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Patient Information

Corneal Cross-linking

Clinic	012 333-1111
Fax	012 333-4848
Emergency	083 441-2975
E-mail	info@lasik.co.za
Website	www.lasik.co.za

1199 Woodlands Drive
Queenswood, Pretoria 0186

PO Box 11846
Queenswood, 0121

What is corneal cross-linking?

Corneal cross-linking is one of the exciting new procedures that became available recently for the treatment of corneal ectasia.

What is meant by the "cornea" and "ectasia"?

The cornea is the clear, transparent 'front window' of the eye through which light enters the eye. Two-thirds of the eye's focusing ability occurs at the cornea. Its shape and clarity is, therefore, critical for normal vision.

The cornea is a multilayered structure, consisting of five separate tissue layers, namely epithelium, Bowman's membrane, stroma, Descemet's membrane and endothelium.

Corneal ectasia is a condition characterized by corneal weakness and instability thereof, that leads to protrusion, astigmatism, loss of visual acuity and, in the final stages, even perforation of the cornea. Possible causes for this condition include keratoconus. It presents with a decrease in corneal rigidity due to decreased corneal stromal stability.

What can be done?

There are various treatment options available, such as spectacles, soft or rigid contact lenses, the placement of special implants (intra-stromal corneal ring segments or ICRS) in the cornea, and finally corneal transplant surgery.

These options, however, only address the visual aspect of the condition and not the underlying process. Recently, a new technique was developed, called corneal collagen cross-linking, which aims to arrest the structural decay in the cornea.

Collagen cross-linking is a minimally invasive procedure that aims to strengthen the cornea by inducing "cross-links" between adjacent collagen fibers in the stroma. The procedure results in an increased corneal tensile strength, with no obvious clinically significant side effects. Patients who underwent this procedure, may even display an improvement both in visual acuity as well as corneal curvature readings, although this is not the primary goal. The idea is to stabilize the cornea, after which one may implement further measures to restore the vision.

What happens during the procedure?

By using ultraviolet irradiation and a "photomediator", a chemical reaction is initiated within the cornea, which induces cross-links between adjacent collagen fibers.

The most superficial layer of the cornea is first removed. This layer regenerates spontaneously within 3 to 5 days.

This is followed by administration of the photomediator, riboflavin, until the cornea is saturated with the vitamin. Thereafter, a quantified dose of UV-A irradiation is administered to the cornea, which leads to the formation of cross-links.

The above process only initiates the formation of cross-links and the process continues within the cornea for a period of up to 2 years after the procedure, during which time the tensile strength within the cornea improves.

Prior to treatment, the progression of corneal ectasia is often monitored for a period of 6 months by means of serial corneal examinations. However, should there be evidence of quick progression at the first examination, the procedure may be done as quickly as possible to prevent further progression.

It is important to emphasize that the aim of a corneal cross-linking procedure is not to improve the vision, but rather to *stabilize* it. Although small improvements in corneal shape and vision may sometimes be seen, this is not the primary goal.

Who are candidates?

All patients with corneal ectasia (loss of corneal stability) such as keratoconus, corneal laser candidates with resulting unstable corneas after the procedure, corneal ulcers, corneal melting and a variety of other corneal pathologies.

Advantages

- Improvement in corneal profile
- Improved visual acuity
- Increased corneal stability
- Increased biomechanical strength of the cornea
- Increase in the thickness of the cornea (although marginal)
- Increase in the symmetry of the cornea
- Reduction of deteriorating spectacle error
- Reduction of astigmatism
- Reduction in higher-order aberrations (corneal coma)
- Reduced demand for corneal transplant

The procedure may be done in combination with the placement of an ICRS to further stabilize the cornea and improve its shape.

Method of treatment

A topical anaesthetic is placed in the eye. Thereafter, the central part of the corneal epithelium is removed to ensure an even distribution of riboflavin into the cornea and to ensure that a high level of UV-A absorption is achieved. Riboflavin drops are then applied for 30 minutes, after which the thinnest area of the cornea is measured with an ultrasound device as a safety check prior to radiation. The cornea is then irradiated with an UV-A light source, with continued application of riboflavin until the complete radiation dose is delivered. At the end of the procedure, antibiotic drops are instilled, along with the placement of a bandage contact lens to increase comfort after the treatment.

Safety

To qualify for the procedure, the cornea must be at least 400 µm (0.4mm) thick after removal of the epithelium to protect the endothelium from accidental radiation.

A specific wavelength with a carefully calibrated amount of radiation is used to ensure that the exposure to the endothelium, natural lens and retina is below harmful levels. Furthermore, the riboflavin acts as a shield to protect the inner structures of the eye. The pupil is also constricted to minimize exposure to the radiation. If the cornea is thinner than the threshold of 400 µm, transient corneal swelling may be induced by using a hypo-osmolar solution of riboflavin for protection.

After the procedure:

It is very important to adhere to the following guidelines.

1. All future visits are important.
2. Refrain from rubbing your eye in future.
3. Avoid contaminated-, shampoo-, soapy- or swimming pool water near or in the eye for the first week after the procedure.
4. Although it is highly unlikely, be alert to the signs of infection in the first five days after the procedure. These signs will be communicated in detail at the approriate time.
5. Adhere strictly to the prescribed medication schedule.