

Controversy in the management of convergence excess esotropia

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What is the clinical problem? Children with a significant esotropia for near but a smaller or no deviation for distance.

What is the controversy? There are two treatment strategies. Patients may be managed either with optical correction (bifocal glasses) or with surgery.

What are the important issues? Are we treating a homogeneous group? What are the objectives of treatment? What are the outcome measures? Is one treatment strategy more effective than the other? What are the complications of each treatment strategy? Can we create an evidence based treatment strategy?

Much of the controversy that has arisen in the management of convergence excess esotropia results from differences in definition. A review of the literature reveals a number of studies concerning the management of convergence excess esotropia which are clearly dealing with different, although related, conditions. This makes comparison of outcomes difficult. The major difference in management is the use of optical treatment in North America (mainly bifocal glasses), whereas in Europe the same condition is more likely to be treated with surgery. Miotics are no longer used to treat this condition.

The objective of this review is to determine whether there is evidence to suggest one form of treatment is more effective than the other. Does it depend on definition? Are some patients with convergence excess esotropia more effectively managed with optical correction and some with surgical correction? What are we trying to achieve with treatment and at what point do we concur that a treatment has been a success or failure? Does the method of bifocal management affect the outcome? Are some surgical strategies more effective than others?

SETTING THE SCENE

Convergence excess esotropia is a condition characterised by an esotropia which is greater for near fixation than for distance fixation. It was first described by Donders in 1864.¹ Most consider that, to be significant, the difference between near and distance fixation should be greater than 8 prism dioptres (8 PD) and that this difference remains after full hypermetropic correction with single focus lenses. An acceptable definition of convergence excess esotropia would therefore be a convergent squint which is more than 8 PD greater for near fixation than distance fixation after full hypermetropic correction. Some reserve the definition for patients who are orthophoric (or have a well controlled esophoria) for distance fixation but are esotropic for near. This definition is particularly popular in North America as it is many of these patients who are appropriate for bifocal therapy.

It is when we consider the aetiological mechanisms of convergence excess esotropia that it becomes apparent we are not dealing with a homogeneous collection of patients. Excessive convergence in response to an accommodative demand may be the cause of a greater esotropia for near than distance. In this group of patients the accommodative convergence/accommodation (AC/A) ratio will be high. However, in some patients the AC/A ratio is normal (non-accommodative convergence excess esotropia) and Costenbader² described a group of patients

with a low AC/A ratio who had a remote near point of accommodation. Their poor accommodation requires them to exert excessive accommodative effort resulting in near esotropia. This uncommon condition has been called hypoaccommodative convergence excess esotropia. In a review of 77 patients with convergence excess esotropia defined as a 10 PD increase in deviation at near, Arnoldi³ found that 51% had a high AC/A ratio, 48% had a normal AC/A ratio (non-accommodative convergence excess), and 1% had a low AC/A ratio resulting in a hypoaccommodative esotropia.

The definition of the AC/A ratio itself has generated some debate. Some consider that the difference between the near and distance angle is a direct "clinical" method of measuring the AC/A ratio.⁴ Others⁵ have suggested the term "high AC/A ratio esotropia" should be reserved for those patients in whom an excessive amount of vergence is induced by a unit of accommodation, best documented by the gradient method. Von Noorden and Avilla⁶ showed that simply using distance and near measurements (heterophoria method) is insufficient to make a diagnosis of high AC/A ratio. However, although the gradient method is preferable, this simply cannot be done for some of the younger patients because of limited cooperation.

Overall, most authors have discussed a group of patients whose eyes are straight or whose esotropic deviation is within the monofixation range in the distance, but in whom an increase in deviation is documented at near. The amount of distance/near disparity required for inclusion into the various studies has varied from "greater than 8 PD"⁷ to 20 PD,⁸ or a deviation which is incompatible with a fusion response at near and therefore "warrants treatment."

BIFOCAL MANAGEMENT

Bifocals have been used to control the near deviation in convergence excess esotropia since the 19th century⁹ and remain a popular option in the management of children with high AC/A ratio. They are viewed by many ophthalmologists and orthoptists as a "tried, tested, and safe" management option. Nevertheless, the fact that this remains an area of controversy in childhood strabismus management suggests that we are still searching for the panacea. The literature concerning bifocals is often ambiguous, and it is difficult to compare different treatments; there has been no consistency in the diagnostic criteria for this disorder, the specifics of its optical management, and little agreement regarding outcome criteria.

When discussing the issue of optical versus surgical management certain points need to be

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Accepted for publication
9 May 2002

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stressed. Firstly, only a proportion of patients with convergence excess esotropia truly have a high AC/A ratio and, secondly, only a proportion of patients with high AC/A ratio will respond to additional plus lenses at near in clinic. It is this subgroup who are appropriate for treatment with bifocals. Many comparisons of bifocals with surgery are probably comparing different subgroups of patients with convergence excess esotropia.

What does optical management involve?

Selection of appropriate patients

Patients with convergence excess esotropia included in the literature have come from a variety of sources. Firstly, some patients whose eyes are aligned in the distance with their full hypermetropic correction glasses do have more than 8 PD of esotropia when viewing a near accommodative target at one third of a metre. Secondly, patients who initially present with a fully accommodative esotropia, corrected at near and distance with the full cycloplegic prescription, may deteriorate with an increase in the near deviation, reported in 6–11% of cases.^{7 10} Thirdly, a convergence excess pattern may appear following surgical correction of infantile esotropia.¹¹ Although these disparate modes of presentation all imply the same sensory challenge (alignment which is outside the monofixation range at near), it is probably incorrect to view them all as the same disorder. Nevertheless, this has been the case in much of the literature. Some authors have taken previous extraocular muscle surgery¹² or signs of infantile esotropia⁸ to be exclusion criteria, while others³ have not.

Providing a near add in clinic will result in satisfactory ocular alignment only for a proportion of patients with convergence excess. In Arnoldi's³ series, half of the patients had a near distance disparity secondary to some other type of esotropia; only 22 of the 39 patients with high AC/A ratio (that is, less than one third of the total group of 77 patients), responded in the clinic to +3 overcorrection at near. Von Noorden *et al*¹¹ reported that patients whose esotropia is not corrected at near with +3.0 add in the office will not respond even after prolonged follow up.

For the minority of patients who do respond to bifocals, meaning that their near deviation is reduced to 8 PD or less of esotropia (compatible with monofixation esotropia), the improvement

in near alignment in clinic is satisfying and prescription of the near correction as a bifocal may be tempting. In the case of a 3 year old in whom fusional amplitudes cannot be determined owing to limited cooperation, the choice of surgery is daunting to many parents and ophthalmologists. An argument can then be made for conservative management with a bifocal add to maintain fusion through childhood in the hope that the AC/A ratio improves with time.^{4 8 11 14}

Managing bifocals

If bifocals are to be used, the full cycloplegic correction is prescribed for the distance segment. For any patient who appears to have a partially accommodative esotropia, the refraction is rechecked using atropine 1% drops for 3 days before repeat refraction. It is worth remembering that "convergence excess" esotropia may be erroneously diagnosed in patients with undercorrected hypermetropia. Bifocals can be prescribed in one of two ways: either as +3.00 add for all patients⁸ or, more commonly, the smallest amount of add which controls the near deviation, up to a power of +3.5 DS.¹¹

The most difficult issue here is the practicality of bifocal wear in childhood. Even alert, intelligent, and motivated 45 year olds sometimes find it difficult to cope with their first pair of bifocals. The instinctive chin-down head posture adopted when viewing near objects needs to be reversed. The blur in downgaze is disturbing and may interfere with daily activities such as walking down the stairs. The position of the bifocal segment needs to be high, preferably bisecting the pupil in the primary position. A flat top design is best, and the glasses need to be fitted securely to prevent slippage, requirements which are often impossible to achieve lastingly in children since the nose offers little support for these bulky glasses (see Fig 1). The bifocal, moreover, becomes effective only at one third of a metre, leaving intermediate and closer distances inappropriately corrected. Progressive bifocals have been used,^{15 16} but their cost, the importance of accurate centring, and their fundamentally adult design which means the plus add often ends up being too far below the primary position are negative factors (Fig 1). All this may add up to the glasses being discarded. Multifocal contact lenses have been shown to be ineffective.¹⁷

Progress

The aim of the treatment is to allow the development of fusional amplitudes. Once the patient has been demonstrated to have stable alignment and fusion with amplitudes for a period of a year or so, the strength of the bifocal may be progressively decreased and discontinued as soon as practically possible. The patient's alignment to a near accommodative target is checked with an overcorrection of -0.50 or -1.0; If the eyes remain straight with this in clinic, the prescription is tapered gradually. The patient is reviewed with cycloplegic refraction every 6 months.¹⁸

While some patients fail to respond to bifocals when they are first tried, another subgroup responds at first and fails at a later stage. Reviewing a group of 44 patients who were initially bifocal responders, Stewart and Scott¹⁸ found that



Figure 1 Inappropriate bifocal prescription. Bifocals should only be prescribed if they fully correct the deviation for both distance and near. The top of the bifocal segment should bisect the pupil.

43% became “bifocal failures,” meaning that their deviation increased beyond fusion range during the course of the study. The presence of a moderate or high hypermetropic refractive error made failure more likely.^{12–18}

Outcome

Ideally, studies on this subject should quote the sensory status of the patients at outcome, preferably in the mid-teens, to see if the “bifocal successes” have been maintained even years after these have been discarded. Furthermore, the most important outcome criterion is the sensory status at near and distance, assessed using tests such as the Titmus stereotest, AO Vectograph, and synoptophore. What proportion of patients, in the various series on the subject, was fusing at near and distance having discarded their bifocals?

Von Noorden *et al* in 1978¹¹ found that 37% of their patients were either fusing at near and distance with bifocals or were on course to be weaned off them. Arnoldi³ reported that only 20% of those initially treated with bifocals were successes, and were being or had been “weaned.” In the other 80% bifocals were discontinued in favour of surgery a mean of 2.4 years after initial therapy for the following reasons—deteriorated esotropia at near through bifocal and/or distance segment in 45%, bifocal intolerance in 20%, and inability to reduce the bifocal (after mean of 8.3 years of use) in 15%. Stewart and Scott¹⁸ found that 52% of their 44 patients were “cured,” defining this as fusion maintained over a 3 year period after bifocals were discontinued. Ludwig *et al*¹² reported a series of 65 patients with strict inclusion criteria whom they followed for an average of 10.5 years. Their “cure” rate was 61%. These patients were able to discontinue bifocals after an average of 5.5 years of wear; 39% continued bifocals or reading glasses. Surgical correction of deteriorated accommodative esotropia was necessary for 50% of those who eventually discontinued bifocals and 36% of those who continued to wear these. The only factor which predicted long term bifocal wear was a relatively high AC/A ratio (measured by the “clinical” method outlined above).

Only one study exists comparing bifocal treatment with unifocal distance prescription glasses (after cycloplegic refraction). Pratt-Johnson and Tillson⁸ showed, in a non-randomised retrospective series of 99 patients, that after an average follow up of 8 years, 87% of patients treated with bifocals ended up with fusion, 7% of whom were bifoveal; 87% of patients treated with unifocal distance prescriptions also ended up with fusion, 4% bifoveal. There was no difference between the sensory result obtained with and without bifocals. They suggested that monofixation esotropia was by far the commonest sensory outcome in both groups, and that this was likely to be already established in most patients even before bifocal therapy was initiated. They felt that, in order to improve the patient’s sensory status from monofixation esotropia to bifoveal fusion, the glasses would need to reduce the deviation at near and distance not to 8 PD or less but to zero, something they rarely do.

In summary, understanding of the relative success of bifocals in the treatment of high AC/A

ratio convergence excess esotropia has been hampered by the variance in terminology used in the literature. Inclusion criteria, mode of treatment, outcome criteria, and duration of follow up have also varied. Most authors are agreed that the majority of patients with a convergence excess pattern are not even eligible for bifocal treatment. For those patients who do have a high AC/A ratio, and who respond to the addition of a near add in clinic, the possibility of avoiding surgery, and achieving some degree of binocularity by the use of bifocals, is attractive. This is particularly so where the patient is too uncooperative to perform accurate measurements of distance and near deviation, fusion, and AC/A ratio at the time of examination creating an appreciable risk of surgical overcorrection. Bifocals could, in this circumstance, be justified either as a holding procedure until fusion is established and documented or even as a long term manoeuvre.

SURGICAL MANAGEMENT

The surgical management of patients with esotropia that is significantly greater at near than distance represents a challenging problem. In many publications, especially those in the US literature, these patients are described as having an esotropia with a distance/near disparity where the near angle exceeds the distance angle. This definition includes patients both with and without high AC/A ratios. The European literature tends to differentiate this group of patients into those with a high AC/A ratio and those near esotropes without high AC/A ratio (so called non-accommodative convergence excess esotropia). When considering surgical management, these patients can usefully be categorised into two groups.

Group A

These patients have binocular vision maintained at distance fixation with or without a microtropia. When patients fix on a near accommodative target they have an esotropia (intermittent or constant). The potential for recovery of high grades of stereopsis may exist in some of these patients. Others will, at best, achieve an underlying microtropia with lower grades of binocular vision.

Group B

These patients have a manifest esotropia at distance (which may be intermittent) with a larger constant esotropia at near when fixing on an accommodative target. These patients, when aligned surgically, may demonstrate some degree of binocular vision, but in many binocular vision is minimal or absent.

Surgical goals

There are a number of outcome objectives in the surgical management of convergence excess esotropia:

- (1) Alleviate the patient’s symptoms (diplopia, asthenopia, cosmetically unacceptable esotropia)
- (2) Eliminate the need for bifocal glasses
- (3) Maintain or improve sensory binocularity

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(4) Reduce the near deviation to a level that enables control by the patient's motor fusion reserves without detrimentally altering the distance angle.

For group A patients with good control in the distance, all of the surgical goals are possible. For group B patients the likelihood of achieving optimal outcomes are generally much less and the likelihood of postoperative symptomatic overcorrection or undercorrection are greater.

The surgical strategy depends on a number of factors including:

- (1) the patient's sensory binocular single vision (BSV) potential
- (2) the patient's motor fusion potential
- (3) the angle of deviation and the near/distance disparity
- (4) the likelihood of symptomatic iatrogenic postoperative diplopia
- (5) previous strabismus surgery.

Studies examining the surgical correction of convergence excess esotropia rarely subcategorises patients into groups based on their motor alignment, motor fusion, and BSV potential. This makes the interpretation of the studies and analysis of the various operations used to manage these patients and production of guidelines for surgical treatment more difficult.

Outcome of surgery

The literature describing the expected functional and motor outcomes following surgical procedures on patients with esodeviations where the near deviation significantly exceeds the distance angle is confusing owing to a number of factors. The majority of studies are retrospective. Patients with accommodative and non-accommodative convergence excess of various aetiologies and diverse binocular potentials are frequently grouped together. The criteria for evaluating the surgical outcome are disparate. Some studies only report motor outcomes, others reporting outcomes in terms of stereopsis or binocular visual acuity for near. Other studies describe success in relation to spectacle wear. The discontinuation of bifocal wear in favour of single vision lenses is widely accepted as a successful outcome while others regard discontinuation of all glasses wear the primary measure of success.

A number of different surgical approaches have been described in patients with near esotropia. These include unilateral or bilateral medial rectus recession, posterior fixation sutures, marginal myotomy, or various combinations of the three.

Bilateral medial rectus recession

Bilateral medial rectus recession is a common surgical solution for convergence excess esotropia but there is much debate about what measurement the surgical dose should be based on. Some surgeons perform bilateral medial rectus recessions based on the manifest distance deviation alone, arguing that larger recessions may lead to overcorrections. West and Repka¹⁹ retrospectively compared the outcome of surgery performed for the distance or the near angle in patients with near/distance disparity esotropia. This study documented satisfactory results with surgery based on either the near or distance deviation.

The use of the distance angle increased the likelihood of undercorrections. The use of the near deviation as a target angle reduced the need for continuous spectacle use but with an increased risk of overcorrections. However, the success of bimodal rectus recessions may be enhanced by using various augmentation formulas or by using conventional surgery based on preoperative prism adaptation for the near deviation.

Augmented bilateral medial rectus recession

The concept of augmenting the amount of medial rectus recession for near/distance disparity esotropia was introduced in the 1970s and is widely accepted.²⁰

If posterior fixation sutures are not being employed then the medial recti should be recessed more than the amount determined by the distance deviation as measured through the correct single vision lenses. "Empirical" formulas have been used to increase the amount of medial rectus recession performed.²¹⁻²⁶ The factors that have been considered include surgical experience, the size of the near deviation, the AC/A ratio, the near/distance angle disparity, motor fusion potential, and preoperative sensory analysis.

Arnoldi and Tychsen²⁵ prospectively examined 23 children with a near/distance disparity of ≥ 10 PD and an AC/A ratio of $\geq 5:1$. Some patients had no measurable distance deviation while others measured up to 50 PD of esotropia. Binocularity was assessed preoperatively and postoperatively. The magnitude of the bilateral medial rectus muscle recessions was based on the maximal near deviation measured on an accommodative target and prism adaptation was used on the last seven cases entered into the study. The effect of preoperative binocularity and the significance of the preoperative distance deviation on the postoperative outcomes were not specifically addressed. Overall, the study findings documented the effectiveness of bilateral medial rectus recessions for the near angle in eliminating the need for bifocals in 96% and improving the grades of binocularity in 70%. The distance esodeviation decreased in some 87% of cases with 13% of these (three cases) developing an exodeviation postoperatively, while three others (13%) demonstrated no documented change in the distance esodeviation. These three cases were among those with higher grades of stereopsis documented preoperatively.

Kushner *et al*²² prospectively examined 46 patients with a near/distance disparity esotropia and a manifest distance deviation exceeding 10 PD (mean 21.5 PD) for a study period of 6 months postoperatively. One group had conventional medial rectus recessions and posterior fixation sutures (21 patients) and the other group (25 patients) augmented medial rectus recessions of some 1-2 mm per muscle. The study did not look at the relation between preoperative sensory findings and the postoperative outcome in either group. Kushner noted more variability in the undercorrection and overcorrection rates among the posterior fixation/conventional recession group than the augmented recession group, although overall numbers were low. Kushner and colleagues believed that augmented recessions result in at least equal if not better outcomes with an easier surgical procedure for this particular

subpopulation of near/distance disparity esotropes. Long term follow up at 15 years showed that motor stability is long lasting, with 19 of 22 patients maintaining less than 10 PD of esodeviation at near.²⁷

De Faber and von Noorden²⁸ have shown that marginal myotomy is an effective, although unpredictable technique for augmenting previously fully recessed medial recti and has a significantly greater effect for near than distance angle.

Preoperative prism adaptation

Prism adaptation is a preoperative technique initially used successfully for the management of acquired esotropia. Although its implied benefits for the treatment of near/distance disparity esotropia are obvious, there is little information available in the literature. Two retrospective studies from the same institution describe the outcome following prism adaptation in this condition.^{29, 30} In the more recent larger study³⁰ all patients had a constant manifest esodeviation at near and distance. The mean preoperative distance deviation on alternate cover and prism test was 22 dioptres (range 10–40 dioptres) while the mean near esotropia was 35 dioptres (range 20–60 dioptres) and the near/distance disparity was ≥ 10 PD in all cases; 69% (45 patients) had surgery for their original near deviation, while 31% (20 patients) were prism builders and had surgery for an amount greater than their original near deviation. Overall, an average of 2 mm of additional medial rectus muscle recession per muscle was required than would have been predicted if surgery had been based on the distance angle and an additional 1.1 mm if the surgery had been based on the near angle. There was a 9–10% overcorrection rate in both the prism builders and non-prism builders. There was no statistical significant difference between the surgical outcome of the two groups. Postoperatively, 88% (51 of 58) of all fusers, 95% (18 of 19) of prism builders, and 71% (five of seven) non-fusers had a good surgical outcome defined as postoperative deviation of less than 8 PD of esotropia at near and less than or equal to 5 dioptres of exotropia at distance or both.

These two studies suggested that uniform surgery for the original measured near deviation may not be appropriate for all patients and may result in an increased number of postoperative undercorrections. Responders to prism adaptation had a better surgical outcome compared with non-responders. These data also provide some support for the practice of performing “seemingly empirical” augmented surgery in patients with esotropia with a significant near/distance disparity.

Posterior fixation sutures

Peterseim and Buckley³¹ retrospectively looked at 18 patients with convergence excess esotropia, six of whom had previous strabismus surgery who underwent bilateral posterior fixation sutures. Preoperatively, all patients were phoric or intermittently manifest at distance and manifest at near. The mean preoperative distance angle was 8.8 PD (range 0–20 phoria or intermittent tropia) and the mean near deviation was 33 PD (range 18–50 esotropia). The mean AC/A ratio was 7.4.

At the most, recent follow up (mean 36 months postoperatively) the mean distance angle

measured 3.2 PD (range 0–6) esophoria or intermittent esotropia and the mean near angle measured 10.3 PD (range 4 intermittent esotropia to 20 esophoria) while the mean AC/A ratio was 2.9. These authors and others^{32, 33} noted that the postoperative degree of reduction in the near/distance disparity was directly related to the magnitude of the preoperative near/distance disparity suggesting a direct correlation between the size of the near/distance disparity and the degree by which it is reduced. The authors found 95% of patients had normalised their AC/A ratio, 70% attained 400 seconds of arc stereoacuity (versus 44% preoperatively), and 86% were able to maintain satisfactory near ocular alignment without the need for postoperative bifocals.

Vivian *et al*²⁶ reviewed the outcome retrospectively of 48 patients with complex convergence excess esotropia the majority of whom had previous surgery on one or more occasions. Thirty one patients had posterior fixation sutures alone, while 17 had posterior fixation suture surgery combined with medial rectus muscle weakening. The medial rectus weakening was employed when the surgeon considered that the distance esodeviation required supplemental surgery.

The measured AC/A ratio preoperatively was 9.5 and postoperatively was 6.75 for the whole group. Preoperatively, 35 of 39 patients had a near BVA (binocular visual acuity at 33 cm) of less than 6/36. Postoperatively, 60% obtained a near BVA of 6/9 or better while 28.5% continued to have a postoperative BVA of less than 6/36. Of these 10 poor outcomes, nine had a residual symptomatic near esotropia and one a consecutive basic exotropia. Eight of the 10 patients required further surgery. These authors recommend posterior fixation sutures with or without medial rectus weakening as a means of improving the near BVA, even in patients who have had previous surgery and have residual near esotropia (see Fig 2).

Sensory outcomes

Leitch *et al*³⁴ reported on the sensory outcomes of 31 cases of convergence excess esotropia who underwent surgery as the primary treatment (21 had posterior fixation sutures plus medial rectus weakening; nine had bilateral medial rectus recessions; one had posterior fixation suture alone). In these cases, medial rectus weakening was based on the distance esodeviation. No patient had a constant distance esotropia preoperatively.

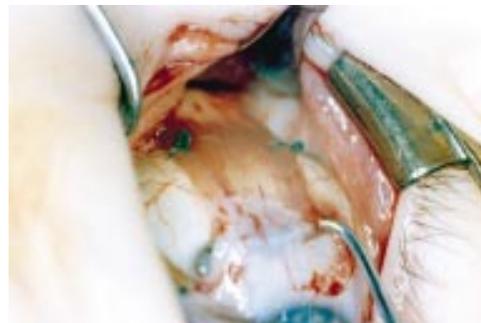


Figure 2 Posterior fixation sutures on the medial rectus.

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Postoperatively, 16% achieved bifoveal BSV (40–60 seconds of stereoacuity) and 32% achieved 80–140 seconds of stereoacuity. Overall, 71% achieved stereopsis. In 26% of cases, cosmesis was improved without a noticeable improvement in binocularity and pre-existing binocularity was lost in two cases (6%); 24% patients who underwent posterior fixation suture plus medial rectus weakening required reoperation (two for overcorrection and three for undercorrection).

CONCLUSIONS

The major barrier to establishing an evidence based management guideline for convergence excess esotropia is lack of consistency of definition in the ophthalmic literature. "Convergence excess esotropia" is a term applied to a heterogeneous group of patients. Bifocal therapy will only be effective if applied to the correct patients. Surgery may be effective in a much larger group of patients but has the drawback of producing side effects in a percentage of cases. However, there is some robust evidence in the literature reviewed above that can help us decide how to divide up this heterogeneous group to provide the most efficacious treatment overall. Analysis exposes deficiencies in our ability to assess children adequately and deficiencies in the evidence base which would allow us to be confident in selecting the appropriate management for our patients.

In order to make the diagnosis of convergence excess esotropia, it is necessary to measure both the distance and near angle of deviation. To further subcategorise these patients, measurement of the fusion range and AC/A ratio using the gradient method is necessary. In order to monitor the patients, sensory binocularity (preferably for distance and near) should be recorded. Herein lies a significant problem in the management of convergence excess esotropia, because many patients present in the first 3 years of life when these measurements are often not possible. There is no doubt that many patients receive surgery based on the near angle long before it has been possible to accurately measure the distance angle and even longer before accurate sensory status and AC/A ratios can be measured.

Why treat convergence excess esotropia?

There are three main reasons to treat this condition:

- (1) To alleviate symptoms (diplopia, aesthenopia, cosmetically unacceptable esotropia)
- (2) To improve (or prevent decline of) sensory binocularity
- (3) To improve motor alignment.

Both bifocal therapy and surgery can achieve these objectives in the appropriate patients.

It is unclear whether having strabismus of any variety is a barrier to learning although clinical experience and reports from parents suggest that children do gain benefit from motor alignment in ways that would be difficult to measure scientifically.

Despite the fact that long term sensory stability is one of the principal outcome objectives of treatment, sensory outcomes have been virtually ignored in the many studies of convergence excess management.

Are bifocal glasses and surgery equally effective in achieving motor alignment?

Bifocal glasses are only effective in a specific group of patients with convergence excess esotropia. These are patients with accommodative convergence excess esotropia with a high AC/A ratio who, with the appropriate bifocal glasses, are orthophoric for distance and have less than 8 PD of esotropia for near. In addition to these patients, a small group of patients with hypoaccommodative convergence excess esotropia may benefit from bifocals. All other patients with an esotropia greater for near than distance will not benefit from bifocal wear and other treatment methods should be considered. Of those patients who should theoretically do well with bifocals, approximately half will become bifocal failures, although the reported failure rate of bifocals is variable. This variability may reflect initial selection of patients to receive bifocal therapy. Bifocal failure ranges from 80%³ to 39%.¹² These failures are mainly due to deterioration of the near angle or bifocal intolerance. Most of the bifocal failures need surgical alignment to achieve the desired outcome of treatment.

Most studies of surgical correction of convergence excess esotropia, although the different groups are rarely delineated, show a success rate of motor alignment with one operation of approximately 70–95%. It may be possible to influence success rate by using careful preoperative assessment (including prism adaptation) and categorising patients into different groups to receive appropriate surgical procedures. In general, half of the failures are due to undercorrection and half due to overcorrection. Of those who are undercorrected, approximately 60% will have an acceptable surgical outcome with further surgery.

Are bifocal glasses and surgery equally effective in terms of sensory outcome?

Sensory results are generally disappointing after either bifocal or surgical therapy, taking convergence excess esotropia as a whole group. Although the data are not robust, only about 10% of patients will achieve bifoveal stereopsis after treatment and there is no evidence that bifocals or surgery produce a better sensory outcome. The chances of achieving less sophisticated sensory fusion are much greater for both groups (approximately 50%–70%) although there is evidence that this may not persist on long term follow up.

Can we create an evidence based treatment guideline for convergence excess esotropia?

Most controversies occur because of lack of evidence, and controversy over the different management approaches to convergence excess esotropia is no exception. Despite repeated recommendations in the literature, there has been no single prospective randomised study comparing the different treatments for high AC/A ratio esotropia. It is our opinion that bifocal glasses have a place in the management of high AC/A ratio convergence excess esotropia. They are certainly useful for those patients in whom the accurate measurements required to achieve a good surgical outcome are not possible. A small group of patients will achieve lasting control with

bifocal therapy and if it were possible to predict this group, a proportion of patients could safely avoid surgery. Reber³⁵ in 1914 wrote: "the only claim made is that this proposed addition (bifocals) to our ordinary methods is simple and harmless and offers not only a logical sequence but a reasonable hope that a still greater number of young esotropes may not only escape the scissors but be vouchsafed the blessings of full binocular vision." Although the full binocular vision claim is doubtful, the general concept of Reber's comments remains largely unchanged.

We believe that, with careful thought and a few well designed studies, the approach to convergence excess esotropia, both optical and surgical, could be refined to achieve a better outcome for our patients and help resolve the controversy.

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Debate