



Strabismus¹

(Also refer to the article on Amblyopia and to the diagrams of the eye muscles and normal gazes)

Characteristics of the Condition

Strabismus is characterized by unequal action of the six extraocular eye muscles, causing a misalignment of the eyes. The imbalance may be of the horizontal or vertical axis and results in difficulties with functional vision. The condition is often secondary to other visual impairments. It impacts the ability of both eyes to focus on an object and to fuse the two images into one single image (binocular vision). Binocular vision is necessary for depth perception and three-dimensional viewing (stereopsis).

The improper alignment of the eyes may be in any direction: inward, outward, up, down, or in a rotary direction. The amount of the deviation is the angle by which the eye is out of alignment. Occasionally, childhood strabismus has neurologic implications and may be related to a brain tumor, infection, trauma, or congenital condition such as hydrocephalus.

When strabismus is present at all times under binocular viewing condition, it is called manifest strabismus, heterotropia, or tropia. Strabismus present when only one eye is covered is called latent strabismus, heterophoria, or phoria. The direction of the deviation and whether it is latent or manifest is described by the following terms:

- **Heterophorias:** the tendency for misalignment when one eye is covered, that is, whenever binocular vision is interrupted
- **Esophoria:** the eye or eyes turning inward
- **Exophoria:** the eye or eyes turning outward
- **Hyperphoria:** one eye moving upward, or higher than the other
- **Hypophoria:** one eye moving downward, or being lower than the other
- **Heterotropias:** manifest deviation of the eyes, where misalignment occurs despite binocular vision
- **Esotropia:** or "crossed eyes," an inward deviation
- **Exotropia:** or "wall eyed," an outward deviation
- **Hypertropia:** one eye upward or higher than the fixating eye
- **Hypotropia:** one eye downward or lower than the fixating eye

¹ Dennison, E.M. (2003) *Eye Conditions in Infants and Young Children that Result in Visual Impairment, and Syndromes and Other Conditions that May Accompany Visual Disorders*. North Logan, UT: Hope Incorporated



HETEROTROPIA OR STRABISMUS

Phorias



fusion keeps eyes straight

Exophoria A tendency for one or both eyes to turn out when fusion is interrupted.



Cover right eye and it wanders to the right.

Esophoria

A tendency for one or both eyes to turn in towards nose when fusion is interrupted.



Right hyperphoria

Right eye tends to turn upwards; left turns downwards.



Left hyperphoria

Left eye tends to turn upwards; right turns downwards.



These can be overcome by natural desire for fusion. They can cause eye strain and headaches or blurred vision. Are not as serious as conditions in the right column nor are they as obvious. Correct with glasses, medication, patching, and/or surgery.

Tropias

Exotropia

Turning outwards of one or both eyes, causing person to see double or suppress vision in one eye and use the other to see.



Esotropia

Turning inwards of one or both eyes causing the above.



Right Hypertropia

Right eye turns upwards and left turns downwards causing the above.



Left Hypertropia

Left eye turns upwards and right eye turns downwards causing the above.



These conditions are worse in degree than the ones on the left and are obvious when looking at child's eyes. May be corrected with patching, glasses, medication, and/or surgery.



Treatment

The major goal in the treatment of strabismus is clear vision (acuity) in each eye, cosmetically straight eyes, and binocular vision. Fusion is the brain's ability to blend the two similar images received from each retina into one single image or mental picture. Fusion must be maintained even as the eyes converge, diverge, and as the gaze is directed in different directions. In some cases, the best result one can achieve with treatment is fusion in primary gaze.

An accurate ophthalmologic history is an important tool in the proper diagnosis, prognosis, and treatment of strabismus. The following points are considerations in strabismus cases. Strabismus is commonly inherited, so the family history needs to be reviewed. The age of onset is an important factor. The earlier the onset, the worse the prognosis for fusion and true binocular vision. The onset can be gradual, sudden, intermittent, or associated with systemic disease. The condition under which the strabismus is most notable determines the type of deviation. For example, do the eyes cross when the child is viewing near objects or when the child is tired? Does one eye drift out when the child views objects at distance or daydreams? Is the amount of deviation constant? Does the child shut one eye in bright sunlight? Lastly, it is important to know if the eyes are in a straight position at any time, or if they are always deviated?

Two to five percent of all children have some form of strabismus, and it is rare for "childhood strabismus" to be outgrown. Upon diagnosis, at any age, it is best if treatment starts immediately. The earlier the condition is detected and treated, the better the chance that good stereo vision and equal visual acuity can be achieved. It is generally believed that if the eyes are made as straight as possible by age 2, the better will be the long-term outcome for the best possible development of visual acuity. The cosmetic and functional result will also be more optimal. There is no "magical" cut-off age, and good results can be obtained later; however, the brain is most receptive for improvements earlier in life, and modifications in making synaptic connections between the eye and the brain become more difficult with time.

Neglect in treatment of strabismus may lead to undesirable cosmetic appearance and psychological trauma, especially as the child reaches school age. Most significantly, amblyopia (lazy eye) often develops if visual input from one eye is neglected. If not diagnosed and treated before age seven or eight years, the impact on the ultimate visual acuity of the weaker eye can be quite serious. Amblyopia must be treated separately from the strabismus; please refer to the write-up on amblyopia.

The treatment of strabismus is best performed by an ophthalmologist, and where available, a pediatric ophthalmologist should be consulted. Treatment plans may include the following:

1. Correction of refractive errors with glasses.
2. If amblyopia is present, occlusion therapy/patching of the preferred eye for carefully prescribed periods to stimulate use of the weaker eye and equalize the visual acuities.





Alternatively, cycloplegic agents or medication in the form of eye drops may be used in the better eye. This results in a blurred image, stimulating use of the neglected eye.

3. Orthoptic/eye exercises in less complicated cases could be beneficial under careful supervision of an orthoptic technician with specialized training in exercises designed to straighten eyes and improve fusion. It is generally believed that these exercises are most effective when performed throughout naturally occurring daily oculomotor routines in normal settings, for instance, at home. Exercise sessions in a physician's office are costly and rarely have lasting effects.
4. Surgery to realign the eyes is necessary in many cases. Without true alignment, there is no chance for binocular vision. Even when amblyopia is treated, and the eyes achieve equal acuity, without fusion, stereopsis will not develop.

When assessing visual acuity of a visually impaired child with abnormal eye movements, it is necessary to modify the procedure. For instance, when adapting the Teller Acuity Card Procedure with an infant who has esotropia, the misaligned eye turns inward towards the nose and the other eye may stay positioned normally when attempting to look at the lines on the test. It may be difficult for the tester to distinguish preferential fixation on the lines because the eye is already turned in toward the nose. Testers have found that these infants respond only when the lines are presented on one side. It may take presenting the card many times before a determination can be made as to whether the child with strabismus can see the grating of the lines on the card. It has been found helpful to present the cards vertically. It is recommended that if acuity is compared between each eye that a similar procedure be used to test the two eyes together.

Possible Effects on Visual Functioning

Strabismus affects binocular vision, depth perception, and eye-hand coordination. The different types of strabismus (discussed earlier) may cause eye strain. They can also cause difficulty in following fast moving objects, tracking, fixating, and scanning. Stress and fatigue will often reduce visual functioning with these children.

Visual Adaptations and Other Considerations

Strabismus must be treated as discussed above, and with diligent care and modern medical techniques, the majority of children with strabismus will not have any visual limitations. A minority of children, in particular those with complex medical conditions such as cerebral palsy, movement disorders, and central nervous system conditions, will have some degree of untreatable strabismus and will benefit from adaptive training. When a refractive error exists, corrective lenses must be encouraged at all times.





Some children may need to be taught strategies such as using one eye to view distant tasks and the other eye for near viewing tasks. Head turns and tilts are a common adaptation to strabismus and may result in sufficient alignment when fusion is possible.

When first helping young children with strabismus learn to follow objects, keep the movement slow. Allow the child to touch the object being followed and give them time to regain their fixation when they lose it. At first, large, easy to see targets should be used against a contrasting background to make "looking" easier. Later, when the child begins to learn to read, use of a black line marker may help them keep their place on a line of print.

References for Further Reading

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