Corneal transplantation

Introduction

A cornea transplant is an operation used to remove all or part of a damaged cornea and replace it with healthy cornea tissue from the eye of a suitable deceased donor.

A cornea transplant is often referred to as a keratoplasty and can be used to improve sight, relieve pain in a damaged or diseased eye and treat emergencies, such as severe infection or a damaged cornea surface (perforated cornea).

A number of eye conditions can lead to a cornea transplant, such as keratoconus, infection, multiple eye surgery or corneal failure from endothelial diseases.

What is the cornea and what does it do?

The cornea is the clear outer layer at the front of the eyeball that acts as a window to the eye. The coloured iris and the pupil (the black dot in the centre of the iris) can be seen through the cornea. It is made up of six delicate layers:

- the outer layer (the epithelium)
- basement membrane
- Bowman’s layer
- the thick middle layer (the stroma)
- Descemet’s membrane
- the inner lining which removes fluid from the cornea to keep vision clear (the endothelium)

The cornea acts like the front lens of a camera; and light rays are bent into the eye at an angle and allows a picture to be projected onto the retina at the back of the eye. This ‘picture’ is in turn transmitted to the brain.

When the cornea is damaged it can become less transparent or its shape can change. This can prevent light from reaching the retina and causes the picture transmitted to the brain to be distorted or cloudy. A corneal transplant may be recommended when you start to lose your sight.

The cornea can also be very painful and sensitive to light when diseased, and a cornea transplant may also be needed to relieve pain.
How is a transplant done?

Due to advances in technology, a full cornea transplant is not always needed and there are several options available, depending on which part of the cornea is damaged, or how much of the cornea needs replacing. These include:

- a full transplant of the cornea (penetrating keratoplasty (PK))
- replacing or reshaping the outer cornea (deep anterior lamellar keratoplasty (DALK))
- replacing deeper parts of the cornea (Descemet's stripping endothelial keratoplasty (DSEK) and Descemets’ membrane endothelial keratoplasty (DMEK).

A cornea transplant can be carried out under general anaesthetic (where you are unconscious) or local anaesthetic (where the area is numbed). Around 5% of transplants are performed as day surgery, the other 95% will require an overnight stay in hospital. If DSEK/DMEK is performed, you will need to lie flat on your back for an hour and be checked before you can be transferred to the ward.

Either the full cornea or part of the cornea is removed and replaced with the donated cornea. If PK or DALK is being performed, the new cornea is then held in place with stitches, which stay in for at least 16 months and are gradually removed. DSEK does not require too many sutures.

You should not feel any pain or be able to see through the eye during the operation as the anaesthetic temporarily stops the eye from working. A mild discomfort could be experienced during administration of local anaesthetic.

There are some risks associated with a cornea transplant, such as the new cornea being rejected by the body, infection, glaucoma and the graft wound reopening at any stage afterwards (dehiscence).

Recovery

The recovery time for cornea transplant depends on the type of transplant you have. A full cornea transplant (PK) can take up to two years to return to full vision, whereas DALK has a faster recovery of around 12 months. It should take around eight weeks to recover from DSAEK or DMEK.

Cone shaped cornea

Keratoconus is a condition that causes the cornea to weaken, get thinner and change shape and affects about one in 2000 of the population. The exact cause is unknown, possibly passed down through the family, or as a result of an allergy. It's one of the most common reasons for corneal transplantation in younger patients and does not usually appear until the early teens, but can occur earlier in a few patients.

Many cases of keratoconus are mild and can be managed by using contact lenses or glasses, but in some patients it can progress to the point where corneal transplant is necessary.
Degenerative conditions
Certain conditions may affect the eyes and cause them to develop problems slowly over time. One example of this is Fuch’s endothelial dystrophy, which causes the Descemet’s layer to weaken (degenerate); this happens faster as you get older. As the layer weakens, instead of clearing excess fluid, it allows it to build up, causing cloudy vision.

Corneal perforation
Perforation is when a small hole is created on a thin surface. If the surface of the cornea is damaged or pierced, it may be necessary to have a cornea transplant to repair the damage and prevent infection.

Changes in the shape of the cornea may also lead to a transplant to stop the cornea weakening, which increases the risk of perforation.

Infection
In rare cases a cornea transplant might be needed if there is an infection in the cornea which does not respond to antibiotics and keeps returning.

Penetrating keratoplasty (PK)
This is a ‘full thickness’ transplant, performed under local or general anaesthetic. A central, circular piece of the damaged cornea is surgically removed and replaced with clear, healthy donor tissue.

The new cornea is held in place by tiny stitches which form a star-like pattern around the edges. You may be able to see them faintly after the operation. The stitches are gradually removed in the clinic, which usually takes about 12-16 months, but can sometimes take longer.

The operation can take between one to two hours. Penetrating keratoplasty (PK) can give the new cornea a survival rate of up to 10 years when the cause is the cornea changing shape (keratoconus). If the operation is due to infection or an ulcer on the cornea it is lower, with about 50% of corneas surviving longer than five years.

Outer cornea (anterior procedures)
Laser eye surgery
Conditions that affect the lining (the epithelium), or top layer of the cornea are usually treated using laser eye surgery. There are several procedures available with laser eye surgery and each one uses a type of laser called an excimer laser to reshape the cornea. This procedure is used to correct conditions such as short sight (myopia), long sight (hypermetropia) and astigmatism.
Automated lamellar keratoplasty

If there is a need to go slightly deeper towards the middle section of the cornea (stroma), then automated lamellar keratoplasty (ALK) is another option. This procedure involves replacing only the affected part of the outer layer of the cornea with donor tissue. There is normally a quick recovery with this method as it does not involve the deeper layers of the cornea.

Deep anterior lamellar keratoplasty (DALK)

This is used in cases where the lining (endothelium) of the cornea is healthy but the thick middle section (stroma) is abnormal. The most common condition causing this is keratoconus. Some infections and inherited diseases of the cornea may also cause the cornea to become cloudy while lining remains healthy. Deep anterior lamellar keratoplasty allows the diseased stroma to be removed, and for the patient to keep the healthy lining of his/her cornea. During surgery, the front part of the diseased cornea is removed and replaced with the new donor cornea, which is fixed with fine stitches. The donor cornea sits on top of the patient’s own corneal lining.

Patients having a DALK corneal transplant take longer to recover, but recent surgical advances have shown results that match those of a full thickness transplant (penetrating keratoplasty (PK)). The advantage is because the inner layer of the cornea is still in place, the risk of rejection is lower, and the long-term survival of the transplant may be better.

Deepest layer (posterior procedures)

Endothelial keratoplasty (EK)

This is a newer procedure available in the UK. It is commonly used for patients whose corneas have become waterlogged because the cells in the deeper layer of the cornea have failed (endothelial failure).

EK removes and replaces the inner cell layer of the cornea. The majority of the patient's cornea is left intact and cornea tissue from a donor is inserted into place. Instead of stitches, a temporary air bubble holds the donor tissue in place until it bonds to the patient's own cornea. It is usually performed under local anaesthetic and general anaesthetic is sometimes used with suitable patients.

Because EK only exchanges the inner cell layers of the cornea, it has little or no effect on its external shape, which means that sight is returned faster and better than with a conventional corneal transplant.
The exact way the procedure is performed varies depending on which the surgeon feels is appropriate. The specific techniques are listed below:

- Descemet’s stripping endothelial keratoplasty (DSEK) – preparation of donor cornea to include a thin layer (approximately 100 microns) containing endothelial cells to replace the posterior part of patient’s own cornea
- Descemet’s stripping automated endothelial keratoplasty (DSAEK) – the preparation of the donor’s cornea is done as above except with a machine (microkeratome) to suit patients cornea
- Descemet’s membrane endothelial keratoplasty (DMEK) – the preparation of the donor cornea to include a thin membrane (20 microns) containing endothelial cells to replace the posterior part of patient’s own cornea

**Risks**

There are several risks and complications involved with having a cornea transplant. Some symptoms will show up early and need emergency treatment, while others may be spotted during follow-up appointments.

**Rejection**

Rejection happens when the patient’s own immune system recognizes the donor cornea as a foreign body and attacks it. Rejection is quite common, occurring in one in five corneal transplant patients.

Most cases of rejection can be treated effectively so that the transplant survives and continues to function. The key is to start treatment as soon as you notice symptoms. You should seek specialist advice as an emergency case.

Early symptoms of rejection usually start about 10 to 14 days after surgery. The main symptom is a cloudy cornea (when the surface of the eye looks clouded instead of see-through) within an eye that is not red or painful. This may also cause blurred vision in the affected eye. This can be a result of damage during the surgery or a problem with the donor tissue. Rejection can happen any time after the transplant (even years). Late symptoms can include:

- red eye (when the whites of the eyes become red)
- a cloudy cornea
- uveitis (an inflamed middle layer of the eye)

Treatment is usually with steroid eye drops and sometimes steroid tablets, or injections.
Other complications

Early complications (within first two weeks) to watch out for include:

- infection
- corneal abrasion (caused by a foreign body in the cornea)
- Transplant detachment requiring repositioning
- photophobia (sensitivity to bright lights)
- irritation or pain
- red eye
- decreased or blurred vision

Late complications, which would usually be spotted during follow-up appointments at an eye clinic may include:

- astigmatism (causes blurred vision)
- glaucoma (pressure in the eyes caused by trapped fluid)
- macular oedema (swelling in the eye)
- retinal detachment – occurs in about 1% of penetrating keratoplasty patients and is treatable with further surgery
- wounds from surgery reopening
- original eye disease (e.g. keratitis) returning
- internal infection due to surgery wounds
- Transplant failure requiring a repeat corneal transplant

After surgery

The care needed after surgery will vary depending on which kind of transplant you have had. A cornea transplant is normally carried out as day surgery, although sometimes an overnight stay is required.

Penetrating keratoplasty (PK)

You may have to stay in hospital for one to two days after a full cornea transplant.

The eye will be covered with an eye pad, which stays in place until the morning after surgery. When the pad is taken away, you may find that your sight is blurred, although this is normal.

You have to use steroids or antibiotics daily – normally for around six to nine months, but some patients may need to use them for longer. The drops reduce swelling and inflammation and help prevent infection and rejection. It's important not to rub your eye; you will be given a patch to wear at night for the first few weeks after surgery.

The stitches holding the transplant are left in place to allow the cornea to heal. They are gradually removed, which usually takes about a year, but can sometimes take longer.
The shape of full thickness transplants is often quite irregular. This can cause *astigmatism* (where the transplanted cornea is rugbyball-shaped rather than football-shaped). This limits the quality of vision and so you may need further surgery to improve the shape of the transplant and improve your vision. Most patients still need to wear glasses and many wear contact lenses to see well after a full-thickness corneal transplant.

**Automated lamellar keratoplasty (ALK)**

This procedure usually takes less than an hour to complete and can take around 24 hours to heal. Vision should start to return to normal within a few weeks but you may be given eye drops to use in order to prevent infection and soreness. However, this procedure is often not used when it is possible to perform laser eye surgery instead.

**Deep anterior lamellar keratoplasty (DALK)**

After surgery care is very similar to that of a full-thickness transplant (above). The difference with DALK is that there are often fewer complications during recovery than with PK so there should be less risk of further follow-up treatment being needed.

**Endothelial keratoplasty (EK)**

In the first day or two after surgery you may be asked to lie on your back with a specified recline position as much as possible to help the air bubble remaining in the eye to push the transplant in position. The air is absorbed after a day or two.

It's important not to rub your eye. It will probably be red and sore for two to three weeks after surgery. At first, your vision will be hazy, but should begin to clear within four to six weeks.

You will be given steroid drops to alleviate any inflammation and reduce the risk of rejection. You should not stop steroid eye drops without prior instructions from doctors in the corneal clinic as this may predispose to transplant rejection.

**Recovery**

Recovery times depend on which treatment you have had, and although there should not be serious pain, care must be taken to avoid certain activities until the eye is fully healed.

**Penetrating keratoplasty (PK)**

Recovery can be slow; it can sometimes take up to two years for your eye to settle down and return to normal vision. There should not be serious pain after the operation but there might be some swelling and discomfort. In the first few months, your vision may change between being better and worse than before, as the eye heals and returns to normal.
You will need regular follow-up appointments at first, but these should gradually become less frequent until they are only needed every two - three months. In some cases further surgery (such as laser treatment) may be needed to improve your vision, and you may need to continue wearing glasses or contact lenses.

**Sports and activity**

There is a lifelong risk of wound rupture after a full cornea transplant. It is important that you do not rub your eye.

You should not take part in any contact sports until the doctor in charge of your care says that it is safe. Protective goggles will also need to be worn when resuming contact sports.

Swimming should be avoided for a minimum of a month. It is possible to have a bath or shower but you should also be careful not to get water in the eye for at least a month.

**Automated lamellar keratoplasty (ALK)**

Recovery can be very quick after ALK and may take up to 24 hours to heal. Normal eyesight should start to return within a few weeks. You may need to use eye drops to avoid soreness and prevent infection of the eye as it heals and eyesight returns. ALK is often not used if it is possible to perform laser eye surgery instead.

**Deep anterior lamellar keratoplasty (DALK)**

Recovery time after DALK can be up to 12 months. Even after full recovery, contact lenses or glasses may be necessary. Further treatment of the cornea with laser surgery may also be required if vision needs adjusting. The advantage of DALK is that there are often fewer complications during recovery than with a full cornea transplant.

**Endothelial keratoplasty (EK)**

Your vision should return much faster after DSAEK / DMEK than with a full cornea transplant. Without complications, your vision should return within four to eight weeks. This type of transplant is particularly suitable for elderly patients.

**Eye drops following corneal transplantation**

Steroid eye drops are prescribed at frequent doses (4-6 times a day) at the early postoperative period to prevent transplant rejection. This dose is slowly tapered to almost once a day over 12 months or even longer period of time. Patients are advised not to stop steroid eye drops without clear instructions from the eye doctor in the corneal clinic.
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