Corneal Collagen Cross Linking (CXL)

Information for patients

Cross Linking is an innovative treatment for keratoconus patients. The procedure is undergoing constant development and change.

As with any surgical procedure, there is always the risk of complications and problems with the cross linking procedure. Please study all information available carefully before considering corneal cross linking. If you have any questions, please ask your eye doctor.

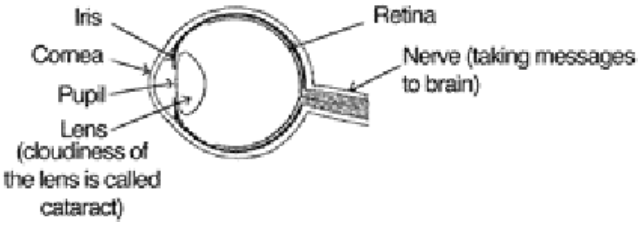
Also please read: "NICE (national institute for Clinical Excellence) patient guidelines on the following website: https://www.nice.org.uk/guidance/ipg466

What is keratoconus?

The surface of the eye is called the cornea. The cornea is the transparent dome-shaped front part of our eyes, which allows the eye to focus. To function properly, it must be smooth and appropriately shaped.

Figure 1: Front view of the right eye

Figure 2: Side view of the eye



In a normal eye, the cornea has the strength to keep a regular curved shape, which helps to focus the image on the retina within the eye. A keratoconic cornea lacks this strength and tends to progressively warp with time. The result is that the cornea becomes thinner in the centre and protrudes forwards, forming a cone shape. This leads to a blurred image on the retina, needing spectacles or contact lenses to sharpen it. In some cases, the inner layers of the weakened corneal tissue can split or tear causing scarring or too much water in the cornea.

For some patients the disease does not progress and they will continue to have good functional vision with glasses. However, for many patients Keratoconus will progress to the point where vision is impaired and can no longer be improved with glasses. Although often only one eye is involved it is not uncommon for both eyes to be affected. The condition generally tends to stabilise once you reach 30 to 40 years of age, but by then the contact lens prescription can be quite complex (with its associated problems) or a corneal transplantation (cornea obtained from a donor) may have been necessary.

The aim of the Corneal Collagen Cross Linking (CXL) is to reach this period of stability early, before the condition has had a chance to progress to the advanced stages. The bonds between adjacent collagen fibres in the cornea increase as the body ages and this maturity is brought on artificially in CXL treatment using a special ultraviolet light.

Once it has been confirmed that your keratoconus is progressing and that your eye measurements meet certain criteria, you can be considered for CXL treatment. However, your true suitability may only be known on the day of the proposed treatment, when the thickness of your cornea has been measured after the surface corneal cells have been removed.

What are the other options in Keratoconus when glasses no longer provide functional vision?

Rigid (hard) gas-permeable (RGP) contact lenses

The development of special Keratoconus RGP contact lens designs has increased the use of RGP lenses over the years, and can greatly improve vision when glasses are no longer effective. Supported by the natural tears in the eye, the irregular surface of the cornea is reshaped, allowing for better vision. However, RGP contact lenses cannot be worn by everyone. Some people will experience unacceptable discomfort, especially for patients with low production of tears, as an adequate supply of tears is needed to provide adequate lubrication for the RGP lens. There is also increased risk of corneal infections.

Soft contact lenses under the RGP lenses

This method, although more awkward, may sometimes be better tolerated than an RGP contact lens alone. Another option is the use of a hybrid lens (hard centre and soft

edge). The contact lenses do not affect the progression of Keratoconus.

Corneal implants

This is a surgical procedure and has associated risks. On their own, they do not slow keratoconus progression. They are clear, small semicircular plastic rings, of various thicknesses that are inserted inside the cornea at its outer edges. They can flatten the central area of the cornea, although glasses or contact lenses will still be required for vision. The results of corneal implants on their own have not been very satisfactory.

Corneal graft (transplant) surgery

Corneal specialists mostly agree that it is best to try non-surgical / less invasive options before undergoing corneal transplant surgery. As an invasive surgical procedure, corneal transplant surgery carries the risk of potentially serious complications, which may involve a graft rejection. The probability of rejection and failure means that, rarely, a second corneal transplant may be required.

There are several reasons to be cautious when deciding if a corneal transplant is a viable option. The absence of blood vessels in the cornea means the healing process is slow and it takes a year or even longer before the shape of the transplanted cornea (and effectiveness as a focusing lens) has stabilised. During this time, vision in a transplanted eye would often not be functional. There is a risk that even after absolutely perfect surgery, the healing process could be distorted causing the graft to become mis-shaped, creating an abnormal corneal shape and the need for further surgical procedures. Although your vision is likely to improve following graft surgery, you would still need glasses or a contact lens for the best vision.

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The aim of this procedure is not to improve vision (although some patients may notice an improvement) but to try and stabilise or slow down the progression of this condition.

Also, due to a degree of corneal scarring even in routine treatment, your vision following the treatment can be somewhat less than at the start. This change may be permanent and not corrected with glasses or contact lens.

Cross Linking is not a new technique and has long been used as a medical interventional technique. It is commonly used to modify other substances, e.g. drugs and chemicals in dentistry to harden fillings, etc.

An Ultraviolet – A (UVA) light source is delivered on to the cornea together with a chemical mix largely made up of riboflavin. The combination of the UVA light and the riboflavin creates a joining or bonding of the chemical structures (collagen fibres) within the cornea. Riboflavin is a micronutrient commonly found in our food and is also known as vitamin B_2, with a key role in maintaining health in both humans and animals.

This procedure has been shown in laboratory and clinical studies to increase the amount of collagen cross-linking in the cornea and subsequently strengthen the cornea. Published European studies show that this procedure has been proven safe and effective in patients however side-effects are reported.

Cross Linking is not for everybody. The first requirement is to make sure that the thickness of the cornea is adequate for the treatment and Keratoconus is not too advanced. Special non-invasive measuring devices are used by your specialist to accurately and quickly take these readings.

The Cross Linking Procedure

The procedure is performed under local anaesthetic (given as eye drops) as a day case in a special “clean” room. A small metal device, called a speculum, helps you to keep your eyes open during the procedure. The top layer of protective skin on the eye, called the epithelium, is then removed. After all the measurements have been confirmed, the treatment will take place.

The eye is bathed in special drops (riboflavin) while you lie on the treatment couch. The drops are applied frequently over the next 10 minutes to ensure that Riboflavin penetrates to the deeper layers of the cornea. This is done before the ultraviolet light treatment to allow the riboflavin to absorb into the cornea.

The ultraviolet light is then focused on your eye for a total of 8 minutes in several small sessions. During the treatment (the activation of the ultraviolet light) the riboflavin eye drops continue to be applied on to the cornea every few minutes. You will be asked to look directly at a light to make it easier to keep the eye still during the procedure. At any time in the procedure a rest can be taken and the procedure continued from that point in time.

The procedure itself may be uncomfortable, but generally the eye will become sore afterwards (after about 1-2 hours, when the local anaesthetic drops wear off) and this could last for a few days (generally 24- 48 hours). You will be given a combination of eye drops and tablets to relieve the discomfort and help your eye to heal.

You may also have a contact lens put in your eyes after the treatment, to allow the cornea to heal and keep the eye comfortable. Your next appointment will normally be a few days following the treatment, at which stage we may remove the contact lens, depending on how well the eye is settling down.

What are the risks of Cross Linking?

Detailed observations so far show that the below side effects can occur after this procedure:

- Post-operative pain and sensation of foreign body will be experienced in the eye for 24-72 hours after treatment and until the corneal surface heals (re-epithelialisation is complete).
- Weeping of eye for 24-72 hours after treatment.
- There will be transient corneal swelling (oedema) with blurring of vision for a month or more after treatment. However, rarely, there could be persistent corneal oedema beyond this, which could affect vision more permanently. You will not be able to use contact lens in the eye unless the surface heals and corneal oedema clears.
- Corneal haze can occur. This represents an individual's healing response to the treatment. However in some people, the healing is more aggressive and the haze may be more marked (corneal scarring). This can cause long-term reduction in vision, which is **not** corrected by glasses or contact lenses.

Other complications have also been described with this procedure. They are rare but can be serious. They can include infection, melting of the cornea, delayed healing or poor healing of the corneal epithelium, increase in eye pressure, dry eye, presence of glare, sensitivity to light, visual disturbances and refractive errors.

These complications may need further treatment, surgery or an additional stay in the hospital and sometimes can affect vision permanently.

While, Cross Linking is a relatively new procedure, experience with Cross Linking is showing promise. However this does not exclude the possibility of further treatment or a corneal transplant. While, it is difficult to mention every possible outcome, your surgeon will be happy to discuss all your concerns in detail and answer your questions, so please write down any queries that you may have.

Is there a risk of losing sight due to CXL procedure?

CXL is a surgical procedure and there is a small but definite risk of losing sight due to a complication such as an infection or corneal scarring, etc. This loss may be permanent, not correctable by glasses or contact lenses and may also require further surgery.

What problems should I seek advice about?

After the treatment, if you experience any increasing pain, increasing redness, yellow or green discharge, or a sudden decline in vision, please contact our Acute Referral Centre (on weekdays) as soon as possible (Tel. **0131 536 3920**). There is always a doctor on call over weekends and public holidays and they can be contacted through the main switchboard (Tel. **0131 536 0000**) or ward E2 (Tel. **0131 536 1172** or **0131 536 1772**).

Do not wait until your next appointment. If you have any queries about your eye there will always be someone available to help.

Note: Because each patient is different, the above information is a general guide only. Remember, your operation is the beginning of a course of treatment, not the end of it.