

SECTION 2 | explaining the science of blindness and visual impairment

What are the names and functions of the different parts of the eyes?

This section is included for people who are interested in understanding the descriptive terms used throughout the text. Anatomy terms are included, along with the basic function of the various parts of the eye. It may be useful to refer back to this section later as needed.

Eyelids – these protect the eye by blinking, they assist in spreading the **tear film** evenly across the **cornea** and they produce part of the **tear film**.

Third eyelid – also called the nictitating membrane or haw, this structure evenly spreads the **tear film** and removes debris, and it contains a gland which makes part of the **tear film**.

Conjunctiva – this pink-coloured thin mucous membrane lines the inside of the upper and lower **eyelids** and the periphery of the globe. It protects the **cornea** from drying out, and allows the **eyelids** to be mobile. It contains blood vessels which provide nutrition to, and remove waste products from, the eye. It also contains lymph tissue for defence against micro-organisms and foreign substances, nerves, and cells which contribute to the **tear film**.

Tear film – a moist layer present on the surface of the **cornea** and **conjunctiva** which is essential to the health of the front surface of the eye. It smoothes out any irregularities on the **cornea** allowing for sharp vision, it provides nutrition and oxygen to the **cornea** and thus helps it to stay transparent; it removes debris and foreign material from the front surface of the eye and contains immunoglobulins (antibodies) which help to protect against infections.

Cornea – this is the clear transparent tough outer part of the eye (the outer ‘window’) which together with the **sclera** maintains the shape of the eye, provides support for the structures contained within it, and transmits light into the eye.

Sclera – this is a continuation of the **cornea** and is the white of the eye. This tough outer layer protects the contents of the eye and provides its shape.

Limbus – this appears as a black line and is the junction between the **cornea** and the **sclera**.

Anterior chamber – this is the space within the eye between the **cornea** at the front and the **iris** at the back, and it contains clear **aqueous humour**.

Posterior chamber – this term is often used incorrectly to describe the chamber at the back of the eye, which is actually the **vitreous** chamber containing **vitreous** (see below). The **posterior chamber** however is actually the small space behind the back of the **iris** and the front of the **lens**. It is a very important area involved in the circulation of the **aqueous humour** which it contains.

Aqueous humour – this transparent fluid fills the anterior and **posterior chamber**. It is made by the **ciliary body** and drained through the iridocorneal (drainage) angle. It is responsible for providing essential nutrition and oxygen to the delicate internal structures of the eye and it absorbs waste products.

Iris – the coloured part of the eye. This structure provides control over the amount of light entering the eye with **iris** movement by constriction (**pupil** getting smaller) or dilation (**pupil** getting larger). In bright light, the **pupil** constricts to allow less light to

enter the eye which protects the sensitive **retina**, and in low light the **pupil** dilates to allow more light to enter the eye.

Pupil – this is not a structure but is actually a space in the **iris**. In the cat, a constricted **pupil** is slit-shaped, but a dilated **pupil** is round.

Ciliary body – this structure is located behind the **iris**. It makes the **aqueous humour**, provides a barrier from the body's blood supply to protect the eye and provides ciliary **zonules** which attach to the **lens** and hold it in place.

Choroid – a layer of blood vessels between the **sclera** and **retina**, which also contains the **tapetum**. This structure serves the **retina** by providing nutrition and removing waste products.

Tapetum – a layer within the **choroid** and underneath the **retina** which acts like a mirror, affording animals better night vision. Light which is not absorbed by the **retina** passes through to the **tapetum**, where it is reflected back onto the **retina** for a second chance at being absorbed by the rods and cones.

Iridocorneal angle (drainage angle) – this is the space at the base of the **iris** through which aqueous fluid exits the eye. It contains pectinate ligaments with spaces in-between them.

Lens – the **lens** is a transparent spherical structure which changes thickness to allow an animal to focus on objects. In cats, the thickness of the **lens** does not alter as much as it does in people, but it still has a very important function in focusing light rays onto the **retina**.

Zonules – these fine hair-like structures grow from the **ciliary body** and attach to the **lens**, keeping it in place.

Retina – this important layer lies at the back of the eye. It contains the rods and cones which are essential for vision. These change light energy into chemical energy and then into electrical energy which is then transmitted through the **optic nerve**. The **optic nerve** leaves the back of the eye to travel to the brain where the information it carries is interpreted as vision and light.

Vitreous – transparent gel which fills the main part of the eye, where it transmits light, supports the **retina** and helps maintain the shape of the eye.

Optic nerve – the nerve endings of the **retina** converge at the back of the eye to make the **optic nerve**, and the impulses generated by light and vision are transmitted through the **optic nerve** to the brain.

Why is my cat blind?

There are many reasons that your cat may now be blind, or severely visually impaired. The most common reasons are listed below. Some cats are born blind, and know no different. Others were normally sighted, but through injury or disease become blind later. The onset of blindness can be very sudden – literally overnight in cats with **retinal detachment** due to **hypertension** (high blood pressure) or very gradual, for example in cats with chronic **uveitis** (long-standing **inflammation** inside the eye). Cats which are suddenly blind will be more obviously affected by the change than those in which blindness progresses gradually. This is because the change is more sudden to them. The learning curve is sharp in these circumstances, but it is important not to under-estimate your cat. Their ability to adapt to such changes

can fill us with feelings of admiration and pride. Cats which slowly become blind can fool you into thinking they can still see beyond the time that your veterinarian tells you that there is no vision at all. They can show very convincing signs of seeing, but in some cases all tests have proven that there is no sight whatsoever. Even cats which have had both eyes removed and therefore positively cannot see, can give an owner a feeling that they retain some visual perception. This is because they learn to cope with their new circumstances using their great memory. They are greatly aided by their amazing instincts, and by features such as their super-sensitive whiskers. This is discussed later.

What causes blindness in cats?

There are many causes of blindness in cats. The cause cannot always be determined despite yours and your vets every effort, but should be investigated every time to ensure the best for your cat.

The most common causes of blindness in cats are discussed below and there are accompanying photographs to illustrate some of the conditions.

1. Hypertension (high blood pressure)

Just as people can suffer from **hypertension**, older cats can too. They may have high blood pressure because of another health condition, or it may arise spontaneously. **Hypertension** causes damage to blood vessels which can result in **retinal detachment**, with or without bleeding into the eye. The early signs can be seen by your vet when they examine the **retina** allowing a

Right: **Hypertension** – both **pupils** are dilated, but the right eye is full of blood. The **retina** of the left eye can be seen and there are signs of impending **retinal detachment** due to high blood pressure. However with immediate treatment, vision can be maintained.

diagnosis of **hypertension** to be made. The diagnosis can be confirmed by measuring your cat's blood pressure. Measuring blood pressure is a routine procedure and cats tolerate it really well. It is important to note that not all cats with **hypertension** have eye problems at the time of diagnosis.

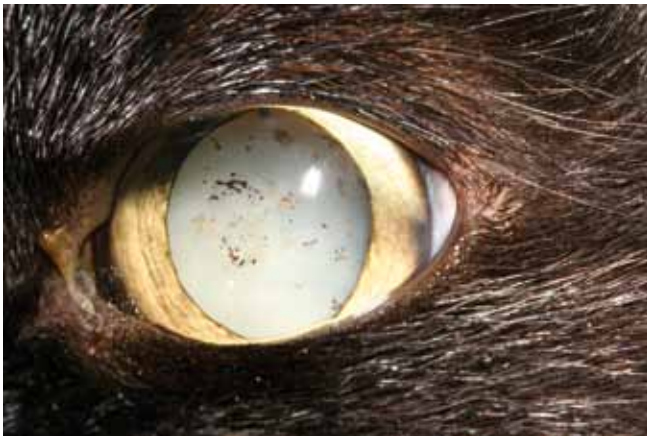
Signs of **hypertension** visible to owners include sudden blindness, dilated **pupils** or blood within one or both eyes. If **hypertension** is diagnosed, anti-hypertensive therapy (medication to lower the blood pressure) can be prescribed. Anti-hypertensive treatments lower blood pressure and prevent further damage to the eyes (and other organs) which can result as a consequence of high blood pressure. Commonly used medications include amlodipine (trade name **Istin** in the UK) and benazepril (trade name **Fortekor** in the UK). Following treatment it is possible for the cat to regain some vision, but this depends on various factors – for example the length of time the **retina** is detached. If vision is restored, it is usually poor, and all sight may gradually be



lost. If a cause of the high blood pressure, such as an overactive thyroid gland (**hyperthyroidism**) or kidney problems (**chronic renal failure**) can be identified, these conditions need specific treatment with medications.

2. Cataracts

A **cataract** is an opacity in the **lens** or in its surrounding membrane. Just as people can develop **cataracts**, so too can your cat. They are not as common in cats as they are in people or dogs. They most often occur as a result of a severe injury or trauma to the eye damaging the nutrition or integrity of the **lens**. Other common causes are secondary to **uveitis** or **glaucoma** (both of these conditions are described below). If a significant **cataract** develops in both eyes, your cat will be blind. The **cataracts** can appear white or grey and can be seen behind the **iris**. An eye with a **cataract** loses the glow that normal cat's eyes have in the dark, as there is no longer a clear view through to the **tapetum** which is the reflective structure lying at the back of the eye behind the



retina. There is a surgical procedure to remove **cataracts** called phacoemulsification which is used in people, and this procedure is now widely performed on animals too at specialist centres. It has its risks and is expensive, but in the right cases it has a high success rate and is a marvellous opportunity to restore sight. Unfortunately not every eye is suitable for this procedure. **Uveitis** and **retinal detachment** are both important contraindications for this surgery – in other words, phacoemulsification surgery can make these conditions worse. Your veterinary **ophthalmologist** will be able to tell you whether this treatment is appropriate for your cat. Unfortunately, there is no non-surgical treatment which successfully improves **cataracts** in animals.

Cataract surgery is discussed in more detail in the section What surgical treatments might be recommended?

3. Trauma

Certain injuries may result in blindness. The most common forms of injury a cat sustains are blunt trauma such as road traffic accidents, or sharp penetrating trauma such as cat claw scratches from another cat, and, unfortunately, gun shot pellets.

Blunt trauma can cause rupture (bursting) of the eye, and this can occur at the back of the eye where it cannot be seen externally. These eyes generally cannot heal themselves and vision is lost. The force may cause **retinal detachment**, as this delicate membrane is torn from its normal position at the back of the eye. The **retina** contains the rods and cones we need for vision, and if it is not attached it loses its blood supply and becomes deprived of oxygen. As a result, the sensitive rods

Left: A long-standing **cataract** (the white structure) with little areas of dark brown pigment on the front of the **lens**.