Article

Brock

A Binocular Approach to Amblyopia Therapy

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This paper describes a philosophical approach to the correction of strabismic amblyopia that was developed by Frederick Brock, OD. It emphasizes the role of macular performance in a peripheral approach to aligned planes of orientation. In addition, a diagnostic technique known as posture campimetry is described. **Key Words:** *amblyopia, strabismus, visual posture, posture campimetry.*

Conventional wisdom[1] within the eye care profession states that an exact, full-spectacle correction of the refractive error in the amblyopic eye is a critical initial step in improving acuity. In addition to full cycloplegia error correction, direct occlusion,[2] either full- or part-time, is considered an integral part of the treatment protocol, reduces inhibition from the dominant eye, and prevents undesirable adaptations such as suppression, anomalous[3] correspondence, and eccentric fixation. Optometry has advanced amblyopia treatment beyond refractive and passive direct occlusion methods by developing aggressive and intensive visual therapy techniques that stress accommodative accuracy, ocular motilities, and eye-hand coordination.[4] One goal of these therapy techniques has been to develop equal "monocular" skills that aid in the development of efficient binocular vision. Clinical experience has shown that appropriate refractive error correction, occlusion, and active monocular skills therapy are effective in improving visual acuity and thus reduce abnormal binocular interactions. Unfortunately, occlusion, when *significant* amblyopia is present, frequently results in lack of patient compliance[5] and may induce strabismus. In addition, it should be pointed out that occlusion, no matter how valid it may be, represents a "reductionist" phenomenon that artificially divorces the visual input of the occluded eye from the integrated sensory-motor continuum of the patient. Brock, throughout much of his professional life, had a strong antipathy for the use of occlusion in strabismic amblyopia. As one who believed passionately in the tenets of Goldstein's organismic therapy,[6] his treatment philosophy and instrument designs were predicated on the belief that an individual would make maximum use of his existing abilities if it were advantageous for him to do so.

A key tenet of organismic therapy is the emphasis on unity, integration, consistency, and coherence of the "normal personality." Brock's reluctance to use occlusion in strabismic amblyopia is understandable in light of his own model of vision. Key points of that model include the following[7]:

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1. The organismic tendency is always toward elimination of retinal rivalry, *if it interferes* with the clearness and quality of the binocular image.
2. The strengthening of retinal rivalry by visual training *is contraindicated with individuals who are incapable of binocular posture.*
3. Suppression is a normal phenomenon in all organismic behavior. Suppression is not only a normal, but a necessary function in binocular vision, because all objects in three dimensional space cannot be on corresponding fusional areas of the two eyes while binocular posture is maintained.
4. Foveal suppressions are almost always due to lack of adequate binocular posture. *They usually disappear* when adequate binocular posture has been regained. Visual training must be directed toward strengthening binocular posture.

Brock's lack of enthusiasm for occlusion as a treatment modality in strabismic amblyopia *related to the specific characteristics of the patient's strabismic adaptation.* In his view,[8] normal retinal corresponders did not require direct occlusion. The appropriate visual therapy (of strengthening binocular posture) would in and of itself reinforce bifoveal vision (or macula fixation in one eye), resulting in elimination or significant reduction in the amblyopia by virtue of the maintainance of an accurate binocular posture and an organismic desire to achieve.

Brock used the term "false fovea" in describing aspects of strabismic amblyopia. By this he meant that, in amblyopia therapy, the maximum acuity improvement implied macular rather than foveal acuity.[8] Thus, even with occlusion and/or pleoptic flashing, the person with *stable,* monocular macular fixation is still fixating eccentrically to the fovea and can be considered as having a false fovea because the macula "assumes foveal-like functions" under conditions of binocular gaze. Brock believed it would be advantageous if training situations could be arranged which forced patients to voluntarily shift fixation from their "good eye" to their amblyopic eye *while both eyes were open,* because this frequently resulted in a diplopia based on normal retinal correspondence. In effect, under conditions of voluntary shifting of fixation from "good" to amblyopic eye, there is a cortical recognition of a temporary distortion in field awareness. The reduction in stability of visual space prevents the patient with strabismus from making his customary egocentric judgment of spatial positioning and causes a shift from anomalous retinal correspondence (ARC) to normal retinal correspondence (NRC). Hence, the patient exhibits a positive performance shift. Thus, *under binocular conditions* we can achieve direct fixation by the amblyopic eye on an NRC basis. "The goal of therapy, including improvement of the amblyopia, is to extend and strengthen the binocular hold . . . once the person was capable of straightening his strabismic eye *under binocular viewing conditions,* the case is then one of amblyopia no longer complicated by a manifest eye turn."[8]

In developing his binocular approach to amblyopia therapy, Brock used the term "planes of orientation" in relating all visible objects to their cortical areas of representation. Figure 1 depicts the relationship between what we see and what is represented cortically. Figure 2 depicts Brock's "planes of orientation" in a cosmetically and functionally aligned individual; figure 3 represents a right exotropia.

In describing the effect of temporary straightening of the eyes and extension of a centration range while engaged in binocular manipulatory tasks, such as pointer and straw, correct localization with the Brock orthotrainer,[8] or accurate silo using pointers during stereomotivator therapy, Brock maintained that the patient with strabismic amblyopia was *operating with amblyopia in the absence of an ocular turn.* To reinforce this concept of a binocular approach to amblyopia, Brock stressed the following:

> We should never lose sight of the fact that an amblyopic eye has its greatest usefulness in combination with the good eye when their planes of orientation coincide. When the eyes are in this favorable position the fusional processes are at their best, provided the functional adequacy of the amblyopic eye suffices to contribute in some measure to the 3D organization at the interpretive level of seeing. It is therefore of paramount importance to set up orthoptic procedures which stimulate the amblyopic eye to its fullest potential without damage to the coincident orientation.[8(p47)]

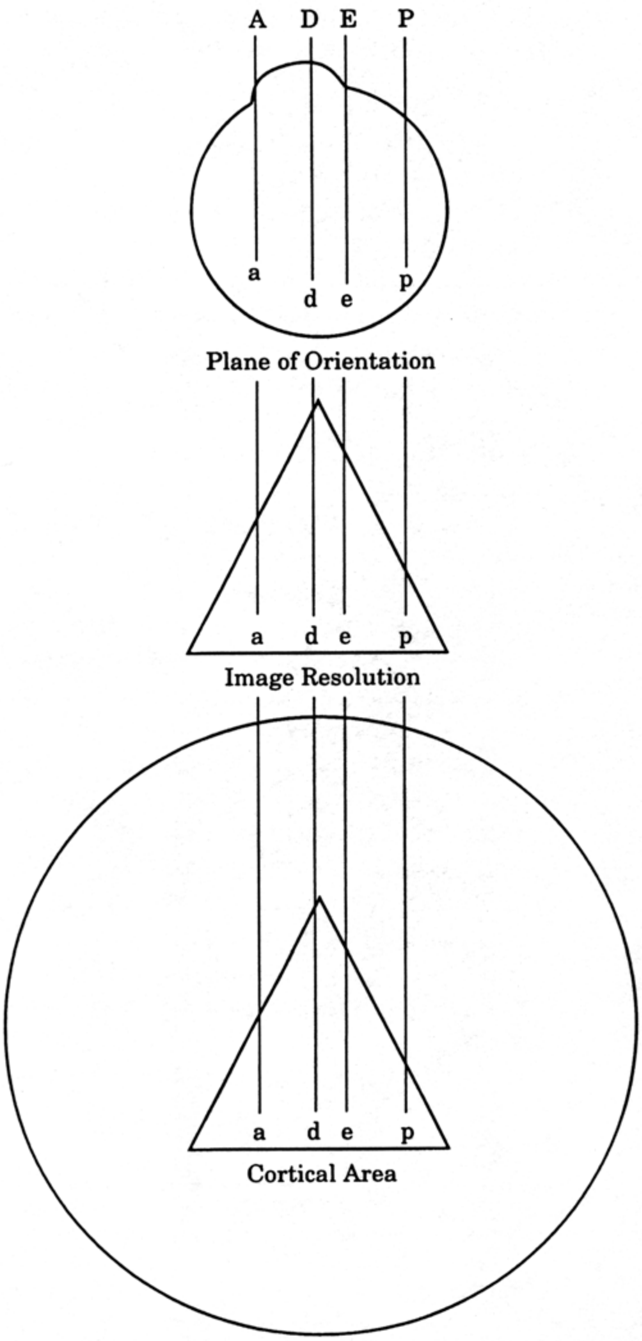
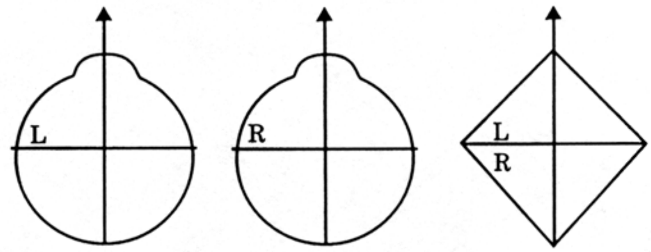


Fig 1. Brock's model of what we see. D = object directly fixated by the eye; a, d, e, p = images of various spatial objects; the isoceles triangle drawn below the viewing eye = visual acuity; d = clearest acuity (represented centrally at the triangle apex); p = most peripherally located image with least degree of clarity. The height of the triangle apex relates to maximum acuity, and the "cortical area" represents the center of the triangle base corresponding to the cortical fovea.

Figure 4 depicts a binocularly aligned person with a right amblyopia (denoted by the missing apex). If a patient with strabismic amblyopia can make this postural shift to a coordinated binocular alignment, the end result is an amblyopic eye with a greater functional ad-



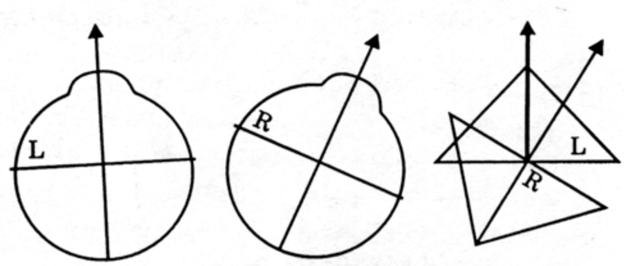
Binocular Order

Fig 2. Straight binocular fixating eyes.

equacy. Such a gain can be achieved on "binocular terms" by what is known as the "peripheral approach" to orthoptic training . . . which places priority on the retention of conjoined planes of orientation. "This really means utilizing a binocular training procedure in which the amblyopic eye is presented with a sufficiently large fixation object so that its functionally inadequate fovea can be contained within it. Such an image has to be large enough to extend across retinal areas A, B, and C" (see Fig 4). It is then quite possible to establish binocular awareness to a remarkable degree around a perceptually defective fovea in such manner that all macular images remain in closest possible correspondence during training. For this type of training the two eyes must remain fully straight and, in turn, this invites binocular participation.

Within this centration range Brock believed that:

> Stereo awareness may be developed to the fullest possible degree in spite of an inability of the amblyopic eye to obtain parity with the good eye in terms of foveal acuity. This is important since it is not the degree of foveal acuity, but the degree of macular participation which determines the quality of the binocular act. The amblyopic eye may then not fixate as steadily as if it had acquired a "false fovea," but the immensely more valuable gain in spa-



Strabismic Order

Fig 3. Deviating strabismic eyes.

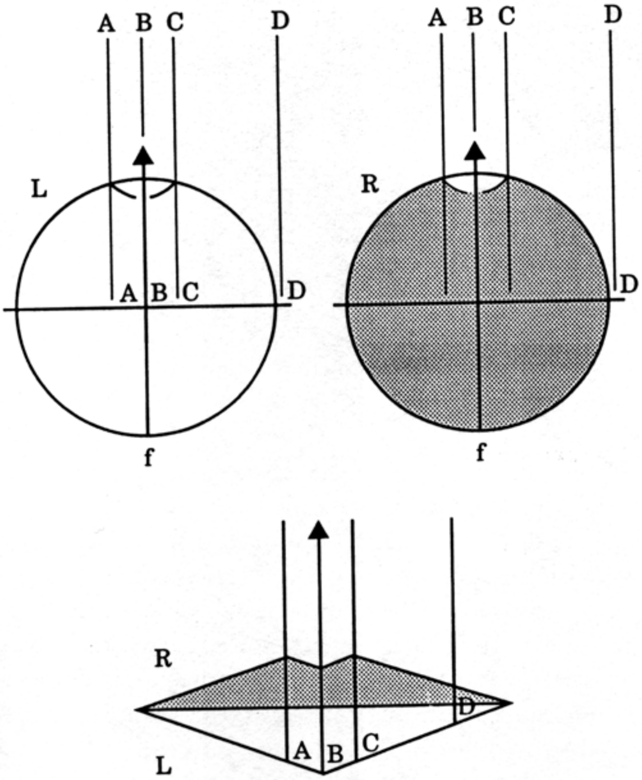


Fig 4. Right-eye amblyopia.

> tial adequacy, particularly in terms of hand-eye coordination more than compensates for this lack.[8(p50)]

If one considers Brock's stereomotivator overhead projector series (eg, rabbit and ring slides) and the "maze" targets of his Posture Board Therapy,[10] it is obvious that they are predicated on his core philosophical belief.

> Visual training should be oriented primarily towards binocular visual functions, namely the strengthening of a weakened fusion hold with the consequent gain of visual acuity. This demands training situations in which the fixation target is visible only to the good eye, while the perimacular objects are only visible to the amblyopic eye, and in which the peripheral field may contain fusion objects which belong to both eyes simultaneously for the strengthening of the ortho eye position.[11]

Regarding diagnostic characteristics of amblyopia, particularly foveal integrity, Brock devised a technique known as "posture campimetry,"[12] which uses his basic Posture Board. Elegant in its simplicity, it provides confirmation of the presence of a central scotoma, its exact location, and the type of correspondence exhibited by the patient in a non-dissociated binocular field. The target sheet is the standard posture board sheet designed to determine a patient's visual posture (see Fig 5). There are no binocular cues available to the patient on the test sheet. The instructions to the patient are as follows:

1. The posture campimeter should be placed on a table in an upright position. Illumination in the room is not dimmed.
2. The lit penlight is placed under the posture campimeter in the lower right-hand quadrant while the patient is instructed to look at the central × target. The patient is not wearing the red-green goggles at this point.
3. While the patient fixates the central × the examiner slowly moves the light around the sheet along with path indicated by the arrows.
4. The patient is instructed to continue looking at the central × but to tell the examiner when the light touches the red line *directly* below the central × (the 6 o'clock); when it is directly to the left of the × (the 9 o'clock position); when it is directly above the × (the 12 o'clock position); and when it is directly to the right of the × (the 3 o'clock position). This is to teach the patient how to observe the position of the light and when to report it.
5. Now the red-green lenses are placed on the patient with the red lens *placed over the amblyopic eye*.
6. If the amblyopia is very deep, it may be

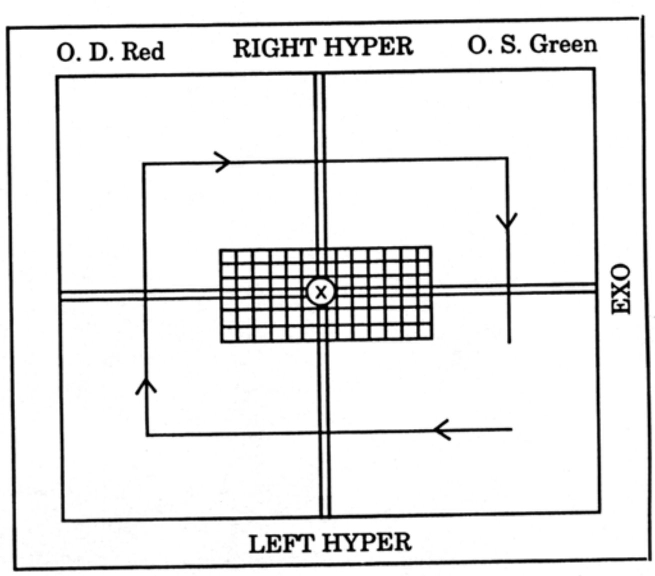


Fig 5. Posture campimeter, 10 inches by 12 inches.

necessary to reduce the room illumination to increase the contrast between the pen-light and the white sheet.

7. With the red-green lenses in place, the examiner *repeats* procedure (4), each time *marking with a red wax pencil where the patient reports the light* passing through the four straight path lines, while he continues fixating the central × target.
8. The examiner should now draw a line with the wax pencil connecting the red wax marks made on the vertical path lines (indicated by the arrows), and another line connecting the marks on the horizontal path lines. Where the two lines meet marks the approximate position on the test sheet *where the projection of the true anatomical fovea of the amblyopic eye is located.*
9. After the examiner has drawn the two lines and determined the point of anatomical fovea on the posture board, the patient is told to once again fixate on the central × while the examiner moves the light slowly toward that spot on the sheet which represents the fovea of the amblyopic eye. By so doing, the patient is under the impression that the light is directly approaching the central ×. The patient is again cautioned to maintain steady fixation on the × and not to look at the light, even if it momentarily disappears from view. However, if this occurs the patient is told to report it immediately.
10. It must be emphasized that any variance in position on the sheet between the × target and the true anatomical fovea represents an existing fixation disparity. Thus, if a patient is a right esotrope with NRC and right eye amblyopia, his true anatomical fovea would be at some point to the left of the central × (as the patient faces the sheet). If the patient is an esotrope with harmonious ARC, he would report the light and × coinciding. They would not be separated linearly on the sheet. In other words, no matter what the cosmetic alignment of the eyes, the patient interprets stimuli within the binocular field as if his para-foveal point in the strabismic, amblyopic eye had the same spatial value as his fixating eye fovea (see Fig 6).
11. With the patient continuing to fixate the central ×, the red light is slowly brought to the exact point on the sheet which represents the true anatomical fovea of the amblyopic eye. If the patient reports seeing the light superimposed on the central × *without any loss of the light,* even momentarily, that indicates that *foveal* perception is *intact.*
12. If the patient reports that he loses sight of the light at the very moment it is about to be centered on the × it indicates a small foveal scotoma.
13. If the patient reports the light disappearing before it reached the × area, this would indicate the existence of a considerable macular scotoma. A large scotomatous area, which would probably be seen in very profound amblyopia, could be plotted by bringing the light toward the true anatomical foveal area from different directions and marking the boundaries of the awareness of light loss.

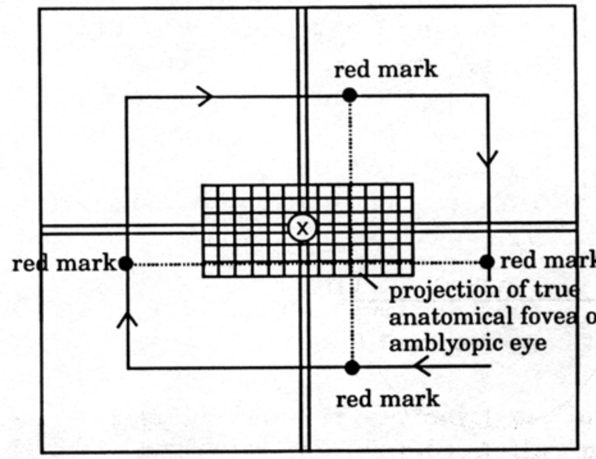


Fig 6. Posture campimeter projection of true anatomical fovea of the amblyopic eye.

In the 1964 study, "Investigating Amblyopia," Brock and Folsom reached certain conclusions concerning the functional nature of amblyopia. These included the following:

1. Most patients with unilateral amblyopia who respond to binocular testing cannot see a very small target when its image forms on the center of the fovea of the amblyopic eye. . . It appears that a scotoma concentric with the fovea of the amblyopia eye is the rule rather than the exception in amblyopia.

2. Fusion, then, can maintain the two eyes in such relationships to each other that the foveolar scotoma is effectively concealed by the contraocular fixation target. Phorias and ductions are available and stereo acuity can be as adequate as the functional loss of foveal vision in our eye will permit. This, then, represents the best adaptation to the amblyopia of which the injured organism is capable.
3. Visual training should be oriented primarily toward binocular visual functions, namely the strengthening of a weakened fusion hold with the consequent gain of visual acuity. This demands training situations in which the fixation target is visible only to the good eye, while the perimacular objects are only visible to the amblyopic eye, and in which the peripheral field may contain fusion objects which belong to both eyes simultaneously for the strengthening of the ortho eye position.

Frederick Brock's approach simply reflected his humanistic approach and passionate belief that man adapts to his environment in whatever way is necessary to survive.

REFERENCES

1. Townshend AM, Holmes JM, Evans LS. Depth of anisometropic amblyopia and difference in refraction. *Am J Ophthalmol.* 1993;116:431–436.
2. Noda S, Hayasaka S. Occlusion therapy of Japanese children with anisometropic amblyopia. *Ann Ophthalmol.* 1993;25:145–147.
3. Griffin JR. *Binocular Anomalies: Procedures for Vision Therapy.* 2nd ed. Chicago Professional Press; 1982.
4. Frantz K. Rationale for refractive correction, occlusion and active therapy for amblyopia treatment. *J Behav Optom.* 1995;6:18.
5. Sherman A. Treatment of amblyopia without full refractive correction or occlusions. *J Behav Optom.* 1995;6:15.
6. Greenwald I. *Strabismus: Brock's Influence on New Therapies.* OEP; Santa Ana, CA: 1982; 14:3. Series 1.
7. Brock FW. *Visual Training.* Parts I, II, III. Chicago, IL: The Professional Press; 1943, 1950, 1959.
8. Brock FW. *Care of the amblyopic child. Am J Optom.* 1967; 44:44–55.
9. *Brock Stereo Motivator Series,* Keystone View Co.
10. Brock FW. *Posture Board Training, Category 1, Techniques 1 and 2.* Long Island, NY: Long Island Orthoptic Co.; 1961.
11. Brock FW, Folsom W Jr. Binocular methods of investigating amblyopia. *Am J Optom Arch Am Acad Optom.* November 1964;41:11.
12. Greenwald I. *Effective Strabismus Therapy* Duncan, OK: OEP Foundations; 1979:34–37.