

## Do my child's eyes work properly, Doctor?

Normal vision in children is often taken for granted, but in some cases vision does not develop perfectly and this may hamper other forms of development and learning. With young children limited letter recognition and behavioural factors often make it difficult to fully assess vision with confidence. For this reason, pediatric vision is best considered in a developmental framework.

Babies are not born with the ability to see well, and in the development of vision much depends on the way a child learns how to use their eyes to see. The way we learn to walk or talk are useful analogies in this context.

It is worth keeping in mind that a visual acuity measurement is actually a measure of the spatial resolution of the eye. This is determined by measuring what fraction of the theoretical minimum letter size, 5 minutes of arc, an individual is able to discern.

A good visual acuity depends both upon appropriate optical focus and the ability to resolve this focus at the retina. This process will be mediated by the child's ability to recognise, interpret and understand what they are looking at.

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The developmental continuum can be briefly summarized as follows:

### At birth

- Opens eyes
- Red Reflexes both equal and bright
- Frequent misalignment of visual axes
- Poor visual acuity (about 6/180)
- Fovea largely undifferentiated
- Refractive status : hyperopia normal, astigmatism common

### By 4 months

- Child should be following things, binocularity very much the norm. Turned eyes and squints should be much less common.
- Reaching for things and actively looking at things
- Developing hand eye coordination and binocular depth perception.
- No object permanence permanency (objects cease to exist when they are not in sight, this is part visual memory and reflects the sophistication of the child's model of the universe).

### By 12 months

- Binocular now, using vision to judge distance and size as child is more mobile, crawling and pulling itself up. These activities

are important for normal visual development and development of abstract awareness like body image.

- More coordinated and good right left integration.
- 6/6 visual acuity binocular, doesn't like occlusion of one eye still fragile (may struggle to regain binocular vision after covering one eye).
- Almost adult visual performance but not really interested in distant objects

### By 2 years


- Hand eye coordination, depth perception continues to develop and understanding of space and distance – more interested in distant objects
- Should be walking, talking, actively looking and naming. Object permanence, body image, depth perception, visual acuity all fully developed.
- Until now, has been learning to see along with other developmental milestones

### By 4 years

- Continues to develop visually guided, eye hand, fine motor skills.
- Visual function as adult
- Doesn't mind occlusion – binocular system is robust, readily recovers from disruption.

It is worth debunking the myth the children grow out of abnormalities in the above process.





Development is a very adaptable plastic process in which we make the best of what we have. Distortions and disabilities will cause deviations in the normal continuum that generally have lasting consequence for the individual. This capacity for adaptation may improve function in the long term but may well deny the opportunity to normalize and remediate thus causing lasting visual deficit, poor school performance and lifelong consequences.

### **Pathology and abnormal vision in children**

There are a number of events and processes that may contribute to abnormal vision or the failure to develop normal vision.

Birth trauma or neurological damage affecting the central nervous system. Examples are cerebral palsy, and ocular deviation from damaged extraocular eye muscles (eg forceps trauma to the abducens nerve).

Congenital strabismus creates interference to normal binocular development

Abnormal red reflex is a strong indicator of internal eye pathology most seriously retinoblastoma but also cataract or high ametropia.

In amblyopia both eyes are functionally capable but information is suppressed to resolve the conflict between high resolution vs spatial resolution. These are neurologically and centrally different visual processes. The high resolution process is temporal in nature and is dependent on “edge detection” and good contrast. Spatial resolution is concerned with the capability of the visual system, in regions away from where the fovea is looking. If visual development is disturbed in this way it can result in histological abnormalities through the entire visual pathway,

including the undifferentiated lateral geniculate nucleus. Understanding of a number of these developmental processes is still evolving as is understanding of neuroplasticity mechanisms.

Control of accommodation and vergence is also an important developmental step in acquiring normal vision. Normal visual processes are themselves dependent on a normally functioning autonomic nervous system and the oppositional but synergistic function of sympathetic and parasympathetic branches. Disturbances that disrupt normal visual function include degraded retinal image from anisocoria (differing pupil size) and unequal accommodation in unilateral variance. And there is some evidence that psychoperceptual issues can impact on visual function among children in high stress or abusive home situations.

### **Evaluating Vision in Children**

It is really important that an appropriate chart is used to test acuity at an appropriate test distance. A logmar type chart is best and you need to take account of the fact that a 3-metre or 4-metre chart will distort findings due to the relative proximity of the target. It helps to use a variety of objective tests as it is a bit like piecing a puzzle together – basing a decision on a single measurement may not be safe. Children will not always be cooperative and can really test your communication skills as you try to find out what they can and cannot see. The key message though, is that vision is important and needs to be investigated whenever there is evidence of developmental delay or disruption.