



# Module 1

## Identifying Signs of Eye and Vision Problems in Babies and Young Children



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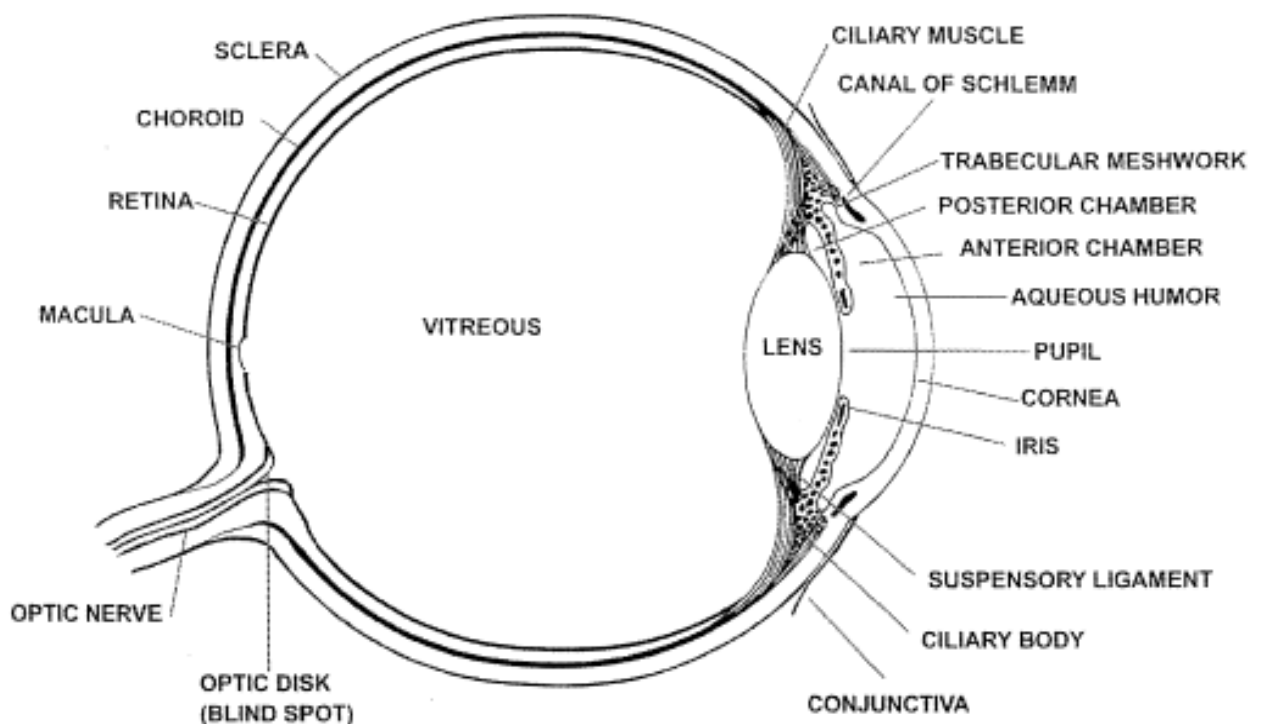
# 1. Basic Eye Anatomy

The eye is an organ that focuses incoming light onto sensitive nerves, which transmit this information to areas within the brain to provide the sensation of sight.

Vision is a complex and amazing sense which relies on the eyes, connections with the brain along the visual pathway and many brain areas to function normally.

Basic anatomy of the eye and visual pathway is briefly outlined below.

## The Anatomy of the Eye



The eye sits in a bony socket known as the **orbit**. The orbit surrounds the eye, providing support and protection. The orbit also contains a layer of fat which acts to cushion the eye.

The **eyelids** are folds of skin that cover the orbit and eye. They protect the eye via the blink reflex - closing when the eye is threatened. The

eyelids also ensure the anterior structures of the eye remains moist by spreading tears over the surface of the cornea with each blink.

The **conjunctiva** is a clear layer which lines the inner eyelids and then bends back over the surface of the eye, terminating at the cornea. The conjunctiva secretes oil and mucous which keep the cornea moist and clean; this also acts to reduce friction between the eyelids and the cornea.

The **sclera** is the tough white outer coat of the eye.

The **choroid** is a layer of blood vessels and tissue that lies between the sclera and retina, providing nourishment for the outer layers of the retina.

The **extraocular muscles** surround the outside of the eye and are responsible for eye movement. Each eye has six extraocular muscles.

The **cornea** is a transparent circular disc located at the front of the eye, through which light passes. It is made up of five layers of cells and has two roles - rigidity for protection and transparency for the transmission and refraction of light. Most of the refraction of light entering the eye occurs at the cornea. If the surface of the cornea is too curved, too flat or uneven, refractive errors will result; this includes longsightedness (hypermetropia), shortsightedness (myopia) and particularly astigmatism.

The **iris** is the coloured circular muscle visible through the transparent cornea. It contains a central opening called the pupil. The diameter of the pupil varies greatly in size under different conditions, e.g. pinpoint in bright light to widely dilated in the dark. It thus regulates the amount of light enters the eye.

The **lens** is a clear, biconvex structure that sits behind the iris. It is responsible for focussing to give clear vision up close.

The **ciliary body** surrounds the lens. It contains the ciliary muscle which contracts or changes in bulk to allow the lens to become more convex to keep the eye in focus for near objects. The lens does about 40% of

the refraction of light entering the eye, with the cornea providing about the other 60%.

The **aqueous humour** is a clear fluid that is formed by the ciliary body, which circulates and then drains from the anterior part of the eye. It creates a pressure inside the eye, and blockage of aqueous humour drainage causes the pressure inside the eye to increase – this is known as glaucoma.

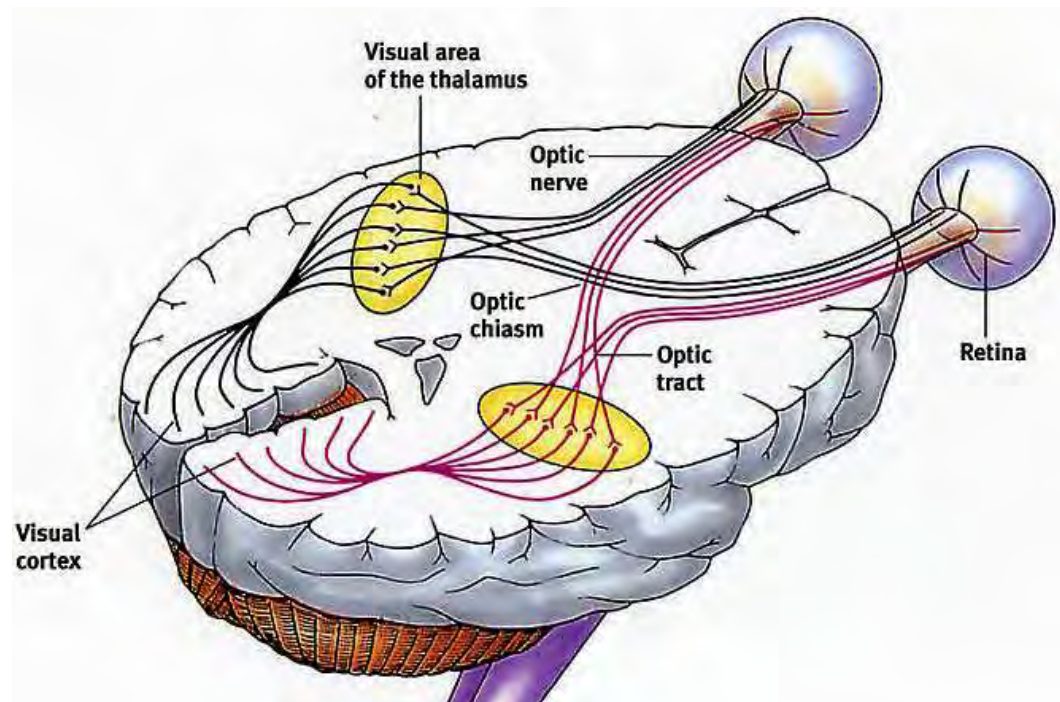
The **vitreous humour** is a transparent, colourless jelly-like substance which fills the posterior part of the eye, between the lens and the retina. It consists of 98.5% of water and allows an undisturbed path for light rays. It lies in contact, but with only slight adherence to the retina. It acts as a support mechanism for the retina, and provides a buffer in the event of external pressures.

The **retina** forms the inner coat of the eye and is concerned with the reception of the images of central and peripheral vision. The retina contains two types of cells - cones for fine quality vision and colour vision, and rods for peripheral and night vision.

The **optic nerve** forms where the fibres from the retina meet at the optic nerve head, also known as the optic disc. The visual fibres leave the eye in the optic nerve and this begins the **visual pathway**.

The visual pathway is highly complex and travels through the main areas of the brain to terminate at the occipital lobe, also known as the **visual cortex**. The eyes act like a camera, with the retina being the film. It is not until impulses are received at the visual cortex that seeing occurs.

## **The Eyes and the Visual Pathway**



## **2. The role vision plays in child development**

The eyes develop from about 6 weeks gestation so if there is something wrong with the eyes or vision this can indicate that the baby will be born with other problems such as neurological conditions.

Babies are born being able to see and use their vision to explore the world before they are moving around or reaching out to things that interest them. Visual information is used with the other senses as the baby begins to understand the environment.

Vision is very important for normal development in all areas including socialization, cognition, motor & communication. Many aspects of development depend on or are guided by vision. When a baby/child has vision impairment all aspects of their development can be affected.

### 3. Normal Visual Development

Understanding the stages of normal visual development will help to identify when vision impairment is present, by the baby/child not reaching developmental milestones on time. Normal visual development is summarised below:

Age	What the baby/ child can see /do
<b>Birth</b>	<p>Babies are able to see at birth although their vision is rather poor, especially for far distance</p> <p>The baby's eye is small, about 78% of potential adult sized eye</p> <p>The response of the pupil to light is present, and the pupil is relatively small</p> <p>The baby will fixate or watch a face 30 seconds after birth using jerky eye movements</p> <p>The baby is able to follow a moving target over a short distance at 9 minutes after birth</p> <p>The baby will stare at their surroundings when awake</p> <p>Random eye movements may be present</p>
<b>4-6 Weeks</b>	<p>The baby can direct their eyes towards a light and will shut their eyes tightly to a bright light</p> <p>The baby may turn their eyes or head to a noise, and fix on their mother's face whilst feeding</p> <p>The baby is fascinated by facial movement, and will look away from negative, expressionless faces</p> <p>The baby may change its facial expression when looking at a human face</p> <p>The baby's original random eye movements should have settled.</p> <p>The baby's eyes should look straight most of the time, however the baby may be observed to go cross eyed for brief periods</p> <p>The baby will be interested in black and white objects, not showing a preference for coloured objects</p> <p>The baby's pupils should react normally to light</p> <p>The baby will show a blink reflex – that is, closing the eyes to a vision threat</p> <p>By 6 weeks the baby is able to look up and down</p> <p>Smiling occurs around 6 weeks</p>



<b>12 Weeks</b>	<p>The baby is visually alert and is able to following moving objects with smooth eye movements</p> <p>The baby shows interested in objects particularly human faces and accurately follows human movements</p> <p>The baby is beginning to become interested in their own reflection</p> <p>The baby's focusing or accommodation is fully functional, allowing for high quality near vision</p> <p>The baby begins to show preference for coloured stimuli over grey stimuli</p> <p>The baby begins to reach for visually stimulating objects</p> <p>The baby will look at their own hands and fingers for long periods</p>
<b>6 Months</b>	<p>The baby is visually alert, attentive for all distances, and curious about their environment</p> <p>The baby's distance vision is improving</p> <p>The baby will move its eyes and head in all directions, eye movements are fully developed</p> <p>The baby shows skill in using vision to locate and reach for objects of interest</p> <p>The baby is able to converge easily and is showing signs of binocular vision developing</p> <p>The baby's vision acuity is approximately 6/36</p>
<b>12 Months</b>	<p>The child shows sustained vision interest for all distances</p> <p>The child shows interest in other children</p> <p>The child sees small, detailed objects well, and recognises familiar figures in the distance</p> <p>The child crawls towards things &amp; avoids obstacles in their path</p> <p>The child stops while crawling to investigate small objects and will pick up things like crumbs, dust and thread (8-9 months)</p> <p>The baby's vision acuity is approximately 6/12</p>
<b>2 Years</b>	<p>The child shows interest in objects far away</p> <p>The child's binocular vision is established</p> <p>The child's vision acuity is approximately 6/6</p>
<b>4-6 Years</b>	<p>The child's vision is 6/6</p>
<b>8 Years</b>	<p>The eye is adult size and vision development is complete</p>

Understanding the behaviour of sighted babies and young children will help identify when they may have vision impairment. For example when a new toy is presented to a sighted baby or young child, if they are interested they will:

- Control their gaze to focus on & follow the object
- The older child may reach to get hold of the object
- The older child may crawl or walks towards the object
- The older child may engage with other people such as their mother during the activity, e.g. smiling at the mother

**When a baby has vision impairment they:**

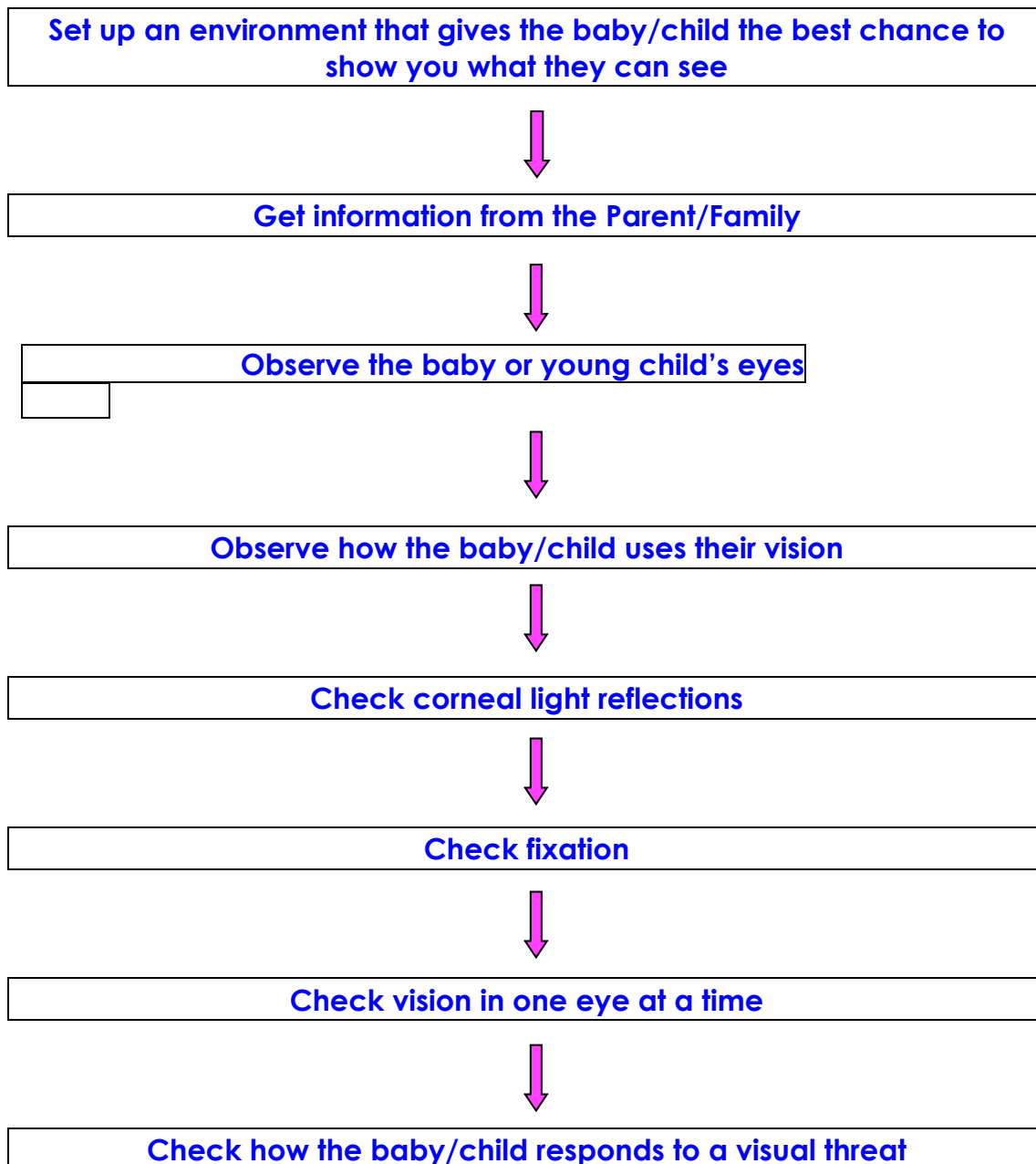
- May not seem to look at things or make eye contact
- May not accurately reach for objects
- May not have coordinated eyes
- May have frequent horizontal or vertical jerky eye movements (nystagmus)
- May not smile by 6 weeks
- May have sensitivity to bright light

**When an older child has vision impairment they:**

- May have started blind behaviours such as eye poking, rocking and head nodding
- May have poor imitation of facial expressions
- May have delayed speech
- May not be able to move about freely, especially in dim light
- May have poor posture such as leaning backwards when walking without holding their head up; seem to walk in a strange way; have floppy hands
- May not cope with different levels e.g. steps & kerbs
- May have difficulty with sleeping

## 4. Deciding if a Baby/child can see

Trying to decide if a baby/child can see can be tricky. The following should be used together to reach a decision. These include:



## **Set up an environment that gives the baby/child the best chance to show you what they can see**

Things to think about before you start:

- Perform testing indoors to avoid direct glare from sunlight
- Wear plain clothes without patterns so that what you use to test will have good contrast with your clothes
- Try to find out from the parents/family the best time of the day to test the child, when they are relaxed and alert. Try to test them then if possible
- Test where it is quiet so the baby/child isn't distracted by noise apart from what you make
- Position the baby or young child's head and body so they are supported and comfortable, facing you, away from the glare of windows
- When you are testing the baby/child remember that you might be a stranger and they will need to get used to you
- Watch for signs that the baby/child needs a rest or is getting distressed
- If the baby/child becomes distracted or unsettled, allow them to participate in another activity for a while, e.g. allow them to crawl or walk about, before coming back to formal testing.
- Often the baby/child will be more interested to look at in their own toys or familiar objects like a dummy or bottle. Find out from their mother what are their favourite things or things that give them comfort, and use these when testing

## Get information from the Parent/Family

Parents and family can provide valuable information about what the baby/child can and can't see. It is helpful to ask them questions which will provide this information. These include:

- Are the parents/family concerned about the baby/young child's eyes or vision & what are the concerns – ask them to fully describe what they have noticed; ask them if this is different to what they have noticed with other children?
- What does the parent/family think the baby/child can see at the moment?
- Birth history: was the baby/child born on time or born early? Did the baby require any special care at or soon after their birth? What was this care? Did the baby suffer any trauma at their birth?
- General health: is the baby/child well at the moment? Has the baby/child suffered any major trauma or illnesses in their life & if yes, what were these? Are there any concerns with the baby/young child's general development? If yes, what are the concerns?
- Family History: is there anyone in the family with any type of eye problem? If yes, what is the eye problem? Is there anyone in the family who is blind?

## Observe the baby or young child's eyes

The observations you make are very important. This includes checking for signs of obvious eye disease and watching how the baby/child behaves and uses their vision.

The baby/child's eyes should be observed. Often children who have a disability will look different.

The eye should be observed for the following:

- Eyelid position: do both eyelids cover the same amount of the eye?
- Eye lashes: are any eyelashes touching the surface of the eye?
- Eye size: do the eyes look the same size and shape?
- Iris: are the irises the same colour & have the same markings?
- Pupils are they both round, the same size & colour?

## Observe how the baby/child uses their vision – Visual Development

How well the baby/child can use their vision should be observed. The following table can be used as a check list.

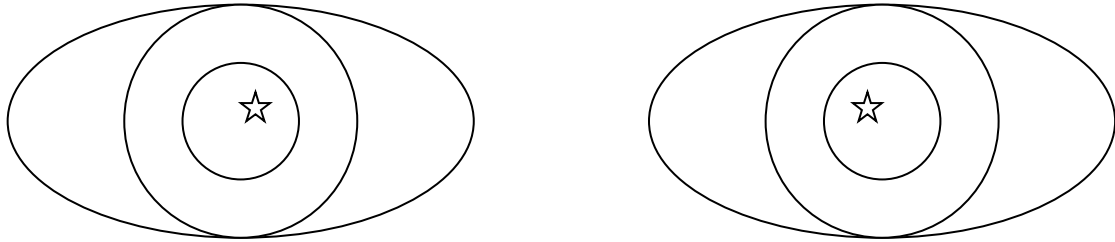
Age	What the baby/child can see & do	Yes	No
<b>Birth to 3 weeks</b>	The baby looks at faces The baby follows a target The baby stares at their surroundings when awake		
<b>4-6 Weeks</b>	The baby will look at light The baby will close their eyes if the light is bright The baby will turn their eyes or head to a noise The baby's eyes look straight most of the time The baby has a blink reflex By 6 weeks the baby is able to look up and down By 6 weeks the baby is smiling		
<b>12 Weeks</b>	The baby can follow a moving objects with smooth eye movements The baby is interested in objects particularly human faces The baby is beginning to become interested in their own reflection The baby begins to reach for visually stimulating objects The baby will look at their own hands and fingers for long periods		
<b>6 Months</b>	The baby is interested in all of their environment The baby can move its eyes and head in all directions The baby reaches for interesting objects		

		Yes	No
<b>12 Months</b>	<p>The child is interested in all of their environment</p> <p>The child is interested in other children</p> <p>The child can see small, detailed objects well easily</p> <p>The child can see familiar things that are located at a distance</p> <p>The child crawls towards things &amp; avoids obstacles in their path</p> <p>The child stops while crawling to investigate small objects and will pick up things like crumbs, dust and thread</p>		



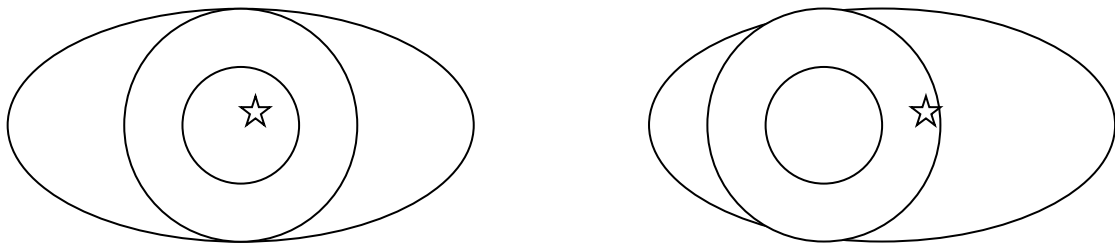
## Check Corneal Light Reflections

When light shines on the eyes it is reflected back off the cornea – this is known as the corneal light reflection. When the eyes are straight the corneal light reflection is found in the same place in both eyes:



**Straight Eyes with equal corneal light reflections**

When the eyes are not straight - i.e. one eye is turning, known as a strabismus, the corneal light reflection is found in a different place on the eyes:



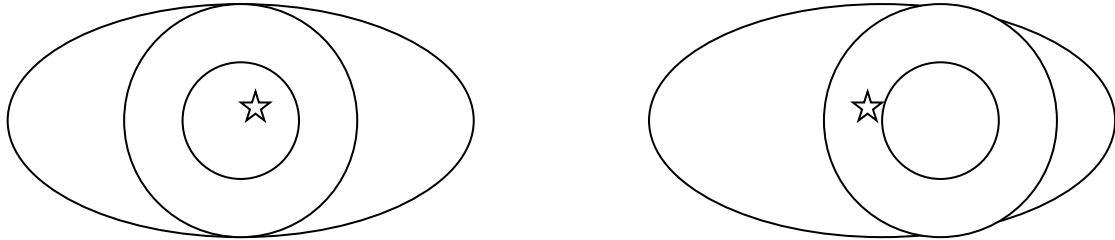
**Left eye turning inwards**



**Left eye turning inwards - Left Esotropia**



### **Right eye turning inwards - Right Esotropia**



### **Left eye turning outwards**



### **Child with outwards turn - exotropia**

It is important to look at a baby/child's corneal light reflection to judge if the eyes are straight. It may not be possible to tell this just by looking at the eyes, as some babies and young children have a wide bridge to their nose. This can make them look like they have a strabismus when in fact their eyes are straight.



**Child with wide bridge to their nose which causes the eyes to look crossed.**

Babies and young children with vision impairment often have a turned eye or strabismus.



**Child with strabismus and vision impairment**

## Testing the Corneal light reflection

### Aim

To judge if the baby/child has a turned eye or strabismus

### Equipment

Small torch, light from the ceiling lights or a window

### Procedure

- Hold the torch level with the eyes at about 30 cms away or look at the reflection of the light from the ceiling lights in the child's eyes; observe the position of the corneal light reflection in either eye
- If a torch is not available then take the baby/child to a window and observe the position of the corneal light reflection in either eye, using the light from the window
- Compare the position of the corneal light reflection in one eye to the other.

### Result

Corneal light reflection is in the same place in both eyes	The eyes are probably straight
Corneal light reflection is in a different place in both eyes	There is probably an eye turn or strabismus. There may be poor vision in the eye with the strabismus.

## Check Fixation

Fixation means being able to move your eyes to look at an object and shows that the baby/child can see – however it doesn't show how much they can see. Babies and young children with vision impairment may not be able to fixate at all, or fixate for very short periods of time.

### Aim

To judge if the baby/child can fixate or look at things

### Equipment

Your smiling face, the mother's smiling face, a toy or object that is familiar to the baby or young child

### Procedure

- Hold the target at about 30cms from the baby or young child's face, without making any sound
- Watch the baby or young child's eyes for signs that they have moved their eyes to fixate on or look at the target
- Move the target slightly & watch the baby or young child's eyes to check they keep watching the target for a short period of time

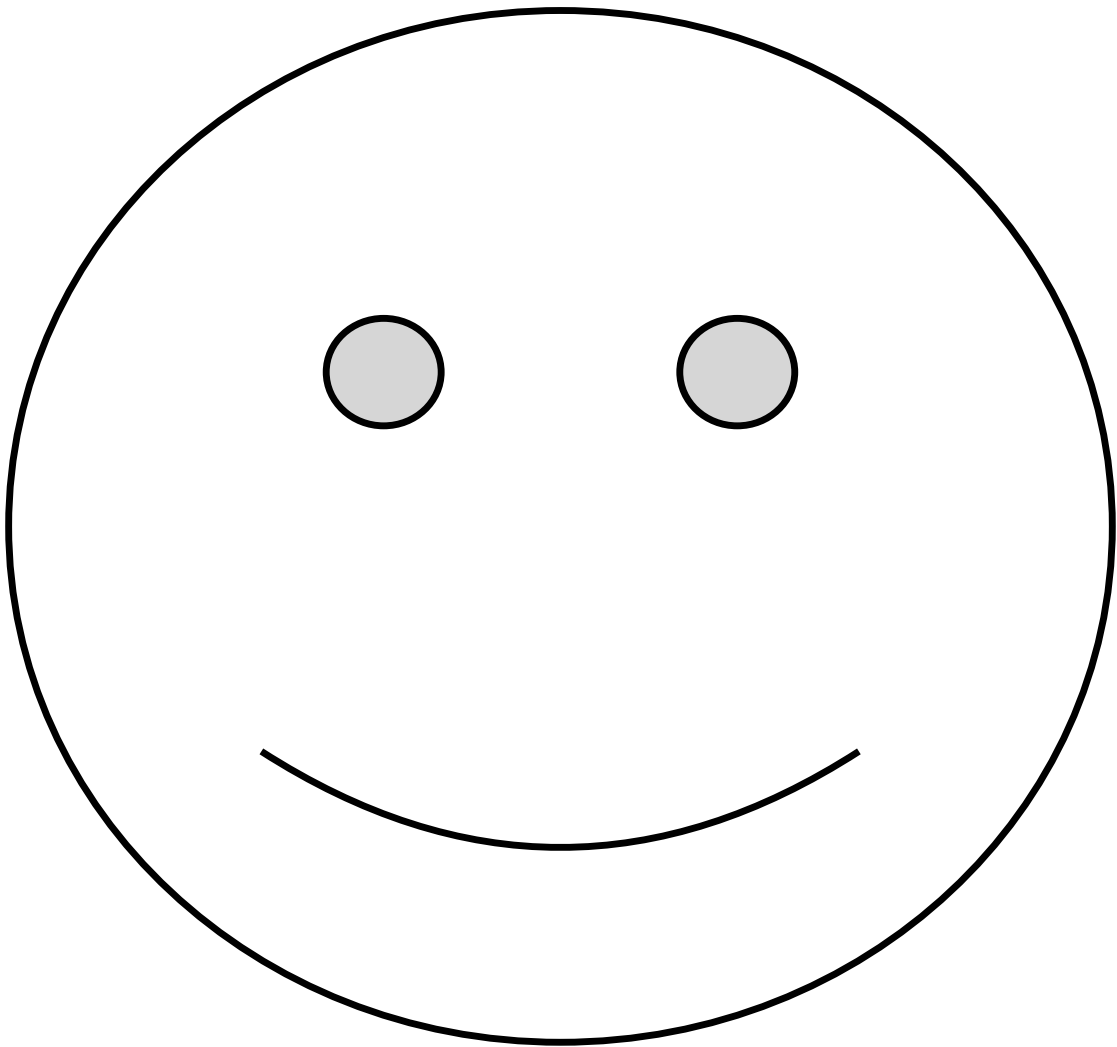
### Result

Baby/child is able to fixate on the target	Vision is present
Baby/child is not able to fixate on the target	There may be a vision impairment

## Babies showing fixation on black and white images



If a baby is not interested in familiar toys, objects, your face or their mother's face, try this black and white face. Move it slowly past the baby's face without making any noise & watch the eyes to see if they move to fixate on the face.





## Check vision in one eye at a time – Vision in One Eye Test

### Vision in One Eye Test

#### Aim

The Vision in One Eye Test aims to find a possible difference in the vision of one eye compared to the other eye, by observing the child's behaviour to looking with each eye, one at a time.

The test provides a very basic idea if the child can see with each eye, and can indicate when the child has poor vision, especially in one eye. A child will often respond badly when made to look with an eye that doesn't see well – they may cry, get upset, and pull away.

#### Equipment

Your hand

#### Procedure

This test is easiest performed with the parent or carer holding the child comfortably in their lap. The tester covers one of the child's eyes with their hand. The fingers of the hand should be closed so the child can't peek through the fingers.

The tester should move their hand from above the child's head & down to cover the eye. This is less distracting than moving the hand up at the child's face. The tester observes the child's behaviour when looking with the uncovered eye.



Covering one eye naturally slightly disturbs children so it is a good idea to entertain the child with some type of target, e.g. a squeaky toy. This helps to distract the child's attention from the covered eye, so the child's ability to see with the other eye can be judged.

The child in the photo below doesn't mind looking with her left eye – indicating she probably has good vision in this eye. However, when the left eye is covered to make her look with her right eye she pulls away. This indicates she probably doesn't have good vision in her right eye.



### Result

Upset when looking with right eye, ok when right eye is covered	Vision in right eye probably not as good as vision in left eye
Upset when looking with left eye, when left eye is covered	Vision in left eye probably not as good as vision in right eye
Upset when looking with either eye	May not like having eyes covered – not able to draw a conclusion about vision in either eye
Happy when looking with either eye	Vision in right eye and left eye probably the same & a good standard

## Check how the baby/child responds to a visual threat – the Blink Reflex

### The Blink Reflex Test

#### Aim

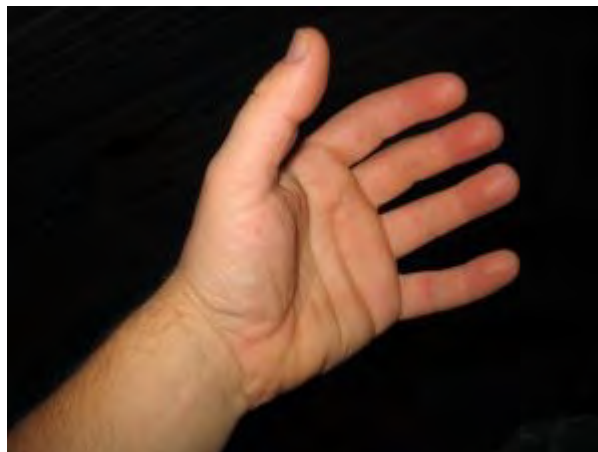
When vision is present the eyes will naturally close when something comes at the face that could cause damage, i.e. a visual threat. Babies and children who have vision impairment in both eyes may not show this response to a visual threat.

#### Equipment

Your hand

#### Procedure

Bring your hand with your fingers spread out, towards the baby or child's face. Don't move your hand too fast as it will create wind which the baby or child may close their eyes to. Do this at least 3 times and watch the baby/child's reaction.



#### Result

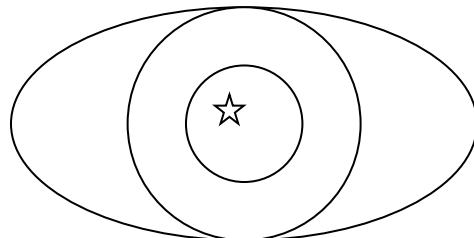
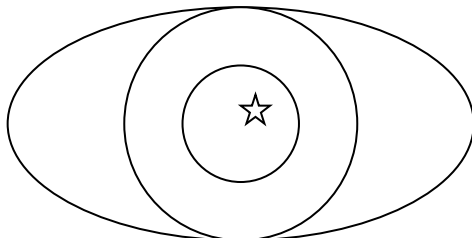
Blinks straight away to hand	Vision is present
Blinks after a few seconds or blinks only sometimes	Vision may be poor
No blink with repeated hand movements	Could have a vision impairment

## Checklist for Vision in Babies and Young Children

### Information from the Parents and Family

Parent/family concerns	
What can the baby/child see	
Birth history	
General health	
Family history	

### Observe the eyes



### Checklist for what the baby/child can see & do

	Yes	No
<b>Visual Development</b> Appropriate for age		
<b>Corneal light reflections</b> Same in both eyes		
<b>Fixation</b> Baby/child is able to fixate on the target		
<b>Vision in One Eye Test</b> Vision appears equal between the eyes		
<b>Blink Reflex Test</b> Blinks both eyes to a visual threat		

## 5. Common Eye Problems

The following common eye problems are described as a parent may notice them or something about the baby's or young child's behaviour that shows there may be a problem with the eyes or vision.

**Leukocoria** is the term used to describe the appearance of a white pupil. This may be observed in one or both eyes. Leukocoria is considered a warning sign due to the conditions it is frequently associated with. The pupil in babies is small naturally, so leukocoria is often difficult to see.



Leukocoria in the left eye

### Conditions associated with Leukocoria

**1. Congenital cataracts** are opacities within the lens. They can be unilateral or bilateral, occurring from or shortly after birth. They can be associated with significant vision deprivation; approximately 10% of blindness in children worldwide is caused by cataract. The incidence of congenital cataract is about 1:250 births.

The cause for about one third of congenital cataracts is not known. Congenital cataracts are common in conditions such as Rubella Syndrome, Toxoplasmosis, and Downs Syndrome. It is also quite common for children with other eye conditions to develop cataracts, and when a child has a moderate to severe eye injury at any age.

**2. Retinopathy of Prematurity:** occurs in preterm babies and is caused by an abnormal response of retinal blood vessels which can lead to severe vision impairment.

**3. Retinoblastoma:** is the most common malignant eye tumour of childhood, and is the third most common form of childhood cancer.

When left untreated retinoblastoma can spread and ultimately result in death of the child. Children can be born with retinoblastomas or develop them within the first 3 years of life, with one or both eyes being affected.

## Watery Eye

Watery eye is most commonly caused by a blocked tear duct.



However some cases of congenital glaucoma in which the pressure in the eye becomes abnormally high, can also present as a very watery eye.



Child with Congenital Glaucoma



## One eye looks different to the other

Parents often say that one eye looks different to the other. This can occur for a variety of reason:

**1. Strabismus:** squint or turned eye results when there is a disturbance to one of the external eye muscles. The eye can turn in, out, up or down.



**2. Coloboma:** is usually noticed by an abnormally shaped iris, often known as a “keyhole” pupil. Other eye structures may also be affected and the vision may range from normal to severely impaired.



**3. Heterochromia:** refers to different colours within the iris. All or part of one eye can be affected so it is a different colour to the other eye.



**4. Anisocoria:** refers to the pupils being different sizes when one eye is compared to the other.





## One eye is bigger or smaller than the other eye

Parents may say that one eye look larger or smaller than the other eye. This may be caused by:

**1. Ptosis:** occurs when one or both upper eyelids hang down. When both eyes are affected children may put their head back to look under the lids. When only one eye is affected it can appear that the eye is bigger or smaller



**2. Microphthalmos:** occurs when the eyes are anatomically smaller than normal; this can occur in one or both eyes.



## **My Child doesn't look at me**

When a parent says that their baby/child doesn't look at them it may indicate a moderate to severe vision impairment.

**1. Delayed Maturation of Vision** occurs when the vision system is slow to mature. The baby can appear to be blind and then slowly vision will develop.

**2. Congenital Nystagmus** refers to an involuntary rhythmical movement of the eyes, usually from one side to the other

**3. Cortical Vision Impairment** results when the eyes are normal but the vision cortex is not functioning properly. This is most common in children who have been born prematurely.

## **Refractive Errors or needing glasses**

Refractive errors occur when the light rays entering the eye do so in an abnormal way, causing blurred vision. The most common refractive error in children is hypermetropia or longsightedness, which when significant can affect distance vision. Myopia or shortsightedness is less common in children and affects distance vision. The amount of refractive error present across the eye can vary and this is known as astigmatism. The amount of refractive error can be the same in either eye, or very different.

It is estimated that approximately 5% of preschoolers have refractive errors. Refractive errors are one of the most common causes of mild to moderate vision impairment in children.

Refractive errors are easily corrected in children with glasses. Because a child has a refractive error it does not necessarily mean they will have to wear glasses as an adult.

It is essential that refractive errors be corrected with glasses, if the refractive error is high enough to pose a threat to the child's normal visual development. Once a child has passed the age of 8-9 years, in most cases they will not damage their eyes by not wearing glasses.

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