Why should surgery for early-onset strabismus be postponed?

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SUMMARY The author presents a continued study of 82 cases of pseudoparalysis of the bilateral rectus muscles in early-onset convergent strabismus following early surgery. Up to 10 years after surgery motor results show that 72% of cases remain within ± 10 prism dioptres after a single surgical procedure. Sensorial findings corroborate the results of other authors' studies in that binocular association is only achieved in those patients where surgery was carried out at a very young age, not older than 1 year. Surgical procedures consisting of bimedial rectus recession with retroequatorial myopexy are described and the development of alphabetical syndromes and dissociated vertical divergence discussed. The evolution of refraction in these cases is also shown.

Early treatment of strabismic amblyopia is no longer contested. Paradoxically, early strabismus surgery still meets with some controversy. Visual acuity and binocular functions do not evolve as a pair. Their development depends on there being no disturbance in the interaction between a maturation process which follows a genetic programme and visual experience which represents indispensable epigenetic influences.

Studies of the age at which adult-level visual acuity is achieved in normal infants give different results according to the testing techniques used. Results range from 4 to 6 months¹ and 4 years.² Stereoacuity, however, is widely found to mature at an early age, from 3 to 6 months.² Recent studies by Held *et al.*³ have shown that 'In comparison with the relatively slow development of visual acuity, the time course for the development of stereoacuity is extremely rapid.' This corroborates the conclusions of the neurophysiologist Vital-Durand⁴ whereby 'acuity follows rather than precedes the development of binocularity.' These findings correspond with my own clinical experience.

Material and methods

The first 82 cases of early-onset strabismus operated upon between the ages of 6 and 30 months have already been the subject of a previous publication.⁵ All 82 cases conform to the definition of pseudoparalysis of the lateral recti. Surgery is always sym-

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Fig. 1 Top: The retroequatorial myopexy—schematic diagram. Bottom: The retroequatorial myopexy—clinical appearance.

Fig. 2A Preoperative crossed fixation with abnormal head posture. Age 8 months.

Fig. 2B Age 10 months—one week after surgery.

metrical on the two medial recti, consisting of muscle recession with a retroequatorial myopexy.⁶ This operation is also known as 'Cüppers' faden operation' or 'posterior fixation suture', but I prefer the term, 'more precise though considered by some as too ponderous, retroequatorial myopexy' (von Noorden).⁷

Retroequatorial myopexy was introduced by Cüppers in Germany in 1974. The principle of this procedure is muscle anchorage to the sclera *behind* the equator (Fig. 1). This reduces the effective arc of contact between the muscle and the globe, thus selectively weakening the muscle in its field of action. There is no effect on the primary position or away from the muscle's field of action. The result of this surgery is reduction of the motor response, while the associated muscle recession corrects the eye position. The variability of the angle of deviation in this form of strabismus is well known. Surgery consisting of combined recession and retroequatorial myopexy permits a more appropriate correction than conventional surgical techniques. Far fewer immediate or late-occurring consecutive divergent deviations are observed, because the necessary muscle recession, when associated with the myopexy, is much smaller.

The myopexy is placed at 13 mm from the original muscle insertion. Exceptionally it may be placed at 12 mm in very small eyes. The associated muscle recession is 2 mm for deviations up to 25°, 3 mm for those exceeding 25°.

Results

The first study of these 82 cases gave⁵ the following results: excellent results concerning the angle of strabismus, with suppression of crossed fixation and the usual abnormal head posture, results showing notable stability with time (Figs. 2 and 3); immediate and complete recovery of abduction, satisfactory conjugate ocular movements, and good vergence; unblocking of amblyopia in a few cases refractory to preoperative treatment.

I have continued to follow up these 82 cases personally with the same two orthoptists. With the statistics brought up to date, there is a current minimum follow-up of at least one year where further surgery was necessary, and a maximum of 10 years. 80% of cases fall into the group of five years' minimum follow-up.

MOTOR RESULTS

Horizontal angle of strabismus

The latest postoperative angle of strabismus and the number of muscle procedures carried out are given in Table 1. This shows that 72% of cases had a long-term angle of not more than ± 10 prism dioptres (PD) after one single horizontal muscle surgical procedure.

Alphabetical syndromes and vertical (oblique) muscle surgery. Fourteen cases required further surgery because of alphabetical syndromes (9V, 4A, 1X). The relative failure of single-step surgery was

Fig. 2C Age 3½ years.

Fig. 3A Preoperative crossed fixation with abnormal head posture. Age 15 months.

thus mainly due to oblique muscle factors. Difficulty in diagnosing alphabetical syndromes in young infants is one argument used by those surgeons opposed to early surgery. In this first series of 82 cases purely horizontal muscle surgery was carried out in those infants under 20 months of age. Alphabetical syndromes in this group (11 cases out of 36) system-

atically underwent further surgery. In infants aged 21 to 30 months combined horizontal-vertical muscle surgery was carried out in seven cases, and only three required separate oblique muscle surgery. However, in a subsequent series of 70 cases with the same proportion of alphabetical syndromes combined horizontal-vertical muscle surgery was carried out in

Fig. 3B Age 16 months—one week after surgery.

Fig. 3C Age 2¼ years.

Table 1 Long-term residual angle

Angle PD	Horizontal procedure		Horizontal procedures	
	No. cases	%	No. cases	%
Up to ± 4	35	43	4	5
>4 to ± 10	24	29	0	
>10	18	22	1	1

a larger number of cases owing to more thorough examination even in the youngest age group, thus reducing the number of reoperations.

Alphabetical syndromes and age. 20% of cases presented an alphabetical syndrome before the age of 20 months, 36% between 20 and 30 months, according to our series of patients. Quéré, *et al.*⁸ noted them in 64% of cases and favoured postponement of surgery until 2½ to 3 years of age. Bérard⁹ observed these syndromes in almost all cases, and considered 3 years as being the ideal age for surgery. It would thus appear that the vertical syndrome is secondary to a neglected horizontal deviation.

Dissociated vertical divergence (DVD). DVD was almost the rule (77% of cases), appearing at the earliest at 1 year, at the latest at 7 years, but in two-thirds of cases between 2 and 4 years of age. As can be seen in Fig. 4, age at the time of surgery had no influence on the development of DVD. Cosmetically unsatisfactory decompensation of DVD requiring

specific complementary surgery was necessary in only two cases, that is, 3% of the total number.

REFRACTIONAL RESULTS

The evolution of refractive error up to the age of 10 years in these 82 cases is shown in Fig. 5. Changes in refractive error followed essentially the same course as that described by Slapater¹⁰ and Brown,¹¹ where hypermetropia was shown to increase up to the age of 8 years, in contrast to Chavasse's findings.¹² Thus early surgery consisting of bimedial recession with retroequatorial myopexy did not influence the evolution of refractive error.

SENSORIAL RESULTS

Our series of 82 cases is divided for closer study into six-monthly groups according to the patient's age at the time of surgery. The following criteria are required for positive binocular responses: 'coarse' stereopsis, moderate convergent and divergent fusion range, four dots on the Worth test, and crossed Bagolini striated glasses. The results are as given in Fig. 6. There is no question of real binocular single vision, even in cases of orthotropia. However, these figures show that the quality and frequency of binocular association diminished as the age at the time of surgery increased. The degree of residual angle (Fig. 7) was also an important factor in the acquisition of binocular association, but only on the following

Fig. 4 Appearance of dissociated vertical divergence.

Fig. 5 Evolution of refractive error.

condition: the smallest residual angle is of any interest only for those patients having undergone surgery before the age of 1 year. Of the 13 cases with binocular association in the smallest angle group, 10 were operated upon between 6 and 12 months old, and one in each of the following six-month periods. Even in the larger-angle groups binocular association may be hoped for where surgery is carried out at a

very young age. These results confirm studies by Archer and associates¹³ in testing stereopsis, whereby 'the most striking feature was that the four patients with positive results were also the four youngest

Fig. 6 Binocular responses according to age at time of surgery.

Fig. 7 Binocular responses according to postoperative angle of strabismus.

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infants at the time of surgery (ages ranging from 6 to 8 months).'

Discussion

In view of these findings it cannot be said that the functional results of early surgery are no better than those where surgery is postponed to around 2½ to 3 years of age.⁸ Our motor and sensorial results corroborate those given in studies by Mohindra *et al.*¹⁴ and Ing,¹⁵ where the limit of 24 months is fixed, beyond which a certain degree of stereoscopic vision may no longer be acquired if binocular coupling has had no occasion to be practised up to that time. I share Helveston's view where 'to our knowledge there is nothing to be gained from delaying surgery in a child who is considered a candidate for eventual surgical treatment.'¹⁶ However, the latter's surgical protocol of 'en bloc' bimedial rectus recession¹⁷ is essentially compensatory at a time when the problem is primarily dynamic, and where passive elements are negligible. Although immediate alignment with such procedures is reported to be good at 82%,¹⁶ up to 30% of these cases require further surgery for later occurring esotropia. In our series of 82 cases of bimedial rectus recession associated with retro-equatorial myopexy, a single horizontal muscle procedure was found to be sufficient to obtain immediate and long-term alignment (to within ± 10 PD) in 72% of cases, with no further surgery necessary.

In conclusion, these results are an indication not for early surgery but rather for immediate surgery, or surgery deferred only the short time necessary for preoperative treatment of any amblyopia. Indeed, why postpone surgery for early-onset strabismus?

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