Management of Anisometropia In Children

Essay
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By
Mira Adel Gabra Botros
[M.B, B.Ch.]

Under Supervision of

Prof. Dr. Osama Abdelkader Salem
Professor of Ophthalmology
Faculty of Medicine- Ain Shams University

Assist. Prof. Dr. Mohamed Moghazy Mahgoub
Assistant Professor of Ophthalmology
Faculty of Medicine- Ain Shams University

Faculty of Medicine
Ain Shams University
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List of Abbreviations

ACD	Anterior Chamber Depth
AC-PIOLs	Anterior Chamber Phakic Intraocular Lenses
BCVA	Best-Corrected Visual Acuity
BSS	Balanced Salt Solution
CLE	Clear Lens Extraction
D	Diopter
DLK	Diffuse Lamellar Keratitis
ECC	Endothelial Cell count
Epi-LASIK	Epithelial Laser-Assisted in Situ Keratomileusis
HOAs	Higher-Order Aberrations
ICL	Implantable Contact/ Collamer Lens
ICO	International Commission for Optics
IOL	Intra-Ocular Lens
IOP	Intra-Ocular Pressure
LASEK	Laser Sub-Epithelial Keratectomy
LASIK	Laser-Assisted in Situ Keratomeleosis
OKN	Optokinetic Nystagmus
PC-PIOLs	Posterior Chamber Phakic Intra-Ocular Lenses
PEDIG	Paediatric Eye Disease Investigator Group
PIOLs	Phakic Intra-Ocular Lenses
PL	Preferential Looking

PRK	Photo-Refractive Keratectomy
SMP	Simultaneous Macular Perception
TACs	Teller Visual Acuity Cards
UCVA	Uncorrected Visual Acuity
VDT	Video Display Terminal
VEP	Visually Evoked Potential

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Introduction

Visual impairment in children pose a special problem for ophthalmologists, as many eye care practitioners are not familiar with performing pediatric eye examinations and measuring visual acuity in infants. Infants are unable to verbalize their complaints, and history from parents and care takers may lack important details. The first year of life is also the time when the visual system develops and binocular vision is formed**. (Day S, 1997)**

If a visual deficit at this age is not treated in a timely manner, amblyopia and permanent visual deficit can occur. Hence early diagnosis and prompt treatment is essential. **(Rahi JS et al., 1999)**

Anisometropia is defined as a difference of 1.00 diopter (D) in the myopic, hyperopic, or astigmatic refractive errors between the patient’s two eyes. **(Chen PL et al., 2007)**

It is well recognized that anisometropia can lead to amblyopia. **(Donahue SP, 2005)**

Amblyopia refers to a decrease in best-corrected visual acuity in an eye with no evident organic cause. It is one of the most common causes of visual loss in childhood and is characterized by reduced spatial vision in the presence of strabismus, refractive error, or form deprivation during the visually sensitive developmental period. **(Von Noorden GK, 2002.)**

Aim of the Work

The aim of the work is to review different approaches for management of anisometropia in children.

1. Binocular Vision

Although we have two eyes, we are not aware of this fact during visual perception: we perceive the world as if through a single ‘‘cyclopean eye’’ (single eye) in the middle of our forehead (figure 1.1).Yet at the same time, we have the remarkable ability to deduce depth from the small differences in left- and right-eye retinal images which occur because our eyes are set apart in our head. **(Read J, 2005)**

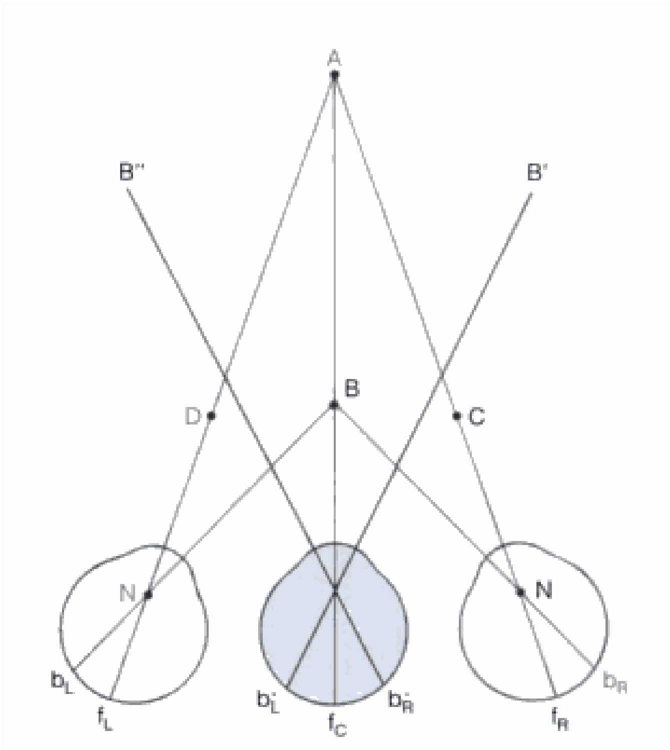

Figure1.1The cyclopean eye (shaded)
The cyclopean eye is fusion of the two images from left and right. Image (a) is fused but image (b) cannot be simultaneously viewed without diplopia due to the projected images at b' & b'' respectively homonymous diplopia would occur if B was distant from A. Using either eye alone for alignment of the object would entail point C aligning with A (right eye) and point D aligning with A for the left eye. N: nodal point. **(Forrester JV et al., 2008)**

Binocular Single Vision may be defined as the state of simultaneous vision, which is achieved by the coordinated use of both eyes, so that separate and slightly dissimilar images arising in each eye are appreciated as a single image by the process of fusion. Thus binocular vision implies fusion, the blending of sight from the two eyes to form a single percept. **(Kaufman FL et al., 2003)**

The Horopter and Panum's area:

It is defined as the locus of all object points that are imaged on corresponding retinal elements at a given fixation distance. Thus a line can be drawn through the object of regard such that all the points on the line are imaged on the corresponding retinal elements and are seen singly. (Figure 1.2) **(Kaufman FL et al., 2003)**

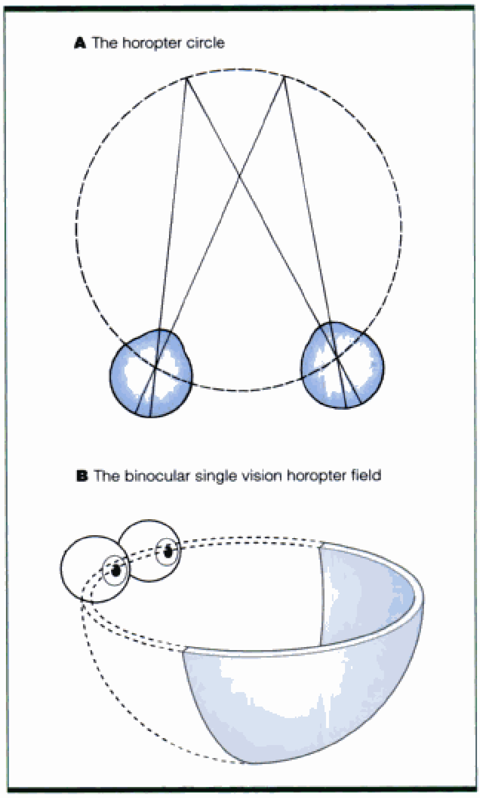

Figure 1.2

(a) The Horopter circle (b) The binocular single vision horopter field. **(Forrester JV et al., 2008)**

Thus all the points not lying on the horopter are imaged by disparate retinal elements and are seen as double. This diplopia elicited by object points off the horopter is called Physiological diplopia. However we normally do not always experience this diplopia. This can be explained on the basis of Panum's Fusion Area. It is defined as a narrow band around the horopter within which the objects stimulation disparate retinal elements transmit the impression of single vision. **(Kaufman FL et al., 2003)**

Thus the range of horizontal disparities around the horopter within which the stimulus will continue to be perceived as single is known as Panum's fusional area. **(Kaufman FL et al., 2003)**

Monocular visual development:

At birth visual acuity is quite poor in the range of hand motion to counting fingers. This poor vision is mostly due to immaturity of the visual centers in the brain including the lateral geniculate nucleus and striate cortex. Rapidly over the first few weeks, retinal stimulation with formed image stimulates specific drop out and growth of the cortical connections and the visual acuity improves. **(Candy TR, 2006)**

This early neural development gives rise to theorganization of small high resolution receptive fields in the central foveal area. Central foveal fixation is established by 4 to 6 weeks along with accurate smooth pursuit. During the first few weeks, only saccadic (fast or jerk) eye movement are available for fixation. By 6 weeks of age, smooth pursuit and reproducible responses to optokinetic stimuli are seen. Central fixation and accurate smooth pursuit is an important clinical milestone of normal visual development. Most children will show central fixation and accurate smooth pursuit eye movement by 2 to 3 months of age, but some infants may show delayed visual maturation. Poor fixation at 6 months of age, however is usually pathologic, and should prompt a full evaluation for ocular, motor or afferent visual pathway diseases, including electro physiologic and neuroimaging studies. **(Candy TR, 2006)**

Binocular visual development:

Binocular visual development occurs in concern with improving monocular vision. Basic neuro-anatomy tells us that the two eyes are linked to provide binocular vision. Optic nerve fibres from the nasal retina cross in the chiasma to join the temporal retinal nerve fibres from the fellow eye. Together they project to the lateral geniculate nucleus and on to the striate cortex. **(Duckman, 2006)**

In the striate cortex the afferent pathway connect to the binocular cortical cells that respond to the stimulation of each eye and monocular cortical cell that responds to stimulation of one eye. Refinement of neuroanatomic connections and development of normal binocular vision function dependent on appropriate binocular visual development include equal retinal stimulation and proper eye alignment. Binocular vision and fusion have been found to be present between 1 and 2 months of age while stereopsis develops later between 3 and 6 months of age. **(Duckman RH, 2006)**

Visual acuity development:

Normal visual development in infants is characterised by a striking imaturity at birth followed by rapid development of visual functions which reach adult levels by about five years age**.** **(Chandna A, 1991)**

Grades of binocular vision:

There are three grades of binocular vision as given by Worth's classification: **(Kaufman FL et al., 2003)**

Grade I: Simultaneous macular perception (SMP) is the most elementary type of binocularity. It occurs when the visual cortex perceives separate stimuli of the two eyes at the same time.

Grade II: It represents true fusion with some amplitude. Not only are the two images fused, but some effort is made to maintain this fusion in spite of difficulties. Thus the second grade implies a motor response added to simple sensory fusion.

Grade III: In the highest type of binocularity, not only are the images of the two eyes fused, but they are blended to produce a stereoscopic effect. This involves a perceptual synthesis at a higher level.

These three grades are not necessarily mutually exclusive, since fusion in the periphery, even showing motor responses, may exist coincidentally with the total absence of simultaneous foveal perception**. (Kaufman FL et al., 2003)**