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Accommodative esotropia: Efficacy of treatment

Abstract

Accommodative esotropia: Efficacy of treatment

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ACCOMMODATIVE ESOTROPIA:

EFFICACY OF TREATMENT

BY

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A thesis submitted to the faculty of the
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A handwritten signature in cursive script, appearing to read "Fred M. Feil", written over a horizontal line.

WILLIAM M. LUDLAM

"Accommodative esotropia and its medical treatment was described by Donders as early as 1864." (22) It was his insight into the relationship between the accommodative and convergence systems that spawned interest in and greater understanding of this ocular anomaly. Since Donders' time, theories concerning both the etiology and various treatment modalities of this ocular condition have emerged. It is the purpose of this paper to discuss these theories and draw conclusions concerning the efficacy of currently employed treatment techniques.

By way of introduction it should be noted that in normal individuals, the synkinetic interaction between the accommodative and convergence system is such that a given amount of accommodation results in a given amount of convergence. The end result is that the focus and alignment of the eyes fall on approximately the same plane. In the case of accommodative esotropia the interaction between the two systems (in this instance the AC/A) may be normal or abnormal, however, the accommodative esotrope cannot maintain bifoveal fixation on the target of regard when accommodation is activated due to the synkinetic convergence mechanism. Parks in a series of 667 patients with acommodative esotropia reported 43%

with a normal AC/A and 57% with a high AC/A ratio. (23) Raab reported an equal split among 274 patients with this condition, however, this is not statistically different from Parks findings. (23)

Accommodative esotropia is also subdivided along the etiological lines of acquired and congenital. The congenital form is generally agreed to occur between birth and 3 years of age with the greatest incidence of onset between 2 and 3 years. (32) Parks, however, sites the range being from 6 months to 7 years. (25) Regardless of where the dividing line is drawn between acquired and congenital, the goals of therapy (to be discussed later) are the same. It is interesting to note that the abnormal AC/A which causes accommodative esotropia is four times more prevalent in the acquired than the congenital form of this anomaly. (23)

In any case, the early age of onset combined with the troublesome nature of this anomaly directly impacts many aspects of the affected individual's life such as visual efficiency, academic performance, social development and acceptance. It is for these reasons that the topic of accommodative esotropia has been and is of major concern to all those involved with the esotrope, especially to the patients themselves.

As a result of this concern, and in an attempt to better

diagnose and treat the problem, the academic community has described accommodative esotropia by defining two categories, refractive and non-refractive. Refractive accommodative esotropia is due to an abnormally high hyperopia which results in a blurred image seen by the child when not accommodating. When the image is cleared through the act of accommodation an esodeviation results from the accommodative stimulation of the convergence system. Esotropia occurs when the stimulus becomes too great for fusional divergence to compensate. Diplopia blur and/or suppression may result forcing the patient to choose between blurry single binocular vision, clear double vision and monocular viewing. Non-refractive accommodative esotropia is not related to the refractive error, rather it is the result of an abnormal AC/A ratio. (26) In most instances the patient does not have the skills necessary to enable them to "choose" between diplopia and confusion and must therefore seek treatment to attain maximal visual efficiency. Of course, there are instances where the resulting esotropia is neither purely refractive nor purely non-refractive, rather it is the result of a combination of the two.

Diorio (12) suggests several mechanisms by which accommodation is thought to cause a near esodeviation; 1) hyperopia with a normal

AC/A ratio, 2) hyperopia with an abnormal AC/A ratio, 3) abnormal AC/A without a significant refractive error, and 4) hypoaccommodation. (12) All but the latter have been borne out clinically.

Because the treatment of this condition depends on the mechanism thought to be operating (refractive or non-refractive) it is important that the clinician understand these mechanisms and be able to determine which is causing the accommodative esotropia. The treatment of choice varies from optical to surgical, with bifocals, miotics and orthoptics being the more favored, least invasive techniques.

OPTICAL

Literature researched states that optical treatment of refractive accommodative esotropia in a younger population (Parks mentions 4 years old and younger) is the full cycloplegic plus lens correction worn on a full-time basis. (24, 22) Parks also discussed the use of atropine if needed to facilitate the acceptance of the plus lens correction. An article published in Ophthalmic Surgery by Preslan and Beauchamp emphasizes the need for regular repeat cycloplegic refractions to ensure that fusion is continuing and the hyperopic component is not increasing. (26, 23)

When children with esotropia and hyperopia are given glasses based on the full refractive error found in the cycloplegic exam one of the following conditions may be found upon reexamination; 1) orthophoria at near and distance fixations while the child wears the glasses, 2) a reduced but not eliminated angle of stabismus at near and distance fixations, 3) elimination of the distance deviation while a significant deviation persists with near fixation. (32, 6) It is generally thought that the latter indicates that an abnormal AC/A ratio is operating. (32) It is for this reason that bifocals have been advocated as an effective means of reducing or eliminating the residual near deviation.

BIFOCALS

Preslan and Beauchamp, in discussing the treatment with bifocals of accommodative esotropia due to a high AC/A ratio, claimed that they were a, "...very effective method of controlling the near deviation." (26) They prescribed the minimal power to allow fusion at 33 cm in the bifocal segment and reported that 55% of their patients with high AC/A ratios normalized. (26) The term "normalized" was not defined in their article and in light of other literature researched these results are questionable.

Parks, for example, prescribes the minimal near add that

converts an esotropia to an esophoria and noted a 52% improvement with use of the bifocal. (23) The term "52% improvement," relates to the percentage of reduction in the near deviation with the bifocal as compared to the deviation without the bifocal (ex. a change from 40 prism diopters without a bifocal to 20 prism diopters with a bifocal would represent a 50% improvement). Parks also stated that, "About 20% of the patients treated with bifocals never improve and required continuous wear into adulthood." He feels that bifocals control symptoms but do little to appreciably change abnormal AC/A ratios. Huber (23) stated in the same article that the use of full plus correction and Mintacol improves the AC/A, whereas use of bifocals does not. (24) Whitwell discusses the use of a bilateral medial rectus recession in preference to the use of bifocals. (24) In another paper by von Noorden, Morris and Edelman 84 patients were treated with bifocals and followed on a long-term basis from 34 to 58 months. The results showed that after treatment 12 of the 84 , or 14.3%, fused at near without the use of bifocals, 22.6% decreased the amount of bifocal power, 46.4% resulted in total dependence on bifocals and 16.7% experienced deterioration of binocular function while using the bifocals. These results indicate that a low AC/A ratio, as in the 39 who became totally dependent upon bifocals, is a poor prognostic sign. In reference to this "nonaccommodative

convergence excess" von Noorden suggests that although patients in this category initially respond well to bifocals, they eventually lose the ability to fuse at near as the esodeviation increases beyond the point where additional plus lenses are effective. He also states that, "...once a child reaches his teens bifocals may become a cosmetic problem and may interfere with athletic activities. Rather than keeping such children in bifocals, we have begun to recess both medial recti when such patients reach their teens." (32) Additionally, he advocates, "surgical correction without delay to preserve binocular functions in patients who lose the ability to fuse at near with maximum bifocal therapy." A persuasive argument for the uninformed. The fact remains that the the results of surgery were "encouraging" (von Noorden's term), however, information concerning actual results of the surgery were not mentioned in this article. Parks disagrees with the surgical correction for purely accommodative esotropia by stating that, "Accommodative esotropia requires therapy that disengages the accommodation, and surgery does not qualify as this type of therapy." (24) This author agrees with Parks on this point, and would add--with respect to von Noorden's argument for surgical intervention--that individuals whose only tool is a hammer tend to view most problems as if they were a nail.

Despite personal bias, if bifocal therapy is instituted, especially where young children are involved the height and style of bifocal is critical to insure its effective use. Because children often have small bridges there is a tendency for the glasses to slip down the nose which can make the fitting task difficult. The generally accepted form of bifocal is the executive in which the height of the seg should bisect the pupil. This allows for some slippage, and increases the chance of the bifocal being used.

MIOTICS

Miotics were first advocated in the 1870's for the treatment of strabismus, but the effects were unsatisfactory, and the use of miotics was not generally accepted until 1949. (12) In 1949 Abraham determined, based on 44 cases, that glasses were not the best treatment for the esotropic problem, especially when the acceptance and cooperation on the part of the patient was questionable. He felt that treatment with miotics was better than no treatment at all and concluded, "...that miotics, if properly used, can become a valuable addition to our armamentarium in the treatment of strabismus, especially after equalization of vision."(1)

The principle miotics used today for the treatment of accommodative esotropia are di-isofluorophosphate (Floropryl, DFP)

and echothiophosphate iodide (phospholine iodide, PI). These are potent antagonists to cholinesterase, and stimulate the parasympathetic system in a parasympathomimetic manner.(14) Because these drugs exert their effect on synaptic transmission mediated by acetylcholine, miosis as well as potentiation of the innervation to the ciliary muscle occur. In short, these drugs increase the amount of accommodation in the lens for a given amount of neural transmission thereby lowering the AC/A ratio.

Diorio (12) summarized that miotics, "...1) should never be used unless some degree of binocularity can be achieved, 2) tend to be less effective in the presence of amblyopia, 3) tend to be more effective when binocularity is present, 4) are more useful in cases of an abnormal AC/A ratio, and 5) are more effective in reducing the near deviation, 6) are never more effective than glasses, and 7) should never be the sole means of determining that an accommodative element is absent." (12) Diorio, in the American Journal of Orthoptics, also stated, "One should never proceed with surgery where miotics alone have been used and have been ineffective. . . . When miotics are used and eliminate the strabismus, this is definite proof that an accommodative element is present." (12) The converse, however, is not necessarily true; i.e. one cannot assume where miotics are used without a reduction or elimination

of the angle that an accommodative component is not operative. Miotics should, therefore, not be advocated as a diagnostic tool. (12) Gellman disagrees by saying that DFP can be used as a diagnostic tool. (14) (probably for diagnosis by exclusion).

There also exists some disagreement concerning the length of treatment with miotics--some authors advocating long-term use, while others short-term use only. Diorio does not suggest long-term miotic therapy. Parks suggests the use use of miotics as a short-term therapy, and not as a substitute for plus lenses. (24) Contrary to Parks and Diorio, Gellman states that the use of miotics must be continued for about two years following the onset of alignment, "to allow the fusion facility to mature." (14) Pratt-Johnson et al state that there is no logical basis for long-term use of miotics in the treatment of high AC/A ratio esotropic patients if the drugs do not reduce the deviation at near to less than 10 prism diopters since fusion is unlikely to develop.

An important question to address is, do the means justify the end. In light of Moore's findings that 64% of patients who had a purely accommodative esotropia responded to glasses as they did to miotics, (25) and considering the potentially harmful side effects (discussed later) associated with the use of miotics, this is a debatable issue. Parks states that DFP almost always causes a

difference in the AC/A between 6 meters and 0.33 meters, however, the important time to judge the merit of DFP in normalizing the AC/A ratio is after it is discontinued. (23) In his study DFP was gradually tapered over a period of several weeks from 0.025% (one drop per eye each morning) to complete removal of the drug. Lasting improvements occurred in 4 of 15 children under the age of 5, whereas 28 of 32 had "durable improvement" in the group aged 7 and older. A 64% improvement (using the same criterion mentioned earlier) was noted in the 32 children whose ratio was improved. (23) The lasting effect in children over the age of 7 may relate to another finding mentioned in his article that approximately half of the strabismus cases improved spontaneously after age 7 (23) which may in turn relate to "fusional maturity" and not the miotic itself.

As stated earlier, miotics are potent antagonists of cholinesterase, and should therefore be given full consideration prior to instituting miotic therapy (especially long-term therapy). Ocular and systemic side effects are not uncommon, can be quite serious, and fatal in certain circumstances. Among the ocular side effects iris cysts are the most common. With prolonged use of DFP in children their occurrence "has been very high." They have the potential of disrupting vision if they grow large enough to encroach upon the visual axis. They resolve spontaneously with

discontinuation of the drug leaving behind a remnant tag that is reportedly inconsequential to the patient. (9) Anterior subcapsular cataracts are another sequela of miotic therapy for which the prognosis for improvement without surgery is poor. Angle closure glaucoma has been reported in one instance. (9) Complaints of blurred vision, headaches, and reduced night vision as a result of miosis are not uncommon. (1) In addition, miotics will not correct significant anisometropia which is common in accommodative esotropes.

Systemic side effects are reported to be rare and to resolve spontaneously with discontinuation of the drug. These side effects include nausea, abdominal discomfort, and diarrhea. The systemic side effects of PI can be enhanced by exposure to organophosphate insecticides. Since succinylcholine is deactivated by circulating pseudocholinesterase, a patient using PI is also at risk of prolonged apnea following anesthesia secondary to the persistence of succinylcholine. This phenomenon has been termed "choline apnea." (9) Discontinuation of the drug, provided emergency surgery is not necessary, 3-6 weeks prior to surgery is recommended (9,24) since children have died on the operating table as a result of choline apnea.

ORTHOPTICS

The goal of the orthoptic management of accommodative esotropia is to provide the patient with comfortable single binocular vision for near and distant viewing without the use of glasses (except as needed to correct any refractive error for improved visual acuity). Treatment consists of eliminating amblyopia, overcoming the suppression and increasing the relative fusional divergence, after appropriate optical corrections are made. (21) Enhancement of sensory fusion is also an important aspect of successful treatment of the accommodative esotrope.

Moore and Cohen (21) found that only one third of their 288 patients met the goals previously mentioned. The difficulty lies in the presence of anisometropia and divergence insufficiency or a high AC/A ratio. To assist in binocularity at near miotics or bifocals can be used in the application of orthoptic therapy. (21) In the treatment of non-refractive accommodative esotropia the patient's ability to cope with the unchanged esodeviation by increasing fusional amplitudes can be improved. (7)

In a study published by Ludlam in 1961 a 64% cure rate was reported for esotropic individuals through the use of orthoptics alone. Ludlam, in treating esotropia, defines "cure" as always having straight eyes and showing no movement in the alternating or

unilateral cover test. The "almost cured" group deviated only when fatigued, with an incidence less than 5% of the time, and always experienced diplopia. The diplopia allowed the patients to recognize their deviation and correct for it. The study also reported that orthoptics worked better with highly motivated patients and parents, that attend training sessions regularly and had less than 30 prism diopters of deviation with onset after the age of three. (19)

SURGERY

In the American Medical Association Archives of Ophthalmology, one article states that of 35 patients treated orthoptically only 4 showed any lasting improvement in their abnormal AC/A ratios. The patients had been converted from esotropes to esophores with no change in the AC/A. (23)

The alternative suggested in the American Medical Association Archives of Ophthalmology is surgery. Recession of the medial rectus was the most successful surgical technique resulting in a 66% improvement in the AC/A, and the recession on only one medial recti was not as successful as resecting both. (23) The improvement mentioned was not defined as a functional improvement (i.e. fusion and stereopsis), but only an improvement of the AC/A and decrease in the angle of deviation. Although Parks reports improved AC/A

ratios following surgery he adds that surgery is justified for the purpose of correcting misalignments that exist at distance while the patient is not accommodating but that it is not justified when the esotropia is the sole result of an abnormal AC/A. (23)

The goals of an en-bloc recession, another surgical technique, as discussed at the New Orleans Academy of Ophthalmology in 1977, were alignment of the eyes and maintenance of concomitance. In light of these goals the technique of en-bloc recession of the medial recti showed a 60% chance of the being over- or undercorrected by 5 prism diopters. Based on the usual criterion for success of over- or undercorrection by 10 prism diopters, 28% of the patients would be considered for reoperation. Again, there was no mention of a functional recovery such as stereopsis or binocular fusion. (16)

Rosebaum et al, by carefully excluding patients with anisometropia, high hyperopia (greater than +3.75), amblyopia, cerebral palsy, and those previously operated on for the condition, reported that high AC/A ratios may be corrected with bimedial recession of 4-5mm without fear of overcorrection at far. He added that the near deviation should be greater than 20 prism diopters preoperatively since all patients with less than 20 prism diopters of esotropia at near preoperatively maintained a postoperative esotropia of 10 prism diopters or more regardless of the amount of

recession. As noted earlier, fusion is not likely to develop spontaneously with a deviation of 10 or more prism diopters. It should also be noted that those excluded from the study were excluded because of the high correlation between their condition and postsurgical exotropia. (29)

In a study on the correction of esotropia resulting from a high AC/A with the use of bimedial recession, the operation was equally effective in reducing the amount of deviation in intermittent and constant esotropes at distance. The most effective results were obtained with recessions of not less than 4mm of each medial rectus, regardless of the amount of deviation. (31) The social consequences of good cosmesis as a result of surgery can not be underestimated, despite the fact that a functional cure may not be possible. If alignment is the primary goal, surgery may be all that is required. However, the limitations of surgery should be recognized.

CONCLUSION

In light of the preceding evidence it becomes apparent that the efficacy of treatment is dependent on many variables. These variables range from scientific/optometric considerations to the goals and motivation of the patient to the perspective of the

attending doctor. It is also apparent that each treatment strategy has its own merits and disadvantages. Presently widespread consensus does not exist in the professional community as to the best treatment for the different types of accommodative esotropia. The success or failure of treatment can be a direct result of prompt and proper diagnosis. Conversely misdiagnosis can result in many wasted hours of inappropriate treatment and in the worst case a surgical procedure when it is contraindicated. Ultimately patient care and well being must be of utmost concern regardless of the treatment strategy employed.

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