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How do eyes work?



hen light hits the retina (a light-sensitive layer of tissue at the back of the eye), special cells called photoreceptors turn the light into electrical signals. These electrical signals travel from the retina through the optic nerve to the brain. Then the brain turns these signals into the images you see. There's a helpful YouTube video available online, HERE showing how it works.

Your eyes need tears to work correctly. Tears keep your eyes wet and smooth and help focus light so you can see clearly. They also protect your eyes from infections and irritating things, like dirt and dust. Every time you blink, a thin layer of tears called a "tear film" spreads across the surface of your cornea (the clear outer layer of the eye). Tears come from glands above your eyes, then drain into your tear ducts (small holes in the inner corners of your eyes) and down through your nose. When your eyes don't make enough tears or your tears don't work the right way, you can get dry eyes.

Source: Nation Eye Institute (US), HERE.



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File URL: https://upload.wikimedia.org/wikipedia/commons/e/e8/Eye-diagram no circles border.svg

Caution: No advice is implied or given in articles published by us. This guide is for general interest only. It should never be used as a substitute for obtaining advice from your Ophthalmologist, Optometrist, Optician, Doctor or other qualified clinician/medical practitioner. The facts are believed to be correct as at the date of publication, but there may be certain errors and omissions for which we cannot be responsible. The hyperlinks were valid at the date of publication.

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Eye Tests

Eye testing will take different lengths of time, depending on age and complexity. An eye test will take at least 20 to 30 minutes in most cases. An eye examination is a series of tests performed to assess vision and ability to focus on and discern objects. It also includes other tests and examinations on the eyes. Eye examinations are primarily carried out by an optometrist, ophthalmologist, orthoptist, or optician. Health care professionals often recommend that all people should have periodic and thorough eye examinations as part of routine primary care, especially since many eye diseases are asymptomatic. Eye examinations may detect potentially treatable blinding eye diseases, ocular manifestations of systemic disease, or signs of tumours or other anomalies of the brain.



Why are regular Eye Tests important?*

A complete eye examination consists of an external examination, followed by specific tests for visual acuity, pupil function, extraocular muscle motility, visual fields, intraocular pressure and ophthalmoscopy through a dilated pupil. A minimal eye examination consists of tests for visual acuity, pupil function, and extraocular muscle motility, as well as direct ophthalmoscopy through an undilated pupil.

Source: Wikipedia, HERE.

If you qualify for NHS-funded sight tests but find it difficult to get to the opticians due to a mobility issue or underlying health condition, you can have your eye test at home instead. An at-home eye test of the same quality as an eye test that takes place at a high street optician. Details of this service from Outside Clinic are HERE.

It's easy to neglect your eyes because they often do not hurt when there's a problem. Having an eye test will not just tell you if you need new glasses or a change of prescription – it's also an important eye health check. An optician can spot many general health problems and early signs of eye conditions before you're aware of any symptoms, many of which can be treated if found early enough. The NHS recommends that you should get your eyes tested every two years (more often if advised by your ophthalmic practitioner or optometrist).

In many cases, eye tests are free. If you're not eligible for NHS-funded sight tests or optical vouchers, you'll have to cover the costs yourself. You're entitled to a free NHS sight test if you:

- are under 16
- are 16, 17 or 18 and in full-time education
- are 60 or over
- are registered as partially sighted or blind
- have been diagnosed with diabetes or glaucoma
- are 40 or over and your mother, father, sibling, or child has been diagnosed with glaucoma
- have been advised by an eye doctor (ophthalmologist) that you're at risk of glaucoma
- are a prisoner on leave from prison
- are eligible for an NHS complex lens voucher your optician can advise you about your entitlement

You're also entitled if you or your partner – including civil partner – receive, or you're under the age of 20 and the dependant of someone receiving:

- Income Support.
- Income-related Employment and Support Allowance.

See the complete list on the NHS website HERE.

* Source: https://www.nhs.uk/nhs-services/opticians/free-nhs-eye-tests-and-optical-vouchers/

- Income-based Jobseeker's Allowance.
- Pension Credit Guarantee Credit.
- Universal Credit and meet the criteria.

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Eye Charts

Snellen chart — This is the most common type of eye chart, and it's probably the one you saw at your last eye appointment. The Snellen chart is the only standardised eye chart used by ophthalmologists. It consists of eleven rows of uppercase letters, with the size of the letters decreasing as you move down each row. Usually, you will stand twenty feet away from the chart to determine which lines you can read without corrective lenses.

Tumbling E chart — Dr Hermann Snellen, the Dutch opthalmologist who developed the Snellen chart in 1862, modified his original eye chart so children could take the vision test even if they didn't know their alphabet yet. The Tumbling E chart consists of rows of the capital letter E facing in different directions. A



Picture Credit: "A boy stands next to a tumbling E chart at a screening for children with disabilities." by IAPB/VISION 2020 is licensed under CC BY-NC-SA 2.0

child can point their fingers in the direction of the E to show whether they can properly read the chart. Source: https://www.eyeque.com/knowledge-center/what-does-an-eye-chart-do/

There are many other non-standardised eye charts, including the **ETDRS chart** (Early Treatment Diabetic Retinopathy Study), **Logarithmic Landolt C eye chart** (although it is the standard optotype for acuity measurement in most European countries), and **Lea Symbols** (the original folding distance chart for preschool and kindergarten children and assessment of vision of persons with difficulties in testing based on letters or numbers), all of which are less frequently because they have not been proven to determine visual acuity reliably. For further information, click HERE.

Different Eye Specialists

Ophthalmologists

An ophthalmologist is a medical or osteopathic doctor who specialises in eye and vision care. They differ from optometrists and opticians in their levels of training and in what they can diagnose and treat. As a medical doctor who has completed college and at least eight years of additional medical training, an ophthalmologist is licensed to practice medicine and surgery. An ophthalmologist diagnoses and treats all eye diseases and performs eye surgery, prescribes and fits spectacles and contact lenses to correct vision problems. Many ophthalmologists are also involved in scientific research on the causes and cures for eye diseases and vision disorders.

Ophthalmic Medical Practitioners

An ophthalmic medical practitioner is similar to an optometrist. Both can assess your eyesight, prescribe vision aids and examine your eyes for conditions. Whilst they are medically qualified doctors, they are not equipped to perform surgery on the eye. If surgery is required, they may refer you to an ophthalmologist.

Optometrists

Optometrists, sometimes referred to as *ophthalmic opticians* or *Doctors of Optometry*, are healthcare professionals who provide primary vision care ranging from sight testing and correction to the diagnosis, treatment, and management of vision changes. Their training mainly focuses on the mechanisms of the eye and health care concerning eye problems. An optometrist is not a medical doctor. An optometrist receives a doctor of optometry degree after completing four years of optometry school, preceded by three or more years at college. They are licensed to practice optometry, which primarily involves performing eye exams and vision tests, prescribing and dispensing corrective lenses, detecting specific eye abnormalities, and prescribing medications for certain eye diseases.

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Dispensing Opticians

Dispensing opticians are technicians trained to design, verify and fit spectacle lenses and frames, contact lenses, and other devices to correct eyesight. To qualify as a dispensing optician, it is necessary to register with, complete and pass a General Optical Council (GOC) approved qualification in dispensing optics. Dispensing opticians use prescriptions supplied by ophthalmologists or optometrists, but they don't test vision or write prescriptions for visual correction. They are not allowed to test sight or diagnose and treat eye diseases. Their role is to give you advice and information on vision care and the different types of lenses and frames. In the past, dispensing opticians even made lenses, but today, this is usually outsourced to specialist manufacturers to save time and money.

Orthoptist

Orthoptics is a profession allied to the eye care profession. Orthoptists are the experts in diagnosing and treating defects in eye movements and problems with how the eyes work together, called *binocular vision*. These problems can be caused by issues with the muscles around the eyes or defects in the nerves enabling the brain to communicate with the eyes. Orthoptists are responsible for diagnosing and non-surgical management of strabismus (squint), amblyopia (lazy eye) and eye movement disorders. They work closely with ophthalmologists to ensure that patients with eye muscle disorders are offered a full range of treatment options.

Eye Health

Vision problems can lead to a higher risk of falls, driving accidents, and incorrect use of medications. They can also make day-to-day life harder. The best way to make sure your eyes are healthy is to have regular eye checks. Many eye diseases can be treated if they are detected early. AgeUK provides a wealth of information to assist older people: here's a list of questions commonly asked – click on the hyperlinks below for the answers:

- What are some common eye diseases that can affect me?
- How often should I get my eyes tested?
- What type of glasses is best for me?
- Am I entitled to free eye tests?
- Am I entitled to free glasses?

- How can I keep my eyes healthy?
- What aids can help me at home if I have a visual impairment?
- How can lighting help me if I have low vision?
- How do I register as blind or partially sighted?
- What should I do next?

Despite the coronavirus pandemic and the fears of going into hospital, it is essential to continue attending scheduled eye appointments or to seek advice for sudden changes in your vision. RNIB have more information.

Eye Diseases of Old Age

Certain eye diseases are more common as we age. These include:					
•	glaucoma	٠	cataracts	٠	macular degeneration

Eye diseases don't always cause obvious symptoms. An eye test by an optician is much more than a check to see whether you need glasses – it is also an important check on the health of your eyes. An optician can detect eye diseases at an early stage, usually before you've even noticed any changes. An eye test checks your vision straight ahead, as well as your side (peripheral) vision.

The Association of British Dispensing Opticians (ABDO) represents 6,578 qualified dispensing opticians in the UK. Their website says the leading causes of sight loss – cataract, macular degeneration, glaucoma and diabetic eye disease – are all age-related.

Sight loss already affects 1.8 million people in the UK. Approximately one person in three has some form of vision-reducing eye disease by age 65. RNIB research predicts that by 2050 the numbers of people with partial sight and blindness in the UK will double to nearly four million people, with most people finding their eyesight worsening as they get older.

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Age-related macular degeneration (AMD)

AMD is the leading cause of permanent sight loss. It damages the eye's central vision, causing reading, writing, and other close work problems. However, side vision is retained, which helps when moving around. There are different types of macular degeneration. Find out more about Macular Degeneration.

Risk factors for AMD include advancing age, family history of AMD and cardiovascular risk factors such as hypertension and cigarette smoking. AMD can be divided into two categories: nonexudative (or "dry") AMD and exudative (or "wet") AMD. Research suggests that a diet high in polyunsaturated fats, particularly the consumption of fish rich in these fats, decreases the risk of developing macular degeneration and may slow down the progression of this condition from moderate to severe.

<u>Glaucoma</u>

Glaucoma is a degeneration of a particular type of nerve cells in the eye that results in a loss of peripheral vision and ultimately all eyesight, if untreated. It is more prevalent in older people. There are two forms of glaucoma:

•

- *Open-angle* which is painless and may be treated with eye drops to reduce internal fluid pressure in the eye,
- *Closed-angle* which may be painful because of increased internal fluid pressure and may require surgery to reduce it.

Primary open-angle glaucoma results in optic nerve damage and visual field loss. Because this condition may initially be asymptomatic, regular screening examinations are recommended for elderly patients. Glaucoma can be detected as part of a routine eye test. Untreated, glaucoma can cause you to lose parts of your peripheral vision which can make it hard to get around as the disease progresses. Central vision is less likely to be affected until very late stages in the condition.

Diabetic Eye Disease (Diabetic Retinopathy)

Diabetic eye disease occurs due to diabetic damage to the blood vessels in the retina at the back of the eye. It is more likely to occur if you have had diabetes for several years and is most likely to occur with poor diabetes management. Damage can occur without you being aware of it, or you may have blurred patches of vision. You may find your vision changes from day to day. Once detected, diabetic eye disease can be treated in several ways. Find out more about Diabetic Eye Disease.

<u>Cataracts</u>

A cataract occurs when the lens inside your eye becomes cloudy. It can make your vision blurred and yellowed. You can find bright lights dazzling and have problems with glare on a sunny day or from car headlights. The cloudiness in the lens grows gradually over time. Cataracts can be removed, and the lens replaced to improve your vision. Find out more about Cataracts.

Detached Retina

A detached retina can cause a shadow at the edge of your vision or create an effect like a curtain or debris falling over a large part of your sight in one eye. It is more common in people with moderate to severe short sight because the retina may be thinner than average. You may experience flashes of light or a dramatic increase in 'floaters', black dots in front of the eyes, in the run-up to a retinal detachment. The condition is not painful, but you should get advice straightaway if you have symptoms like this. Find out more about detached retina.

Smoking and Eye Damage

Smoking is one of the leading preventable causes of blindness and, according to RNIB, is the number one threat to the health of your eyes. It can cause macular degeneration and cataracts, two of the leading causes of sight loss. Smoking reduces the blood flow at the back of the eye, which causes damage to the macula, the part of the eye essential for detailed vision. Tobacco smoke contains heavy metals which accumulate in the lens at the front of the eye, leading to cataracts. Innocent bystanders can also suffer - passive smoking can cause almost as many problems for those near a heavy smoker.

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Obesity and Eye Damage

If you are overweight, you can have a high risk of eye problems. Obesity is linked to high blood pressure, high cholesterol, diabetes and heart disease. It has also been recently linked to all the leading causes of sight loss, macular degeneration, diabetic eye disease, cataract and possibly glaucoma. High blood pressure can damage the blood vessels in the retina at the back of the eye. High cholesterol can cause the arteries in the retina to harden and thicken, pressing on and blocking veins, causing fluid leaks at the back of the eye and sight damage.

Common Eye Problems and Care Tips

The Elderly Health Service of the Hong Kong Department of Health has some helpful information about common eye problems and provides tips for coping with them. Ageing can bring about decreased visual acuity and other eye disorders or diseases. By knowing more about different eye problems and adopting proper eye care, we can help to keep our eyes healthy as we grow old.

Common Eye Problems :

- Drooping of Eyelids
- Dry Eyes caused by degenerative change of the tear gland, extremely dry or polluted environment, an eye infection, the side effects of some drugs such as cold tablets, antihistamines, diuretics or preservatives in eye-drops, etc.
- Excessive tearing the leading causes include: drooping of eyelids leading to poor contact between the openings of the tear ducts and the eyeballs, which means tears cannot be drained into the ducts but spill out of the eyes, tear-duct blocks, foreign bodies irritating the eyes, eye infection, etc.
- Presbyopia the eye's lens loses elasticity with age resulting in an inability to focus clearly on near objects. It can happen around the age of 40 and progresses with age, becoming stable at around age 60. Corrective glasses can help correct vision.
- Floaters small mobile, opaque particles in the jelly of the eyeball. They appear as dark spots in the visual field. Floaters are a mostly transient phenomenon. The amount varies with time, and they often disappear spontaneously.

The NHS (HERE) says that you should ask for an urgent GP appointment or call 111 if:

- Your swollen eyelid is red, hot, painful, tender or blistered.
- Your eyelid droops suddenly.
- The pain is in your eye (not your eyelid).
- The white of your eye is very red, in part or all over.
- You're sensitive to light (photophobia).
- Your eyesight changes for example, you see wavy lines or flashing.
- You have a very high temperature, feel hot and shivery, or feel generally unwell.
- You think it's an allergic reaction.

The people at III can arrange a phone call from a nurse or doctor if you need one.

Blurred Vision

It is recommended that you should consult your doctor immediately if any of the following appear:

- Blurred vision not corrected by appropriate corrective glasses.
- Persistent eye pain or acute sharp pains.
- Over-sensitivity to light. Halo or rainbow is seen around lights.
- Partial loss of visual field.
- Red eyes or burning sensation is experienced.
- The sudden appearance of large amounts of floaters or black spots in the visual area.
- Abnormal growth in the eye or on the eyelid.
- The transparent part of the eye looks cloudy.
- Eyes become watery, with persistent discharge or crust.



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Eye Infections

Three common eye infections that are potentially made worse when an older person is bed-bound are blepharitis, blepharoconjunctivitis, and corneal ulcers.

Blepharitis - When Eyelids Become Inflamed

Blepharitis is a condition of the eye that involves inflammation of the eyelids. You can recognise blepharitis when you observe the following:

- Inflamed and swollen eyelids
- Crusty eyelids and eyelashes
- Matting of the eyelids (eyelids getting stuck together) and eyelashes
- A bothersome gritty feeling of the eyes alongside burning sensation
- Soft greasy scales on the eyelids and eyelashes
- Tiny sores that ooze or bleed around the eyelashes and eyelids

Another likely cause is long periods of sleeping during which blinking does not occur. Blinking refreshes our eyes with a fresh coat of tears filled with the essential oils secreted from glands inside our eyelids.

Blepharitis is often a chronic condition that's difficult to treat. It can be uncomfortable and unsightly. But it usually doesn't cause permanent damage to your eyesight, and it's not contagious. While blepharitis is a condition that cannot be cured, it can be controlled. The primary treatment for blepharitis is good eyelid hygiene and eliminating environmental factors that trigger the disease. Mayo Clinic (HERE) suggest treatment can be as simple as self-care measures, such as washing your eyes and using warm compresses. If self-care measures aren't enough, your doctor might suggest prescription treatments, including:

- Antibiotics applied to the eyelid have been shown to provide relief of symptoms and resolve bacterial infection of the eyelids. Antibiotics are available in several forms, including eye drops, creams and ointments. If the eyelids don't respond to topical antibiotics, your doctor might suggest the alternative of an oral antibiotic.
- Blepharitis caused by seborrheic dermatitis, rosacea or other diseases might be controlled by treating the underlying condition.
- Steroid eye drops or ointments are used to control inflammation, generally only for people who don't respond to other therapies. Your doctor might prescribe both antibiotics and anti-inflammatory drugs.
- Topical cyclosporine (Restasis) has been shown to offer relief of some signs and symptoms of blepharitis.

Blepharoconjunctivitis

When blepharitis is severe or left untreated, it can turn into blepharoconjunctivitis. As the name implies, this condition consists of a combination of blepharitis and conjunctivitis. Conjunctivitis is a general term indicating an irritation and inflammation of the *conjunctiva* (the thin, clear layer of tissue covering the white part of your eye). Blepharoconjunctivitis occurs when the bacteria that have caused the infection in the eyelids also infect the *conjunctiva*.

Because the disease can have a variety of causes, treatment for blepharoconjunctivitis is typically tailored to the individual's circumstances. However, the treatment for blepharoconjunctivitis is very similar to blepharitis alone.

Corneal Ulcers

Also known as infectious keratitis, corneal ulcers caused by infection are characterised by open sores on the eye surface caused by a virus, fungus, parasite, or bacteria. While a corneal ulcer can be caused by dry eye or other eye issues, they are usually caused by or are associated with some type of infection. It is important to note that a corneal ulcer is a potentially vision-threatening emergency.

Treatment needs to be started as soon as possible, as patients have a high risk of developing other complications, including vision loss, cataracts, glaucoma, and more severe damage to the cornea.

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Corneal ulcers are usually associated with the following symptoms:

- Severe pain in the eye.
- Eye irritation and the feeling of something stuck in your eye.
- A white spot in the cornea that may or may not be visible.
- Discharge from the eye.
- Excessive tearing.
- Blurry vision.
- Light sensitivity.
- Redness of the eye.

Depending on the type of infection, the treatment of choice is usually an antibiotic, antiviral, or antifungal eye drop. Other less used medications include pain medications, antifungal tablets for fungal infections, and certain injectable medications.

Other eyelid problems* include the following:

<u>Ptosis</u>

Over time, the upper eyelids may start to sag as the muscles supporting them lose their strength. Eye injury, nervous system problems, and disease (such as diabetes or myasthenia gravis) can also cause this condition. Although upper eyelid drooping is often only a cosmetic concern, it can interfere with sight if the lid is so lax that it covers or partially covers the pupil. Before trying any treatment, you will need a medical exam to identify the cause. If a droopy eyelid is unattractive or interferes with your vision and is not caused by a treatable disease, you may want to consider surgical repair. The ptosis repair procedure removes excess tissue and lifts the lid. It can be performed under local or general anaesthesia on an outpatient basis. Many health insurers will cover this operation, but only if the ptosis affects your vision. Your ophthalmologist or oculoplastic specialist can determine whether you qualify for coverage.

Blepharochalasis

When eyelid skin loses elasticity and sags, it creates new folds that can droop over the lashes and block the upper field of sight by covering the pupil. In blepharochalasis, just the skin of the lid begins to droop, not the entire lid as in ptosis. A surgical procedure called blepharoplasty can correct this condition. As with ptosis, most health insurers will pay for this repair only if the condition interferes with vision.

Ectropion

This condition occurs when the muscles of the lower lid weaken, making the lid sag and turn outward, away from the eyeball. As a result, the upper and lower lids no longer meet when the eye is closed, and the eye may tear excessively. The constantly exposed cornea and conjunctiva may become red and irritated. In mild cases, no treatment is needed. You can use over-the-counter artificial tears and a plastic eye shield at night to hold moisture in your eye. If the symptoms or appearance bother you, surgery can tighten the lower eyelid and surrounding muscles. After the surgery, you may need to wear an eye patch for a few hours and apply an antibiotic ointment for a few days.

Entropion

In this condition, the lower lid rolls inward toward the eye. Because the lashes constantly rub against the cornea, entropion may produce irritation, a feeling of something in the eye, tearing, and blurring. In mild cases, it can help to tape the lower lid to the cheek every night, ensuring the edge of the eyelid and the lashes are kept in their proper position. Ask your doctor if this approach might work for you and find out how to do it properly. A surgeon can also correct this disorder with a relatively simple procedure that removes a piece of your lower eyelid to tighten the skin and muscles there. For more information about keeping your eyes healthy, you can buy *The Aging Eye*, a Special Health Report from Harvard Medical School.

 $\label{eq:source:https://www.health.harvard.edu/staying-healthy/the-aging-eye-when-to-worry-about-eyelid-problems$

As if the eye problems listed above weren't enough, there are several others. Here are two more:

Temporal arteritis

Temporal arteritis causes the arteries in the temple area of the forehead, as well as other areas of the body, to become inflamed and possibly obstructed. It can begin with a severe headache, pain when chewing, and tenderness in the temple area. You may have a chronic fever, shoulder or hip weakness, and scalp tenderness.

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It may be followed by sudden vision loss, which is usually permanent. It's more commonly diagnosed in older women. If you have any of these symptoms, see your doctor immediately. Source: https://my.clevelandclinic.org/health/articles/8567-common-age-related-eye-problems

<u>Aniridia</u>

Aniridia is a rare condition where the iris (the coloured part of your eye) has not formed properly, so that it may be missing or underdeveloped. The amount of iris tissue missing will vary from person to person. People with aniridia will often have very large pupils (the hole in the middle of each iris), which may also have an irregular shape because so much of the iris tissue is missing. Some people with aniridia may have more regular looking iris, and the changes are only visible to an eye specialist. Most people with aniridia have a central part of their retina that is not fully developed, and many have nystagmus, a constant and involuntary movement of the eyes. Aniridia affects both eyes, and it is a genetic condition present from birth. A factsheet on aniridia can be downloaded from RNIB, HERE.

Source: https://www.rnib.org.uk/eye-health/eye-conditions

There's a comprehensive list of eye conditions on the RNIB website, HERE.

Dealing with Sight Loss



Picture Credit: "Guide Dogs for The Blind 16" by musgrave_archive is licensed under CC BY-NC-ND 2.0

It is not easy to go through sight loss; you may feel alone and desperate in a world that is suddenly unfriendly. Your usual sources of information, leaflets or the Internet, may be hard to access. People who haven't experienced sight loss may not appear to understand what you are going through, and you may find it harder to get out and see friends, leaving you isolated.

Don't despair: there are services to help. Start by calling RNIB's helpline, 0303 123 9999. RNIB also offer an emotional support telephone service run by a team of telephone counsellors. Through the RNIB helpline or emotional support telephone service, you can be put in touch with support in your local area through befriending or support groups. Everything you share with the trained counsellors is confidential. If you have been diagnosed with eye disease at the hospital, they may have a trained worker to help talk you through what you are experiencing. Ask if there is a patient support service or an eye clinic liaison officer. Find out more about Low Vision and the support available.

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Sources and Further Information

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