Frequent recurrences with sudden disease and fever occurred in some cases or if the glasses were not worn constantly. The binasal segments and the continuous wear of the glasses proved helpful in such cases.

RESULTS

The time factors of the case history: age of onset, interval (or delay until the therapy was started) was plotted against the duration of necessary treatment until orthotropia was achieved.

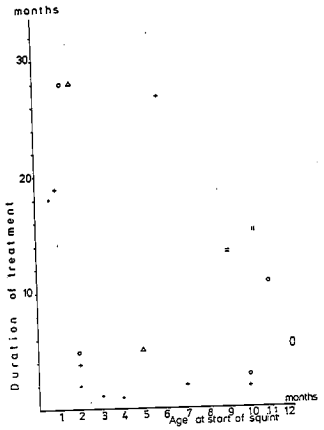

Figure 7. Duration of treatment (until straight for distance/near) and age of onset of 18 "congenital" strabismic cases are illustrated. There is seemingly no causal relation between these.

The formula of a hyperbole shows the resistance arising quickly during the interval between the onset of strabismus and the start of therapy, especially if the onset was at an early age. It is similar to a "learning curve" demonstrating the anomaly as an adaptation of the brain to the strabismic angle.

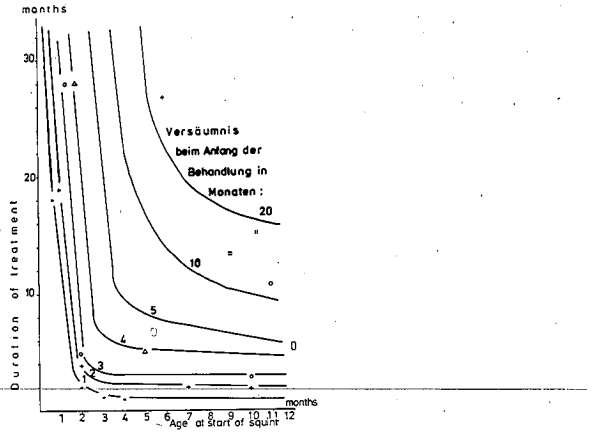

Figure 8. The relation between the time factors of the onset of strabismus and duration of necessary treatment are obvious if we connect with continuous lines the cases which had the same delay of treatment.

As for terminology: My proposal is to call anomalous retinal correspondence (ARC) adapted retinal correspondence (ARC) and non-adapted retinal correspondence (NRC).

In all our cases, the adjustment of the brain to the deviation was the cause of the resistance. If the necessary flexibility of the brain decreased, the strabismic position was stabilized, and the readjustment was no longer possible. Such cases are not analyzed in this paper.

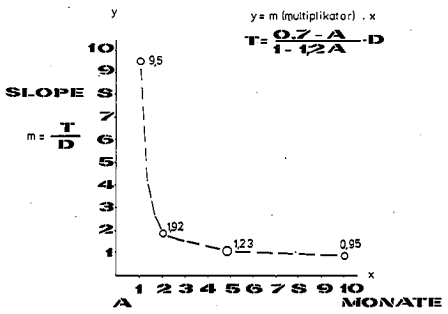

Figure 9. The equation of a hyperbole contains the time factors of age at onset (A), delay (D) and therapy duration (T) until the eyes regained parallelity.

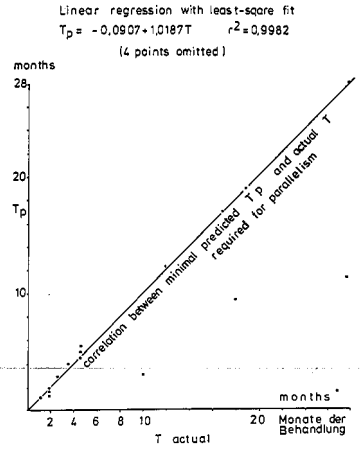

Figure 10. Good correlation between the predicted and required duration of treatment until bifoveal eye position. Four cases are omitted, because of intermittent wearing of the glasses the duration of the treatment was longer than the necessary minimal time.

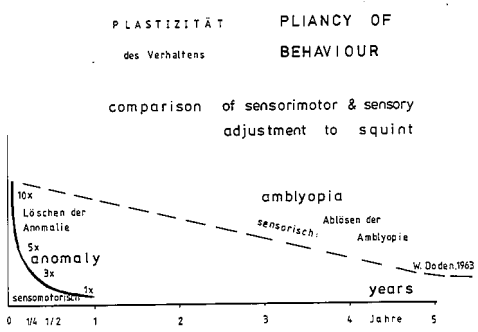

Figure 11. Different speeds of sensorimotor and sensory adaptations to strabismus.

DISCUSSION

We were able to show the range of growth of sensorimotor anomaly which arose quickly at an early age, as the cause of resistance to therapy.

In all "congenital" strabismus cases, we assume a decrease of plasticity to the adjustment by the brain. The angle of strabismus could not be reduced immediately but further adaptation was stopped immediately.

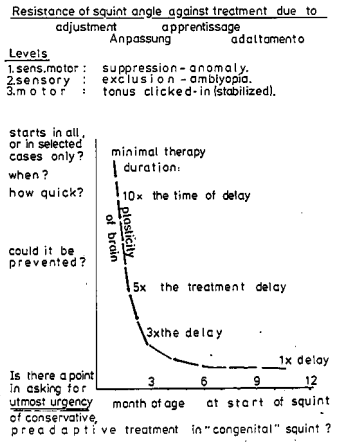

Figure 12. Decrease of plasticity of adaptive behavior is showed to be important in early strabismus.

A 4 month interval between the onset of strabismus and the start of treatment can cause irreversibility of adjustment (anomaly) by the prompt decrease of behavioral flexibility.

The reversal of amblyopia is easier than reduction of the strabismus. The decrease of sensorimotor plasticity (responsible for anomaly) is quicker than the plasticity for sensory adaptations of that occurring in amblyopia. The treatment of amblyopia is therefore not as demanding in respect to early antiadaptive treatment.

To understand the relations between the impulse pattern of the muscle tonus and the anatomic features emanating without fusional control, we can examine the baby during the first trimester of life as it learns to process the wealth of visual information. We can study the bifoveation during first weeks of life as the divergent anatomic position of the neonates is corrected by a compensation in the tonus impulses of the muscles.(6-8) The eye-hand coordination starts during the second and third months of life, stimulating more regular convergence and accommodation impulses. The first cases of intermittent strabismus can be observed at this age. This may be proof that fusion is present at this age. Fusion development is extremely sensitive to disturbances. Our new cases are more frequently intermittent strabismus. The behavior pattern is less stabilized than in babies referred at a later age for examination.

We did not establish the interval necessary to prevent successful treatment of congenital strabismus. When the immediate treatment of all strabismic babies becomes the routine for everyday practice, then the critical inverval may be established.

We hope this paper may lead some strabismologists to consider early medical treatment in some of the congenital strabismic cases which would usually be sent for surgery.

Strabismologists interested in the medical treatment of strabismic babies should correspond with each other. Such experiences and results should be circulated without delay to promote and establish early medical treatments. Further, the deterioration of accommodative esotropia to a nonaccommodative one that requires surgery means the failure of anti-adaptive measures. Sensorimotor adjustment (anomaly) can prevent the disappearance of the angle with glasses only. An "aggressive anti-accommodative therapy" as Baker and Parks employed in their 21 cases(1) is not enough because anti-adaptive treatment in form of binasal segments is also needed.

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