Chapter 4

AMBLYOPIA

Evaluation and Treatment

I. INTRODUCTION

A. Definition

Diminution of VA of one eye with a difference of one or more lines on the vision chart while wearing any significant optical correction. If there is no *organic* cause, it is a functional amblyopia.

B. Classification (Von Noorden)[3]

1. *Strabismic amblyopia*
   Defect of visual acuity in one eye without visible pathologic changes in the fundus or refractive media. It is found in patients with strabismus or a history of such imbalance. It is a result of longstanding active inhibition of macular function of form vision in the course of an adaptation to avoid visual confusion or diplopia.

2. *Ametropic / Anisometropic Amblyopia*
   Impaired vision due to uncorrected refractive error or a high degree of anisometropia.

3. *Organic amblyopia* (sensory amblyopia)
   Although the fundus appears normal, anatomic damage to the retina or visual pathway must be assumed to be present. Example: possible retinal hemorrhage in the newborn infant that then clears with a visible trace of macular impairment. Example: corneal and lens opacities.

   IMPORTANT: Neutral density filter placed in front of the amblyopic eye will differentiate between organic or functional amblyopia.

   Functional – Visual acuity remains the same or improved
   Organic – Visual acuity is decreased

C. Risk factors for amblyopia

VA Per Age

Anisometropia (spherical or cylinder) > 1.5 D	AGE	VA
Any manifest strabismus 23% improve with full time spectacle correction	4 months	20/2000
	6 months	20/1000
	9 months	20/200
Hyperopia > 3.5 D in any meridian	1 year	20/150
Myopia > 3.0 D in any meridian	2 years	20/45
	3 years	20/30
Astigmatism > 1.0 D	4 years	20/25
Ptosis < 1 mm margin reflex distance	5 years	20/20
VA → per age appropriate standard		

D. Testing vision

Vision should be tested whole line letters (cortical VA) as well as isolated letters (angular VA) due to the crowding phenomenon in amblyopia. It is very important to test near VA. If near VA is better than distance vision it indicates excellent potential for improvement with treatment. Refer to vision assessment in preverbal and verbal children in Basic Tests Chapter One.

E. Amblyopia with Central Fixation and Eccentric Fixation

1. Central Fixation

The fovea is the carrier of the principal visual direction with a retinal motor values at zero. When the preferred eye is occluded, the amblyopic eye picks up fixation with the fovea. This indicates excellent potential for normal VA.

2. Eccentric Fixation

A retinal element other than the fovea becomes the carrier of the principle visual direction. When the preferred eye is occluded, the amblyopic eye does not pick up fixation with true fovea. In other words, an eccentric retinal element has assumed all the characteristic of the fovea except potential of normal VA. In eccentric fixation, the patient has separation

difficulty when whole letters are presented. When linear VA is markedly reduced compared to isolated letters, eccentric fixation is probably present.

F. Testing Fixation

1. Visuscope to Diagnose the Presence of Central or Eccentric Fixation

The visuscope is a conventional ophthalmoscope in which a small star is projected onto the fundus and the patient is asked to fixate on the star. If the foveal reflex is seen on the center of the projected star (☆), the patient's fixation is central. If the star does not fall on the foveal reflex, the following types of eccentric fixation may be observed.

a. Types of Eccentric Fixation

1. Central but unsteady (i.e. fixation shifts on and off the fovea).

2. Fixates a point close to the fovea, either nasal, temporal, superior or inferior. The distance can be measured by projecting a disc that has several rings surrounding the star. Each ring is equal to ½ degree and the location of the fovea on the rings determines the amount of eccentricity. When the fixation point is to the nasal side of the disc, it is called Ceco Central.

3. No definite fixation point (patient's fixation constantly wavers) indicates a very poor prognosis because the patient is unable to establish a definite pattern.

b. Technique for visuscope or ophthalmoscope examination

Examine the dominant fixing eye first and cover the eye not under examination. Use low illumination to prevent dazzling of the retina. First look with the green filter disc before switching to the white light when assessing the area of the retina. This can be performed with an ophthalmoscope by displaying the disc with the circles and instruct the patient to fix in the center of the smaller circle to check fixation pattern.

2. Haidinger Brushes to Diagnose Central or Eccentric Fixation

   The Koordinator or ocular synoptophore are instruments that contain the Haidinger Brushes. Only the macular and paramacular areas can perceive the Haidinger Brush. It is produced by a rotating Polaroid, cobalt lens which stimulates the macular-papillar bundles and the propeller-like image observed is the Haidinger Brush. A circular aperture (measured in degrees) is placed in front of the lens containing the Haidinger Brush. As the field is slowly diminished with the circular aperture, the patient will inform the examiner when the Haidinger Brush disappears. *If central*, the patient is aware of the Haidinger Brush with the smallest aperture opening of ½ centimeter. *If eccentric*, the Haidinger Brush will disappear as the field is diminished, depending upon the degree of eccentricity. If the eccentricity is outside the macular area, the patient will not be aware of the Haidinger Brush.

   NOTE: The Haidinger Brush phenomenon is not only used in evaluation but also in pleoptic treatment.

3. Past Pointing

   Small dots of various sizes are drawn on a white sheet of paper and the patient is given a pointer with a sharp tip. With his dominant eye occluded, the patient is told to point directly to the dots. This can also be done with the amblyopic eye occluded to check the comparison of either eye fixing. If the patient is central, he will point directly on the dot. If eccentric, he will point to the side of the dot. This is based on the concept that, in the absence of foveal fixation, the patient does not have a true sense of spatial value.

II. AMBLYOPIA TREATMENT IN PATIENTS THROUGH THREE YEARS OF AGE WITH CENTRAL OR ECCENTRIC FIXATION

(Significant refraction error should be prescribed)

Full-time skin patch of the dominant eye during waking hours but patch should be removed at bedtime. If a significant refractive error is present, correction should be given. In children age three or younger with central fixation will improve very quickly; those with eccentric

fixation will improve at a slower rate but prognosis is excellent because the eccentricity is not firmly established.

Infants below 1 year of age should be checked weekly to guard against the dominant eye becoming amblyopic. Children from age one through three years should be seen at two week intervals. Once the patient can fix steadily and voluntarily with the amblyopic eye, begin to alternate patch three hours a day. At the next visit (2-3 weeks), the patient should be able to alternate freely and be ready to be treated for the strabismic problem. Patients that have marked anisometropia (central or eccentric) have good prognosis in the age group.

NOTE: According to the PEDIG Study – four to six hours of occlusion should be sufficient to eliminate amblyopia in this age group.

III. AMBLYOPIA TREATMENT AGES FOUR TO TWELVE YEARS WITH CENTRAL FIXATION

In visual acuity ranging from 20/80 → 20/200 or more initiate full time skin patch of the dominant eye. Patch is removed at bedtime and immediately applied in the morning. In older children, if the patch cannot be accepted during school hours, patch is worn after school and full time on weekends. Improvement is slower, normal acuity should be obtained.

During occlusion of the dominant eye, the child is encouraged to sit back from TV, and do various detailed near work (i.e. drawing, tracing, models, reading, stitchery). Total skin occlusion of the dominant eye is continued until 20/50 VA is obtained. Patients are seen at three to four week intervals for VA check.

Once 20/50 VA is achieved, discontinue the skin patch and initiate Bangerter foil full time in front of preferred eye usually 0.3 foil. Translucent (magic transparent) scotch tape or clear contact paper five hours a day on the lens in front of the preferred eye can be an alternate method of treatment.

When the vision in the amblyopic eye is equal to the vision of the dominant eye, the patient is taught to alternate. A 0.8 Bangerter foil is worn full time (20/30 VA level) for three to six months. Clear contact paper or scotch tape is worn three hours a day. The patient should schedule a return visit in six to eight weeks to check if improved vision in the amblyopic eye is maintained.

IMPORTANT: Some studies show two hours of patching is as effective as six hours. Furthermore, six hours of daily patching is as effective as full time (less one hour) daily patching. Other studies PEDIG (Pediatric Eye Disease Investigative Group) suggest six hours daily patching is similar to 12 hours daily patching. It also has been reported that two, four, and six hours and patching full time are similar. In addition, studies have shown that after cessation of treatment, 7% of children in this age group have recurrence of amblyopia.

IV. AMBLYOPIA TREATMENT AGES FOUR TO TWELVE WITH ECCENTRIC FIXATION, INCLUDING PLEOPTICS

A. Treatment VA 20/200 or less

1. Initial Treatment

Full-time skin occlusion of the preferred eye during all waking hours. The patient is observed at three weeks intervals to evaluate:

a. the fixation pattern and visual acuity of the amblyopic eye, and,
b. the vision of the dominant eye being occluded.

In cases in which the child cannot accept occlusion of the good eye during school, the patch is transferred to the amblyopic eye and the dominant eye is patched after school and on weekends. The amblyopic eye must be occluded when the dominant eye is being used to prevent reinforcement of the eccentric area.

The occlusion program is continued as long as fixation or visual acuity improves. Once improvement remains stationary for two consecutive months, the second stage of treatment is based on the visual acuity and fixation achieved with full-time occlusion.

2. Treatment After Full-Time Occlusion of the Dominant Eye

a. 20/30 to 20/50 and good fixation

Fixation is central, central unsteady or minimal degree of eccentricity. Skin patch the preferred eye only half a day

or full-time occlusion with 0.3 or 0.2 Bangerter Foil. The child should be observed in two to four weeks to monitor any change in visual acuity. If vision does diminish, return to full-time skin occlusion for an additional two months. (Correction of any significant refractive error should be worn full time). Make another attempt with ½ day skin occlusion for an additional two months to reinforce and stabilize the improved VA in the amblyopic eye. The management of the strabismic problem can now be initiated.

b. 20/60 to 20/80 vision with fixation is eccentric

The success of retaining 20/60 to 20/80 visual acuity is poor once occlusion is discontinued. However, the examiner can reassure the parents that if anything would happen to the dominant eye, the patient has reserved vision in the amblyopic eye (spare eye). The level of improvement can always be regained if needed during his or her life span.

c. 20/100 or less

If after three months of full-time occlusion, the vision has not improved to 20/100, stop the occlusion of the dominant eye and transfer patch to the amblyopic (eccentrically fixing) eye. The patch is worn full-time (waking hours) over the amblyopic eye for six to eight months to prevent stimulation or reinforcement of the eccentrically fixing area. Following this period of inverse patching, reinitiate full-time occlusion of the dominant eye for three additional months. If no improvement, stop treatment.

B. Treatment with Pleoptics for Eccentric Fixation

1. The amblyopic eye is constantly patched except when treatment is given.

2. Two methods of treatment with pleoptics are:

    a. Bangerter's Method-Instruments

        1. Pleoptophor with passive stimulation of the macula after dazzling the eccentric area. This instrument allows treatment for children in four to six age level.

        2. Corrector, Centrophore, Separator, Localizer and Memoscope are hand and eye memory practices to actively stimulate the macula.

    b. Cuppers' Method-Instruments

        1. Euthyscope (after-image technique): Re-educates the fovea to localize straight ahead.

        2. Koordinator, Space Koordinator, Ocular Synoptophore and Koordinator: contains the Haidinger Brushes which can only stimulate macula-papillar fibers of the macular area.

C. Binder's Red Filter Technique

The sound eye is occluded and a Wratten 92 red filter is taped to the plano or corrective spectacle lens in front of the eccentric eye and a shield is placed around the sides of the frame to prevent outside light from entering the amblyopic eye. Because of the familiar Purkinje phenomenon, the red light transmitted by the filter is much more heavily weighted for the excitation of cones in proportion to rods than is the case for the unfiltered visible light.

V. PHARMACEUTICAL PENALIZATION

An alternate method to patching in children with moderate amblyopia (20/50 to 20/80) studies has shown that in patients with central or unsteady central fixation, atropine penalization is as effective or better than patching. Children who patch initially improve more quickly than with atropine.

A. Method of Treatment

1. 1% atropine drops are instilled in the dominant eye

2. If a hyperopic correction is worn, remove lens in front of the dominant eye and replace with a plano lens.

3. Child is seen at three-week intervals as long as VA continues to improve. Stop atropine once improvement of VA remains the same for 2 consecutive months.

PEDIG studies show that using atropine two days during the week (weekend atropine) is as effective as using atropine daily in children with moderate amblyopia. Weekend use of atropine is also effective in children with severe amblyopia but the improvement is greater in younger children.

VI. ADDITIONAL MODALITIES OF TREATMENT

If the optimum VA is not obtained with 1% atropine other modalities of treatment may be considered.

A. Bangerter foils - worn full-time in front of the dominant eye.

B. Optical penalization – increase *plus* lens in front of preferred eye.

C. Occlusion contact lens – over the dominant eye.

D. Clear contact paper or magic scotch tape in front of the dominant eye.

E. Levodopa/Carbidopa - oral medication with patching of the dominant eye.

F. Botulinum toxins – inducing ptosis in the sound eye.

G. Suturing a plastic occlusion shield over the sound eye.