Examination of the Eyes

Teaching Set

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1. Anatomy of the Anterior Eye

In order to understand diseases of the eye it is important to know about the anatomy of the eye. Look at the picture on the left. This shows the front part of a normal eye. On the right we see a diagrammatic cut section of the front of the eye.

The white of the eye as seen on the left is the main outer coat of the eye - it is called the sclera. Covering the front part of the sclera as well as the inner surface of the eyelids is a thin membrane called the conjunctiva. This membrane contains many blood vessels and becomes red when inflamed.

At the front of each eye is a disc of clear tissue, the cornea. This is not seen in the photograph on the left because it is transparent, but it is clearly shown in the picture on the right - slightly curved and shown as pale blue in the image.

Behind the clear cornea is the iris with a circular hole in its centre. The hole is the pupil. The iris is seen clearly in the photograph on the left because the cornea is clear. The pupil appears black. The sclera and the iris are opaque - they do not allow light to pass through them. Light enters the eye through the clear transparent cornea and then passes through the pupil.

Between the cornea and the iris is the anterior chamber of the eye.

Behind the pupil is the transparent lens. The lens can change shape and power so that we are able to focus on both near and distant objects.
2. Anatomy of the Eye

Normal Eye in Section

This diagram shows that our eyes are almost round in shape, like a ball.

If we follow the iris to its base (or periphery), we find that it is continuous with a thicker area, the ciliary body, and this, in turn, continues behind as a layer, called the choroid. The iris, ciliary body and choroid form the uvea and are all coloured dark brown in the picture. This continuous layer consisting of iris, ciliary body and choroid, has many blood vessels supplying nutrients to the eye via the blood. The choroid forms the second coat of the posterior part of the eye.

Towards the back of the eye, the innermost layer can be seen. This is called the retina. It is mainly composed of nerve fibres which collect at the back of the eye to form the optic nerve. When light forming the image of an object is focused on the retina, the message is carried to the brain through the optic nerve. We 'see' an object when the message reaches our brain.

The aqueous fluid of the eye is produced by the ciliary processes on the surface of the ciliary body. Aqueous fluid passes through the pupil into the anterior chamber of the eye and most escapes out of the eye at the base of the iris and cornea, through the trabecular meshwork. The vitreous gel fills most of the intraocular space of the posterior eye.
3. Instruments for Examination

Equipment for Eye Examination

Routine **examination of the eyes** requires a vision chart and a few basic instruments. You need a good light and if possible some magnification.

A good torch (flashlight) is obviously important for examining the eye and either a binocular or monocular loupe will magnify details of the front of the eye. A binocular loupe is shown in the picture.

If you have an ophthalmoscope it will allow you to examine the back of the eye and with practice you can recognise features which may suggest diseases such as glaucoma, diabetes and high blood pressure. We shall consider ophthalmoscopy later.

The image also shows a Schiotz tonometer which is used for measuring the pressure inside the eye (intraocular pressure). Ordinary paper clips (see bottom right in the picture) may be bent and shaped for use as simple eyelid retractors where examination of the anterior eye is difficult, for example in a child.
4. Testing Visual Acuity

Testing Distance Vision

Visual acuity testing is very important. The eye is made for sight - if it is damaged its function is reduced or lost. Our aim is to preserve or restore sight. By testing vision we have an indication of how far a disease may have progressed. We can record at a second visit if the vision is improving or getting worse. Careful records of the visual acuity in each eye must always be made.

To measure the visual acuity, stand the patient 6 metres from the chart, cover one eye and ask the patient to read the letters from the top downwards, reading as far down the chart as possible. The result is recorded and then the same procedure is followed for the second eye. This is also recorded.

If the patient wears spectacles for distance these should be worn to test vision at 6 metres.

It is necessary to record distance vision with each eye separately. In the picture you see an 'E' Chart which the patient views from a distance of 6 metres. The position of the 'E' varies, pointing up, down, right or left. Gradually the size of the 'E' becomes smaller from the top of the chart to the bottom of the chart. If the patient can see the top letter only, this is recorded as 6/60. The first number is the distance at which the patient is standing (6 metres), and the second is the distance at which a person with normal vision can stand and still read the letter (60 metres).

Each line has its own reading - the next line, in standard charts, is 6/36, then 6/24, 6/18, 6/12, 6/9, 6/6 and 6/5. Not all lines are necessary and for screening purposes it may be sufficient to use only the 6/60, 6/18 and 6/6 lines.
Standard normal vision is 6/6.

If a patient fails to see the top letter at 6 metres bring him closer to the chart - to 3 metres. If the top letter is seen at 3 metres, the reading is 3/60. If he still cannot see at 3 metres, test the visual acuity at one metre, where recognition of the top letter would be recorded as 1/60.

Alternatively you can ask the patient to count the number of fingers you hold up - the equivalent to 3/60 would be counting fingers (CF) at 3 metres.

Vision worse than counting fingers is recorded as hand movements (HM) - the ability to see a hand moving in front of the eye. Vision less than hand movements may be recorded as perception of light (PL). Projection of light is also important - that is the ability to point in the direction from which a light is shining. Good projection of light suggests a healthy retina and optic nerve behind whatever is obscuring vision - this is a very important test in assessing a patient for cataract surgery.

No perception of light (NPL) means that the patient is totally blind in that eye, and cannot even see light.
5. The Pin-hole Test

Testing Distance Vision with the Pin-hole

If a patient wears spectacles (glasses) for distance vision these should be worn when testing the visual acuity of each eye. If a patient does not have spectacles for distance, a quick and simple method of screening for refractive errors is by use of the pin-hole disc.

The 'pin-hole disc' (seen on the left) has a tiny opening - or multiple openings - in a plastic disc or piece of card. Holding the disc close to the eye and viewing the chart through the small hole will improve vision if there is a refractive error. Vision will then be helped by spectacles of the correct power. No improvement in vision, when using the pin-hole to test an eye with reduced vision, suggests a cause other than a refractive error.

If vision in either eye is worse than 6/18, the patient should be referred for specialist advice.
6. Testing Near Vision

Near Vision

Usually vision testing for near is measured using both eyes together. After the age of 35 years a person who has not required spectacles for near, may then need spectacles to see clearly when reading or sewing. This is called presbyopia.

The picture shows a man who requires spectacles for near vision - he needs plus convex sphere lenses for reading. The reading chart has print of different sizes beginning with very small print and progressing to very large print. The size of the smallest print read is recorded in the case notes. This particular chart is in English. Similar charts are available in many languages.

This test is not usually part of a routine screening examination.
7. History of the Complaint

The **Patient’s History**

- What is the major complaint?
- What is its duration?
- Was the onset of the complaint gradual or sudden?
- Is there any loss of vision?
- Is there any pain?
- Is the condition improving or getting worse?
- Is there any history of trauma?
- Is there any family history of a similar complaint or other eye problems?

The **history of the complaint** is most important. The patient will describe the problem in his own words - but you may need to ask specific questions.

Patients will come to you with a variety of symptoms and signs - e.g. pain, loss of vision, headache, double vision, redness, watering, discharge and eyelid swelling. These are all examples of the type of complaint you may have to consider.
8. Examination from a Distance

Examine the whole person

Why should this picture of a young boy be part of a teaching set on eye examination?

He came to the eye clinic with discomfort and inflammation of both eyes. He was unwell. He was coughing. He had a fever. His eyes were red. Note the swollen glands in the submandibular region - you can see the swelling on the right side of his neck.

The importance of this picture is to emphasise that examination (of the eyes) begins with the whole person. This boy may have had tuberculosis which was also affecting his eyes.

Examine your patient from a distance.
9. Examination of Both Eyes Together

Examine Both Eyes

The abnormality affecting this boy's eyes is obvious! He has a **squint** - also called **strabismus**.

To examine a patient with a squint, stand back and confirm that the eyes are not straight. If a torch is shone from a distance of one metre into the eyes, the light reflex on the cornea can be examined to determine if the eyes are straight. A squint may affect one eye or it may apparently affect either eye - the second type is called alternating strabismus. The squint which affects one eye only is more significant as the eye can become a 'lazy' eye and vision in that eye can become very poor.

Patients under the age of 8 years with squint should be referred to a specialist. If you see or even suspect a squint in a very small child refer for advice.

Adults who have a squint and complain of double vision should also be referred to a specialist.

**Examine both eyes together.**
10. The Peri-Orbital Region

Peri-Orbital Abnormalities

The next stage of your examination is to look at the region around the eyes, including the eyelids - the **peri-orbital region**.

- Is there any swelling?
- Is there any bruising?
- Is there inflammation?
- Are the eyebrows present? They may be lost in leprosy.
- Are the eyelashes present and in the correct position?
- Do the eyelids turn in (entropion) or do they turn out (ectropion)?
- Do the eyelids open and close correctly?

**What do you see in this picture?**

This patient has developed **herpes zoster ophthalmicus** or **shingles** affecting the ophthalmic branch of the 5th cranial nerve. This causes a rash on the skin, swelling of the eyelids and may also cause inflammation in the eye. Refer for specialist treatment.

**Examine the peri-orbital region of each eye.**
11. The Lacrimal Sac

One particular area of the peri-orbital region requires special mention. That is the region of the tear sac (or lacrimal sac). This small sac lies under the skin between the eye and the side of the nose - where the patient's finger is resting in the picture on the left. Two small canals carry the tear fluid from the front of the eye into the tear sac and from the tear sac a larger canal allows tear fluid to drain into the nose.

Sometimes the drainage becomes blocked and tears cannot flow - this results in a watering eye. Because of blockage the tear sac can become infected and may become swollen and red. This is called acute dacryocystitis. Treatment is with local antibiotic eye drops and usually an oral antibiotic also. Each time the patient puts in the eyedrops, advise him first to press on the tear sac - in order to express any pus out of the tear sac. The pus is then wiped away with a clean swab or cloth.

What is abnormal in the picture on the right of section 11?

There is pus at the nasal side of the eye. This appearance of pus only at the nasal side of the eye is typical of an eye with an infected tear sac where the tear sac has been compressed.

If the problem persists despite treatment the patient should be referred to the specialist. Surgery may be required.

Note - if a patient has an obvious problem with an infected tear sac it is best to examine the eye itself first and then concentrate on the tear sac at the end of the examination.

Remember the very important practice of hand-washing. We encourage our patients to observe good hygiene - it is clearly good medical practice to wash our hands.
thoroughly with soap and water (before and after examination) so that we do not pass on infection from one patient to another.
12. General Appearance of the Eye

The eye on the left has an obvious **laceration of the cornea** which will have been caused by an injury to the eye.

**What is unusual about the eye on the right?**

The upper, white part of the eye (the sclera) has a bluish colour and also appears to be swollen or bulging. This is called a staphyloma. Notice that, in this patient, the cornea and iris seem to have a normal appearance.

**What is the purpose in showing these pictures?**

In order to develop a good routine in examining the patient's eyes we have begun with the whole person, then both eyes together, then the peri-orbital region including the tear sac, and now we look in detail at each eye in turn.

We examine:

1. The eyeball - *what is the general appearance of the eye?*
2. The conjunctiva and sclera - *is there any redness or inflammation? Are the conjunctiva and sclera 'white' and 'quiet'?*
3. The cornea - *is it bright and clear or is there corneal ulceration, injury or scarring?*
4. The pupil - *is it black, circular and reacting normally to light?*

These pictures emphasise the importance of a careful **first impression** of the eye. This leads us on to the next section.
13. The Bulbar Conjunctiva

The conjunctiva lines the inside of the eyelids and the front part of the eyeball over the white sclera. The conjunctiva can be abnormal in many different ways. Observe and always keep in mind the appearance of what is normal.

Examples of a variety of abnormalities involving the bulbar conjunctiva (which covers the anterior sclera) are shown in these four pictures.

Top left: **acute purulent conjunctivitis** is infection usually caused by bacteria and characterised by inflammation and discharge. Carefully clean away the discharge and instil local antibiotic eye drops intensively, every one to two hours. The other eye often becomes involved. If there is no improvement with treatment after two to three days of if the cornea becomes involved, refer to the eye specialist urgently.

Top right: you may see an area of localised fleshy and sometimes inflamed tissue - often at the nasal side of the conjunctiva. This is called a **pterygium**, which means 'wing'. It may be thin or it may be thick. It may be 'quiet' or it may be red and inflamed. Apart from the irritation that may occur, the significant feature of a pterygium is growth across the cornea which may affect vision. Before vision is affected surgery should be considered. However, avoid surgery if you can, as a
pterygium will often recur after surgery. If a pterygium is causing problems refer to the eye specialist.

Bottom left: a **Bitot’s spot** is a well recognised sign of vitamin A deficiency, often in a young child. It is foam-like in appearance, often triangular in shape (although not in this example) and situated on exposed, usually temporal conjunctiva.

Bottom right: the tiny abscess shown in the picture is often found at the margin of the cornea and sclera, although it may occur elsewhere on the conjunctiva or sometimes on the cornea. It is called a **phlycten**. It can be most uncomfortable but will respond very quickly to specific treatment given by the specialist. This eye condition may be associated with tuberculosis and so the patient should be examined for this disease.
14. Eversion of the Eyelid

Everting the Upper Eyelid

These two pictures show an important technique in eye examination.

It is necessary to routinely *evert the upper eyelid* to view the conjunctiva which lines the inside of the eyelid. This will reveal conditions such as trachoma, allergic conjunctivitis or a foreign body which is hidden behind the upper eyelid. A gentle approach is required. **Do not carry out this procedure if there has been a penetrating injury of the eye or if the cornea is thin due to ulceration.** Pressure on the eyeball during this technique could cause the eye contents to come out in the presence of a penetrating injury or deep corneal ulceration.

With the patient looking down, but not with the eyes closed, gently hold the eyelashes between finger and thumb. Place a small object against the outside of the upper part of the eyelid - a cotton wool bud or your thumb will be fine. Turn the eyelid using steady and gentle pressure on the upper eyelid and the eyelid will quickly evert. The eyelid will return to its normal position if the patient looks up.
15. The Tarsal Conjunctiva

Look at the picture top left showing the appearance of the normal conjunctiva lining the inside of the upper eyelid. This was also shown (at some distance) in the last section which described eversion or turning of the upper eyelid.

When you evert an eyelid you may see an abnormal appearance. An inflamed conjunctiva can be typical of trachoma and this is seen in the picture shown top right. You can see the follicles characteristic of inflammatory trachoma.

On evertting the eyelid you may also observe the papillae of vernal conjunctivitis (a form of allergic conjunctivitis) - seen bottom left. You may find a foreign body (bottom right) which usually can be removed very easily on evertting the eyelid - a simple procedure giving great relief of discomfort.
16. The Cornea

Infection, inflammation and injury to the cornea may have a very severe effect on vision because corneal scarring may result. Only the corneal epithelium on the surface of the cornea can repair itself without some scarring. Good vision requires a clear central cornea. Corneal disease requires specialist advice and treatment.

Corneal injury has many causes - the example shown in the picture (top left) is injury due to a metallic foreign body. Where a foreign body has caused deep injury to the cornea, the treatment is to apply a topical antibiotic, shield the eye with a plastic shield or pad and refer to the eye specialist.

Infection of the cornea may be bacterial, fungal or viral. The eye shown top right has a measles kerato-conjunctivitis and the associated pus suggests secondary bacterial infection. Fluorescein dye, which appears green on the cornea, highlights the areas of corneal disturbance and is a useful diagnostic aid in outlining corneal ulceration. Fluorescein dye must be used only in single drop (minims) or paper strip applications as fluorescein prepared in bottles may become contaminated with pathogenic organisms.
Severe infective corneal ulceration will cause an inflammatory cell response. Pus may settle in the anterior chamber of the eye (hypopyon) as shown with a fungal corneal ulceration (bottom left).

Intraocular infection may go on to the unhappy picture of endophthalmitis (bottom right).

Infective corneal ulceration or intraocular infection requires very intensive treatment with suitable antibiotics or antifungal agents.

An infection involving the cornea should be given a topical antibiotic and the patient referred immediately to the eye specialist.
17. The Anterior Chamber and Iris

Chronic Iritis in Leprosy

How would you describe the abnormal features affecting this eye?

Notice that the eyelashes are missing.

The eye is red. While the cornea appears clear, the iris is seen through a slight haze. The circulating aqueous fluid in the anterior chamber contains abnormal proteins and cells. The pupil is constricted and irregular. There is inflammation of the iris - iritis. The pupil in this patient is unable to dilate evenly and fully. There is iris atrophy which includes the dilator muscle of the iris. Phenylephrine eye drops may be used to attempt dilatation of the pupil.

Iritis has many causes including leprosy, onchocerciasis and tuberculosis. This patient has leprosy.

Refer this patient for expert advice and treatment.
18. The Pupil Reaction

Pupil Reaction to Light

**Why do you think the focal light is shining directly into the centre of the left eye?**

The examiner is testing the reaction of the pupil to light. A normal pupil constricts (that is, becomes small) when a light is shone into the eye - and the other pupil will constrict at the same time. Each pupil should have the focal light shone into it in turn and you should observe if each pupil constricts equally. This test shows that the nerve pathways, from the back of the eye, along the optic nerve to the brain and then back through the motor nerves to the pupil, are normal.

Some pupils are slightly different in size. This can be normal. However, if you see a very obvious difference between the size of the two pupils, or if the pupils fail to react to light, this is abnormal.

Remember to ask the patient about any previous eye surgery or recent eye medication because these can change the shape and appearance of the pupil. In acute glaucoma the pupil is often dilated and 'fixed' - it will not constrict when a light is shone into the eye. If a miotic eyedrop, such as pilocarpine, is being used - usually in both eyes - the pupils will be constricted in each eye.
19. The Lens

Age-Related Cataract

By this time, it is understood that the best way to examine an eye is in an ordered manner, gradually looking deeper into the eye having previously examined the more superficial parts.

What is unusual about the appearance of the pupil in this eye?

You will note that the eye is a 'quiet' eye without inflammation - the cornea is clear in the central part and the iris is well seen. The patient does not complain of any pain. But the pupil area is white in colour. This is an opacity or clouding of the lens of the eye, situated behind the iris and involving the pupil area. This is cataract.

Not all patients with a white pupil have cataract, but in most patients, particularly in the older age group, this will be the diagnosis. If you see a patient with this appearance you should ask for specialist advice. A cataract can be removed surgically and sight restored.

It is very important to refer any child with a white pupil to the eye specialist. Occasionally a child may have a serious tumour growing inside the eye which can look like a cataract when you examine the pupil area. Remember also that children may be born with cataract - congenital cataract.
20. The Intraocular Pressure

Absolute Glaucoma: Schiotz Tonometer

What do you see in the picture on the left?
The blood vessels on the white of the eye are dilated. The cornea looks slightly hazy and you will notice that the light shining on the cornea does not have a sharp edge as with a light reflex on a normal cornea. The pupil, which is semi-dilated, is grey-white in colour.

This patient has had acute glaucoma - the pressure inside the eye has increased - in this case due to an enlarged cataractous lens which should have had surgical removal. The aqueous fluid is unable to escape out of the eye through the trabecular meshwork at the angle of the anterior chamber. The consequence is raised intraocular pressure. The patient will have had ocular pain and headache, often with nausea. Vision is often severely reduced, and in the picture shown the eye has become blind with no perception of light - described as absolute glaucoma.

The diagnosis in cases where the pressure is very high can sometimes be confirmed by the fingers’ test. Place the tip of each index finger on the outside of the upper eyelid with the patient looking down. Press gently with each finger in turn and sense the resistance given by the eyeball. It may be quite hard, even like a stone. Compare with the other eye which, if normal, will be softer.

A more accurate method of measuring the intraocular pressure is with the Schiotz tonometer - shown in the picture on the right. This method requires local anaesthetic eye drops and careful antiseptic technique.
The patient lies comfortably on his back. After anaesthesia of the cornea is achieved with anaesthetic eye drops, the clean footplate of the vertically placed Schiotz tonometer is rested on the cornea of each eye. The lower end of the plunger of the tonometer indents the cornea. The resistance to indentation is indicated by the position of the pointer against the scale. A calibration card is supplied with the Schiotz tonometer and the scale reading is converted into the intraocular pressure measured in millimetres of mercury.

There are different types of glaucoma, but the acute form is an emergency. The patient should be referred to the eye specialist immediately.

In another common type of glaucoma (open angle glaucoma) the increased pressure in the eye or eyes may not always be very high and may occur without pain or headache. Raised intraocular pressure can slowly damage the optic nerve at the back of the eye, and cause cupping of the optic nerve head which can be seen with the ophthalmoscope.
21. The Ophthalmoscope

Using the Ophthalmoscope

If you are able to obtain an ophthalmoscope and become familiar in its use, this will help you to record more details during your eye examination and also make your examination more complete. The patient should look with the other eye at a specific object in the distance. Examine first the central area of the retina, the optic nerve head and the major blood vessels. You should also ask the patient to look in different directions - 'up, right, down, and left' - to see different parts of the retina.

Not only can you use the ophthalmoscope for examination of the retina, optic nerve and blood vessels at the back of the eye - but you can use the ophthalmoscope to see details at the front of the eye also.
22. Ophthalmoscopy

Traumatic Cataract: Normal Fundus

If you look into the eye with the ophthalmoscope using the +10.00 dioptre sphere lens turned into the eyepiece, you will focus on the front of the eye instead of the back of the eye.

What do you see in the picture on the left?

The pupil has been dilated with a short-acting dilating eyedrop. The distinct red background is from the back of the eye; it is called the red reflex.

Against the red background you see some dark opacities. This is a cataract, in this case placed centrally in the lens. Cataracts may develop in different parts of the lens and this can be revealed by this examination. In fact any opacity centrally placed in front of the retina can be seen in this way, whether on the cornea, in the lens or in the vitreous - simply by using the correct power of lens in the eyepiece of the ophthalmoscope.

It is important to know what the normal fundus looks like. The normal fundus is shown on the right.

The retina appears deep pink or red - this is due to the many blood vessels of the choroid lying behind the retina. It is a fairly uniform colour without inflammation, scars or abnormal pigmentation.

Examine the optic nerve head, also called the optic disc. It is usually pale pink in colour and its edges are seen clearly. A pale, white disc indicates optic atrophy. Blurred edges of the disc suggest a swollen disc. A large cup in the disc occurs in glaucoma. The optic disc shown in the picture has a small, central cup - which is normal.
The blood vessels are evenly distributed, the veins appearing slightly more full when compared with the arteries.

Examination of the fundus can give important information about many diseases - these include glaucoma, optic atrophy, diseases of the macula, retinal detachment, diabetes and hypertension.
23. Examination of a Child

Examining a Small Child

So far we have discussed methods used in examining a patient who is helpful, and usually wanting your advice. A young child, however, will often be frightened and disturbed and so we should consider how to reassure and examine a child.

Examination of a young child is not always easy and a moment or two given to speaking with the child and the parent, reassuring them if possible, may allow your examination to be completed much more quickly.

A small child often requires special methods in examination and the photograph gives one example. The examiner has the child’s head on his lap and his assistant (or a parent) sits opposite holding the child’s arms firmly on each side. A good method is to wrap a sheet or blanket around the child’s body, keeping the arms and legs from moving.

It is necessary to be firm, but gentle. Do all you can to reassure the child. Do not make sudden movements - always move slowly when coming close to the eye in order to carry out the examination.
24. Summary

- Take a careful history
- Record the distance vision in each eye - with distance glasses if worn or with a pin-hole
- Examine first from a distance - a general impression of health or systemic disease
- Examine both eyes together
- Examine the peri-orbital region of each eye
- Examine from the front of each eye through to the back of each eye
- Record your findings
- Treat if possible
- Refer to the Eye Specialist whenever in doubt

We have briefly studied examination of the eyes in an ordered way (see right).

One final point. You may be faced with a patient who is anxious or afraid. The patient has come to you for advice and has confidence in your ability to make a diagnosis and give guidance on treatment. Your clinic may be extremely busy with many patients to be seen. But even a very brief and kind word together with gentle hands in examination are very reassuring to the patient and increases confidence that he or she is receiving the very best care.
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