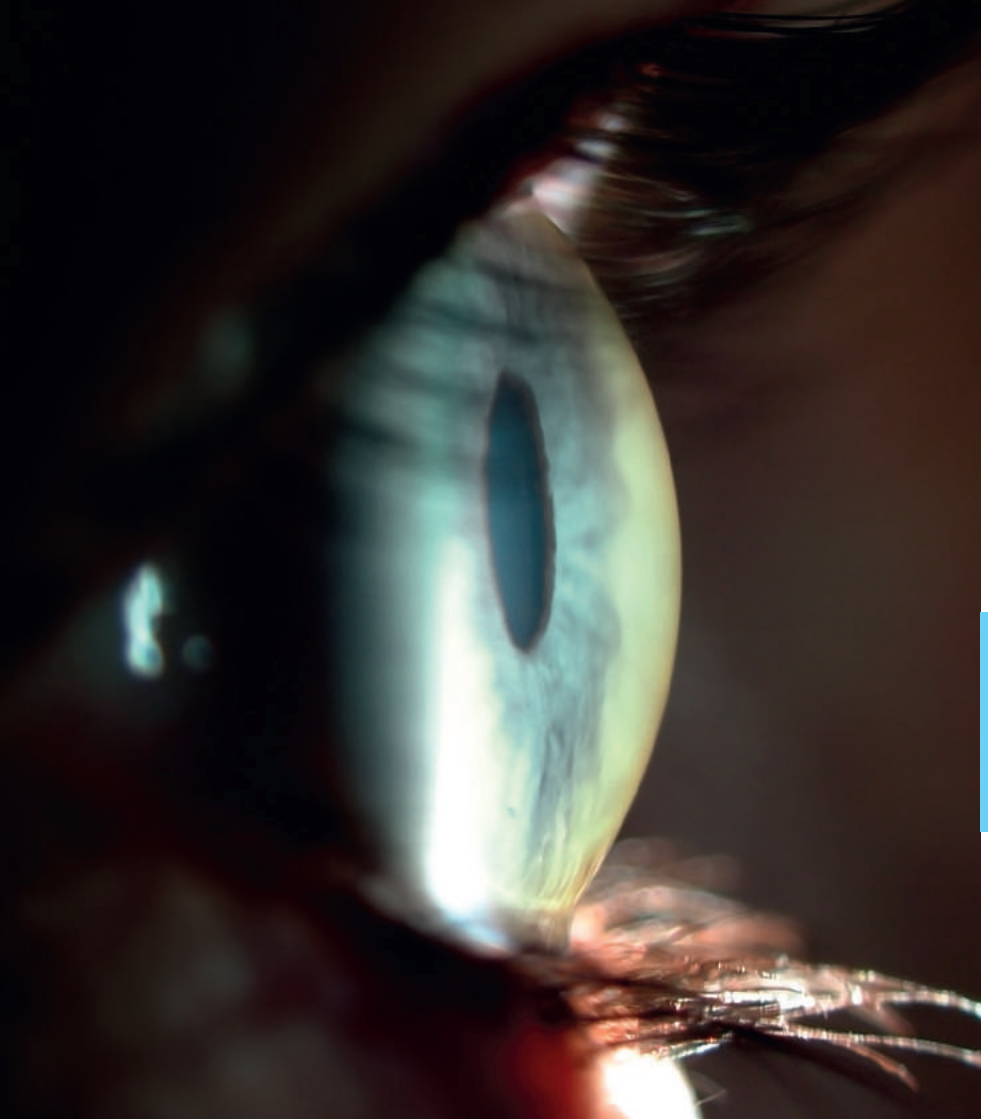
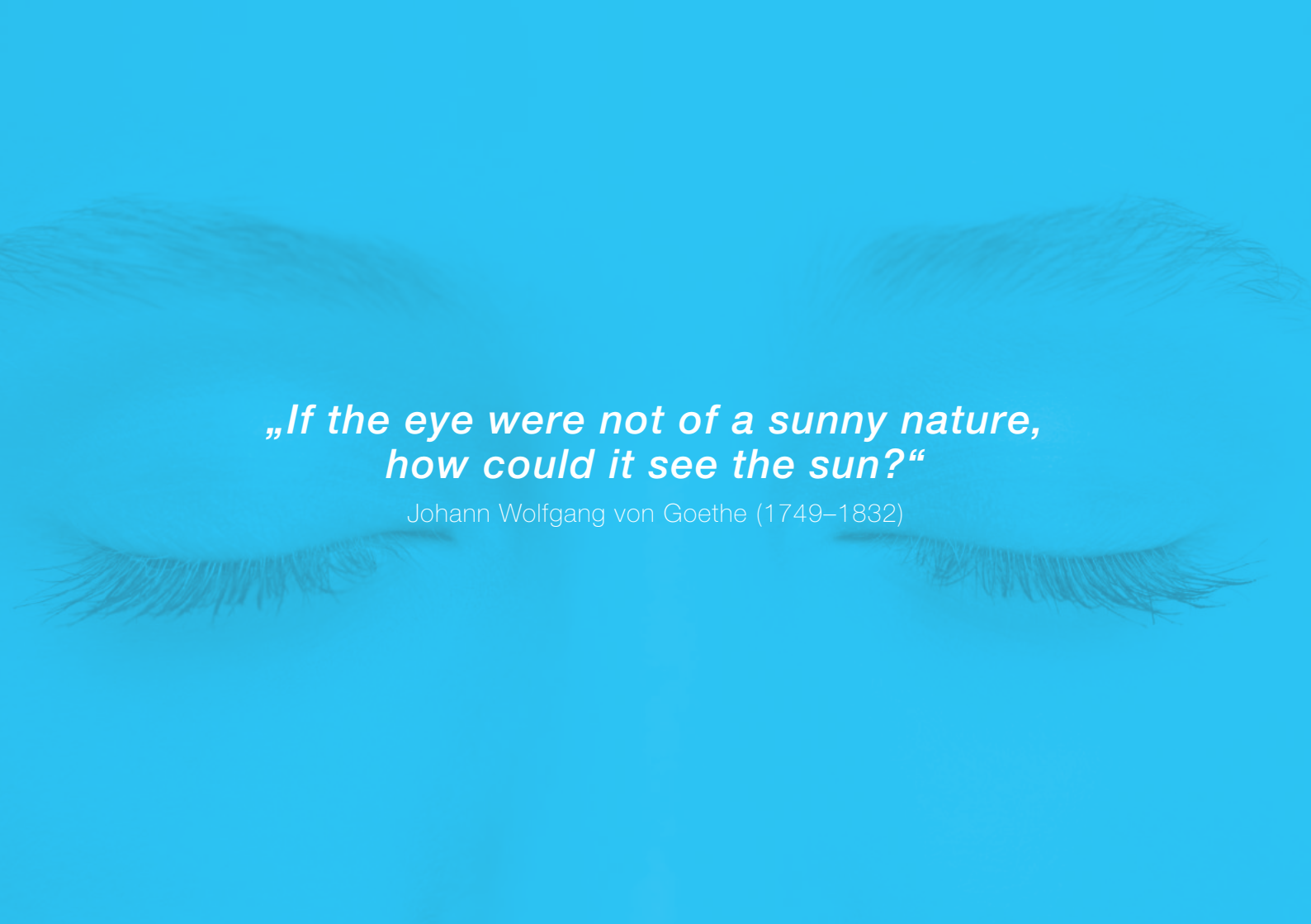


CORNEAL TRANSPLANTATION

INFORMATION

HORNHAUTBANK MÜNCHEN
Gemeinnützige GmbH


„If the eye were not of a sunny nature,
how could it see the sun?“
Johann Wolfgang von Goethe (1749–1832)

CONTENTS

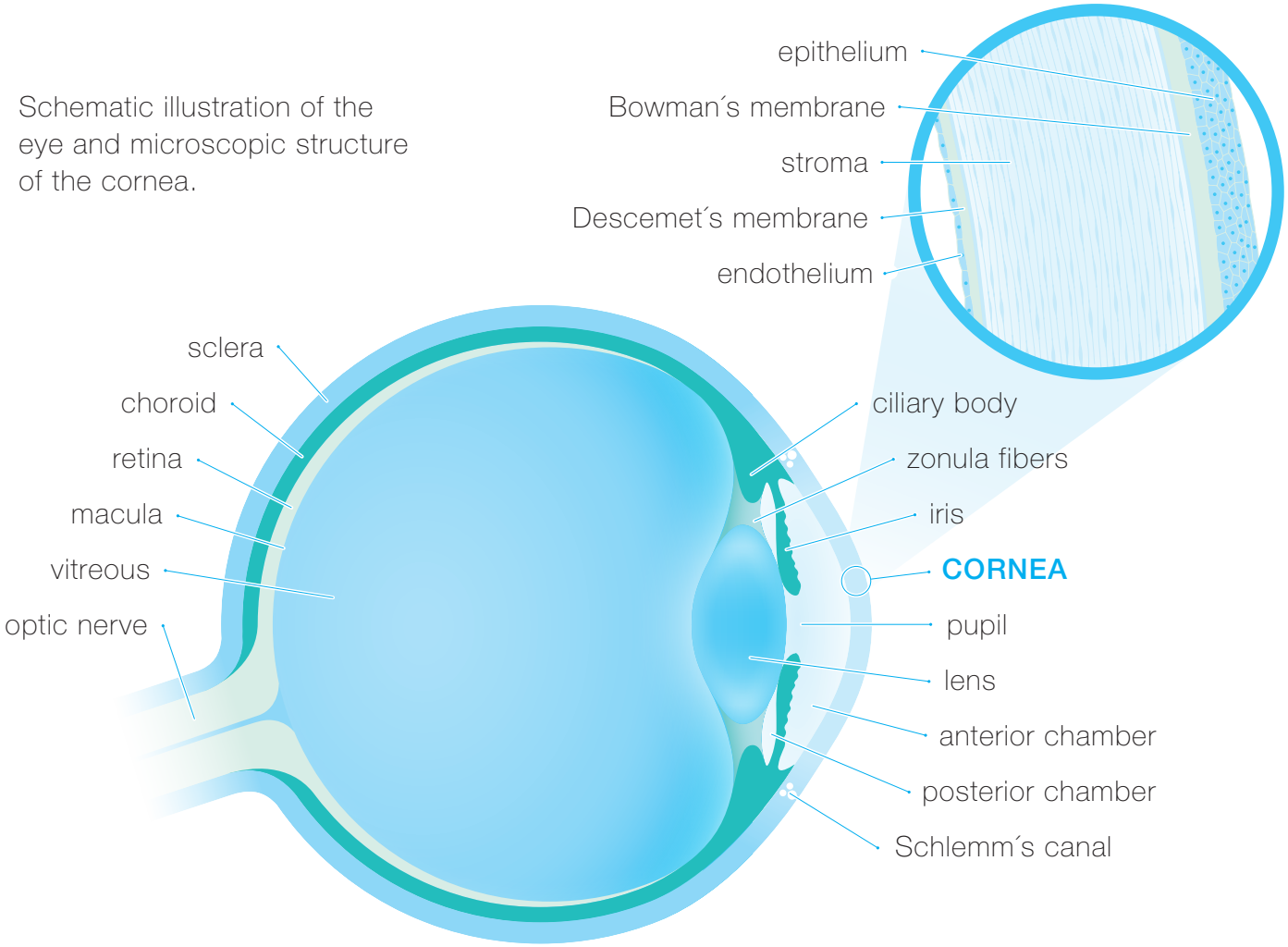
This brochure attempts to answer your questions related to these and other interesting questions.

Thank you for taking the time to learn more about corneal donation or corneal transplantation, respectively.

Yours sincerely,

Hornhautbank Muenchen
Gemeinnuetzige GmbH

Schematic illustration of the eye and microscopic structure of the cornea.



THE CORNEA

The cornea is the crystal clear window in the front of the eye which reveals the colored iris and the black pupil. Microscopically it is composed of 5 layers which all have a specific function. Further, its surface is coated with an ultra-thin liquid film, the tear film.

The epithelium is the outer protective cell layer of the cornea. Similarly to the upper skin layers it continuously regenerates and usually heals quickly after injuries.

The innerst side of the cornea is only covered by a single cell layer, the endothelium. These cells pump excess liquid out of the cornea and in this way maintain precisely the moisture content that is required to ensure a perfect transparency.

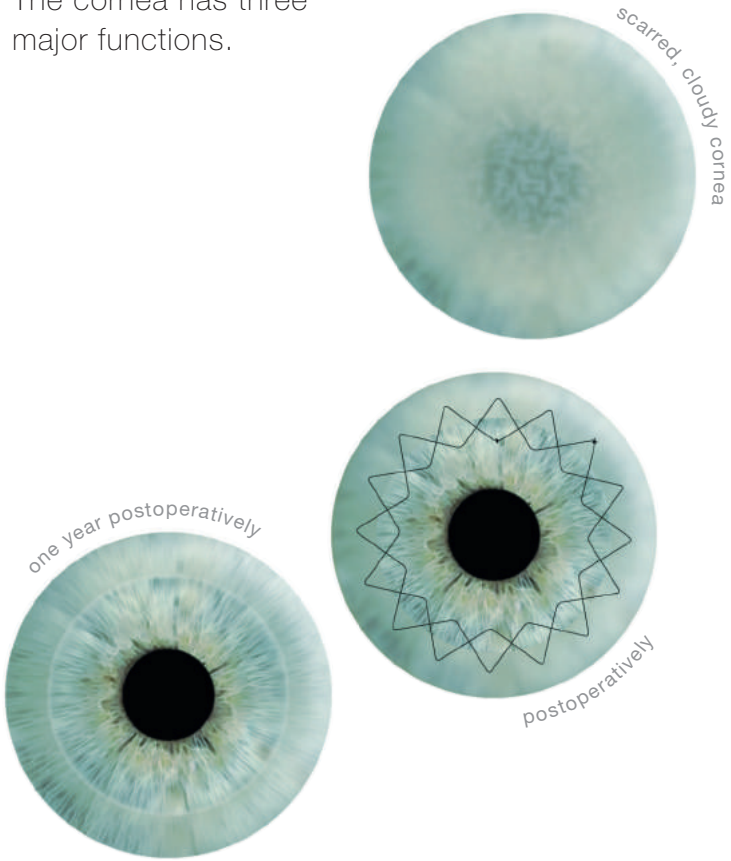
To ensure this function, not even the tiniest gap may originate in this cell layer.

If endothelial cells are lost, the remaining cells have to enlarge to cover the originating gap, since endothelial cells are unable to propagate or re-grow.

Owing to a highly complicated fine structure the layers in the middle of the cornea, the stroma, are transparent, although they consist of body tissue. Any damage to this area results in cloudiness.

Epithelium and stroma are separated by Bowman´s membrane. Descemet´s membrane serves as a base for the endothelial cells and connects them to the stroma.

The cornea has three major functions.



1. **TRANSPARENCY**
This is how it ensures an unobstructed passage of light rays into the eye and onto the retina, so that you can see.

2. **CURVATURE**
This is how it obtains the refraction (together with the crystalline lens) needed to create a focused image of the environment on our retina.

3. **STABILITY**
The cornea is a continuous component of the outer protective and formative shell of the eyeball (the remaining white and non-transparent portion is called sclera).

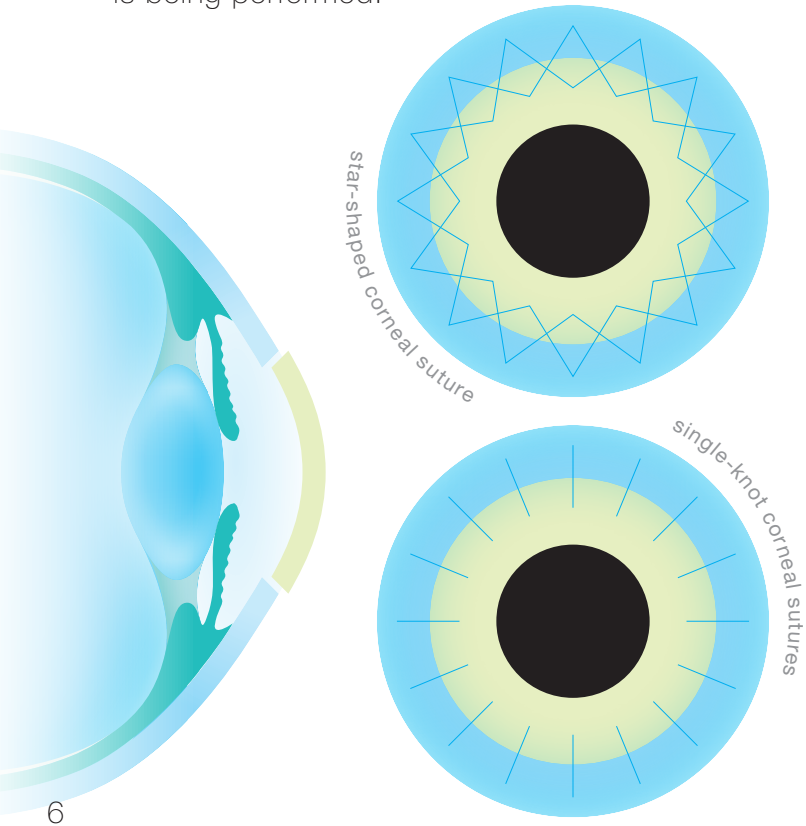
CORNEAL TRANSPLANTATION

Every corneal transplantation (keratoplasty) is a replacement of diseased or damaged tissue with healthy tissue. Leaving aside extreme exceptions, not the entire cornea with its total diameter is transplanted but rather only a central part varying in size analogously to the specific circumstances of the individual case.

Further, full thickness corneal replacement (penetrating keratoplasty) and the replacement of partial-thickness corneal layers (lamellae) (lamellar keratoplasty) which may be restricted to the pathological changes are differentiated.

If only pathological changes in certain corneal layers are treated, suitable cases allow a replacement of these layers only, while the person´s own healthy layers are preserved. In this kind of lamellar transplantation a differentiation is made between transplantation of the innermost layers (posterior lamella) on the one hand and of the external layers (anterior lamella) with preservation of the eye´s own innermost layer on the other.

In penetrating keratoplasty full thickness corneal replacement is being performed.



+ ADVANTAGES

- Small-sized transplant which is not supplied with blood, therefore less transplant rejection.
- The most frequent transplantation worldwide, therefore high technical and scientific experience standard.

i PLEASE NOTE:

- Uneven corneal curvature following transplantation, which can be corrected through re-operation or laser treatment.
- The new cornea heals over time and forms a solid scar, which, however, will never reach the stability of a non-operated cornea.

PENETRATING KERATOPLASTY

In penetrating transplantation a circular disk of the diseased cornea is removed under the surgical microscope with the help of a special instrument. A disk of the donor cornea is removed which precisely matches the size and sutured in the created aperture in the recipient eye with the help of finest sutures.

Sometimes additional changes require surgical treatment (e.g. debridement, vitrectomy or removal or exchange of a lens). This is done in the open eye between removal of the diseased corneal disk and suture-fixation of the healthy one.

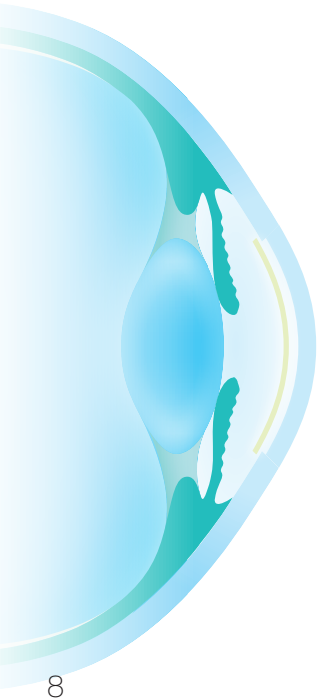
Whether the transplant is sutured with two star-shaped continuous sutures or an appropriate number of single-knot sutures is the decision of the surgeon depending on the circumstances of the individual case.

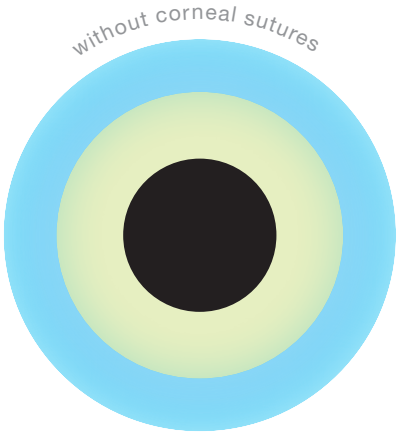
The sutures used are made of nylon and are several times thinner than a human hair.

FEMTO KERATOPLASTY

The most recent technical progress is removal of the diseased tissue and of the transplant with a laser (the so-called Femtosecond laser). Since the laser can only cut through clear tissue, this method cannot be applied in all cases. Also, this method is not recommendable for strongly deformed corneas for technical reasons. Whether this method would be beneficial or not needs to be discussed personally and in detail with the treating surgeon.

In inner layer transplantation (posterior lamella) only the inner layers of the cornea are replaced.





ADVANTAGES

- Shorter recovery time – often good visual acuity after only 3 months.
- Preserves the own cornea´s stability and curvature.
- Lower risk of induced high corneal astigmatism or other visual defects.
- Nerve fibers of the own corneal surface are preserved.
- After endothelial transplantation a penetrating transplantation remains possible.

PLEASE NOTE

- Good but not full (coll. 100 %) visual acuity in most of the cases presumably resulting from the contact of the recipient and donor tissue layers (so-called interface).

POSTERIOR LAMELLAR KERATOPLASTY

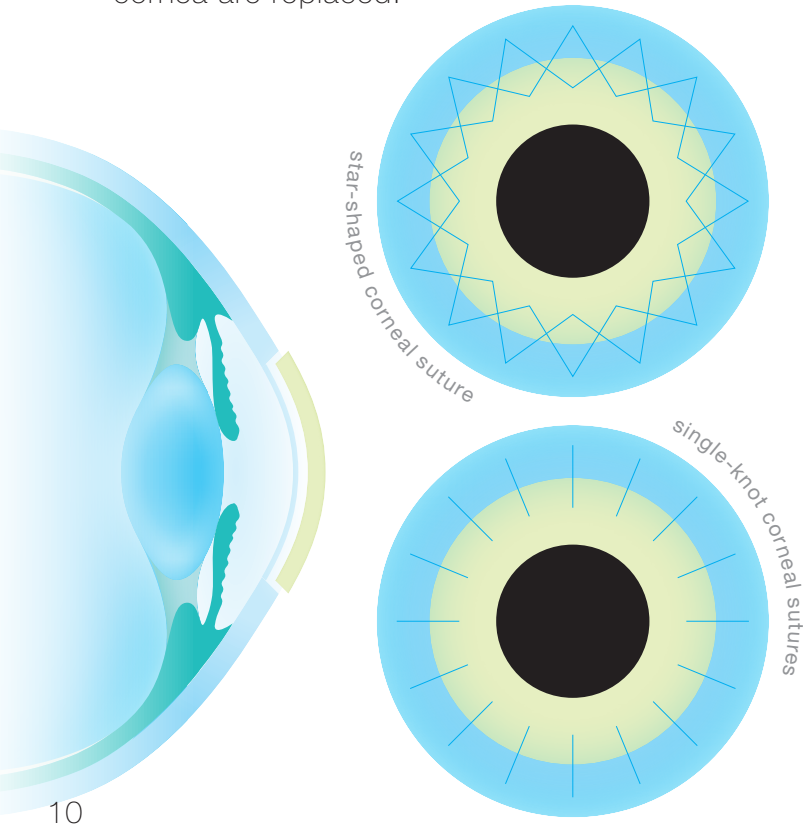
In inner layer transplantation (posterior lamellar or endothelial transplantation, Descemet´s stripping automated endothelial keratoplasty = DSAEK or Descemet´s membrane endothelial keratoplasty = DMEK) the defective endothelium of the diseased eye including Descemet´s membrane is circularly cut, separated, removed and replaced with a corresponding lamella or disk of healthy donor tissue.

The rolled donor corneal disk is inserted into the eye through a small lateral incision. It finally unfolds inside the eye and is then pressed against the corneal bed and kept in place at the intended position with an air bubble. There it adheres, while the air bubble is absorbed and dissolves within several days.

To avoid a so-called pupillary block with massive intraocular pressure increase due to the air inside the eye, a small opening in the iris (iridectomy) is created during surgery. In case of an inner layer transplantation the patient must remain in supine position 24 hours after surgery, so that the air bubble inside the eye may press the transplant against the bed, thus ensuring adhesion.

Today this method has increasingly become the method of choice in the relatively frequent corneal opacifications due to failure of the innermost cell layer (endothelium) regardless of its cause, if the remaining corneal layers do not exhibit pathological changes. In many cases the operation is combined with cataract surgery.

In outer layer transplantation (anterior lamella) only the outer layers of the cornea are replaced.



ADVANTAGES

- Preservation of the own endothelium and therefore significant decrease in rejection risk.

PLEASE NOTE

- Good but not full (coll. 100 %) visual acuity in most of the cases. The assumed reason is residual stromal material on the donor tissue, between the recipient and donor tissue layers (so-called interface).

ANTERIOR LAMELLAR KERATOPLASTY

Outer layer transplantation (anterior deep lamellar transplantation, deep anterior lamellar keratoplasty = DALK) so to say works the other way round: Here the anterior corneal layers are separated from Descemet´s membrane and the endothelium, removed and replaced with donor tissue from the same layers. In this case the transplant needs to be fixed with fine sutures, like in penetrating keratoplasty.

This technique is preferred in cases which are limited to pathological changes of the anterior corneal layers, while the two innermost corneal layers (Descemet´s membrane and endothelium) are perfectly healthy.

This operation technique, even though planned, cannot always be reliably carried out, so that the surgeon has to switch to a penetrating keratoplasty intraoperatively in some cases, which is possible without any problems. For this reason principally an attempt is being made in all suitable cases.

It is important to know that the technical details of all lamellar operating techniques are constantly and rapidly further developed – the principles, however, remain mostly unchanged.

DONOR TISSUE

To be able to expect a reasonable chance of success, tissue can only be transplanted among living beings of the same kind – so that human beings need transplants from other human beings. Corneal transplants are always obtained from deceased persons. In the case of corneas we additionally have the particularity that it can still be removed within about 12 – 16 hours following the definite confirmation of death.

Brain death diagnosis is not required to maintain this tissue, i.e. the donor is not artificially respirated (heart-lung machine) to maintain the blood circulation, which may be necessary to maintain blood supply of the solid organs (such as heart, liver, kidney etc) for organ removal.

In corneal donation only the anterior corneal caps of the donor can be removed.

Such a cap is not bigger than a contact lens or a 2-cent-Euro coin, respectively. Following removal of the corneal disk protective caps are put in place and the eyelids are gently closed. The facial expression remains unchanged – there is no visible sign of the removal of the cornea.

Very careful investigations and laboratory examinations (pertaining to the eye itself and also the deceased person´s blood) ensure that the cornea is functional and that no contagious diseases may be communicated. In suitable storage solutions a cornea can also be kept and preserved over a certain time period.

Anyone who has healthy eyes and is free from contagious diseases can be a corneal donor after his or her death, independent of the person´s age.

Like any other tissue or organ donation, corneal donation is principally completely voluntarily and can never be performed against the intention a person declared while he or she was still alive. The safest and absolutely certain way to declare one´s intention with respect to organ donation is an organ donor card or clear statement to close family members. The donation of a cornea/of organs after one´s death is a gift to another person which lives on. Any financial profit from such a(n) tissue/ organ donation is excluded.

Since the demand for transplants is much higher than the offer, our healthcare system needs organizations like Hornhautbank Muenchen.

HORNHAUTBANK MÜNCHEN
Gemeinnützige GmbH

ADDRESS AND CONTACT

Hans-Stützle-Str. 21
81249 Munich, Germany

Tel.: +49 (0) 89 132910
Fax: +49 (0) 89 132911
info@hornhautbank-muenchen.de
www.hornhautbank-muenchen.de

HORNHAUTBANK MUENCHEN

Augen-Hornhautbank Muenchen is a non-profit organization, which obtains and preserves suitable corneal donor tissue in accordance with stringent medical and ethic standards and distributes this tissue to patients who need a new cornea via ophthalmic surgeons.

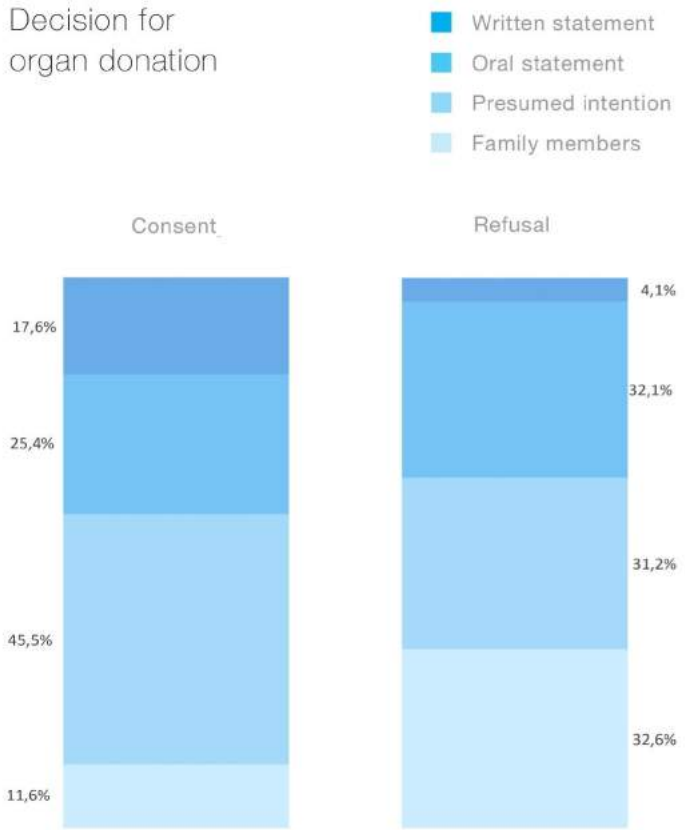
Through national and international cooperation our cornea bank ensures that, if possible, every suitable donor tissue reaches the patient who needs it.

Owing to the invention of methods to preserve a cornea in storage solution it has become possible to establish this kind of cornea bank. As a result, Prof. Thomas Neuhann, MD, founded a non-profit private cornea bank in Munich, Germany, in 1991.

Ever since the team of Hornhautbank Muenchen has endeavored to ensure the supply of high-quality transplants to patients in collaboration with cooperating hospitals and ophthalmic centers. Our cornea bank is TÜV (German Association for Technical Inspection)-certified and meets all legal requirements pertaining to the operation of a tissue bank.

Cornea banks are charitable, non-profit organizations as a rule. They only charge the costs originating from organization, removal, examination, testing, preservation and transport.

Please contact us at any time for further information on organ donation and organ donor card.



Reference: Deutsche Stiftung Organtransplantation / Organspende und Transplantation in Deutschland 2018

RISKS

Compared to the transplantation of inner organs corneal transplantation shows a considerably higher success rate.

In addition to the remarkable progress in microsurgical technique and medicinal treatment this is owed to a biological characteristic of the cornea, which makes it less prone to the body´s immune defense, the „rejection", than other organs.

Nevertheless, it is a transplantation, which bears a higher risk than other ophthalmic surgeries.

WHAT CONDITIONS REQUIRE CORNEAL TRANSPLANTATION

If a cornea is no longer able to adequately accomplish one or more of its functions (transparency, focused imaging, stability) and no other therapy is possible, the only available help is the transplantation of a clear human cornea.

The most frequent causes are abnormal curvature and deformation of the cornea, with keratoconus as the best known example.

Another frequent cause for corneal transplantation is corneal cloudiness. Cloudiness can have many reasons: If the corneal endothelium fails, the cornea swells due to the excess permeation of moisture and exhibits a milky haze.

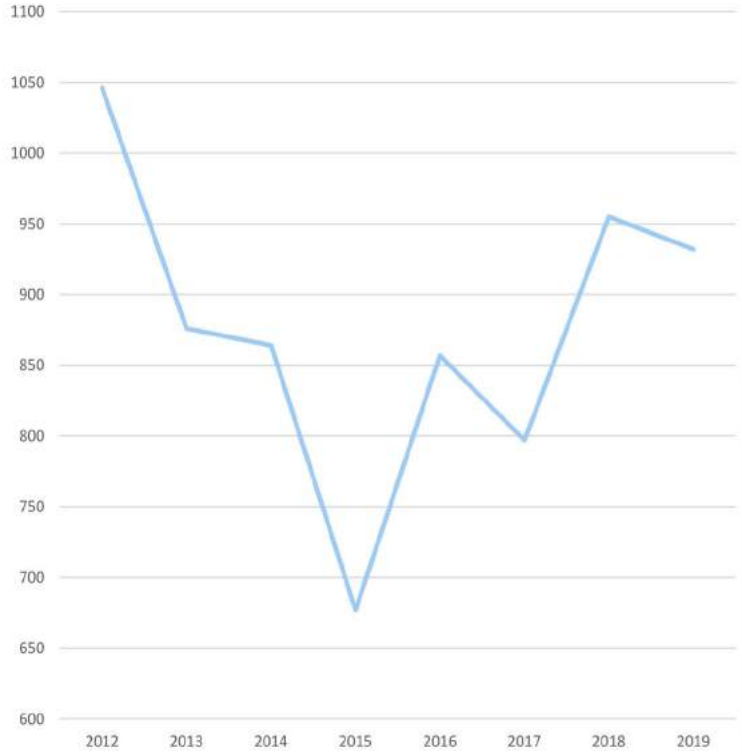
Another reason may be opacification due to scars, for example after injuries, chemical burn, thermal burn, infection or ulceration.

Also certain hereditary diseases and metabolic diseases may lead to opacification.

If a cornea develops non-healing defects under certain circumstances, a transplantation may be the only effective treatment in single cases.

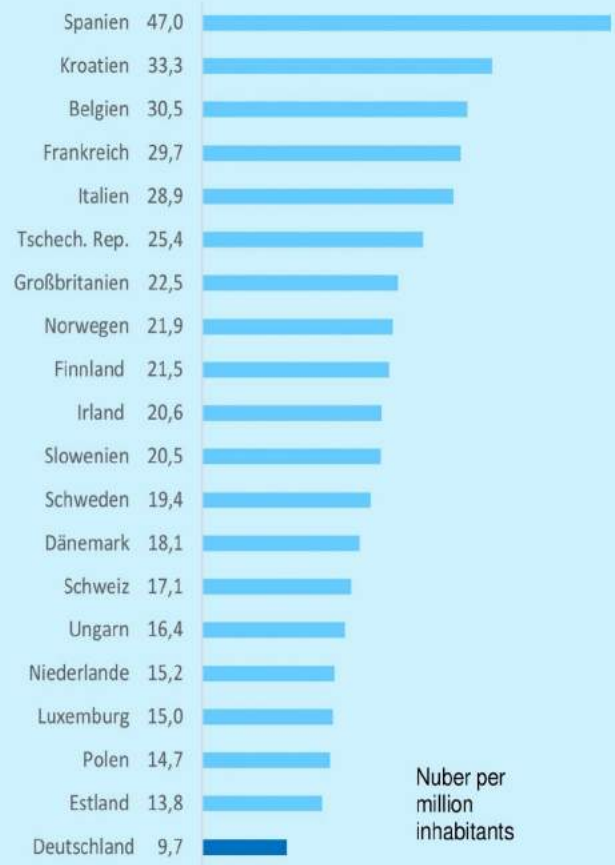
If a cornea melts due to certain diseases or infections, an immediate emergency corneal transplantation may become necessary.

Nuber of organ donors in Germany since 2012



Reference: Deutsche Stiftung Organtransplantation / Organspende und Transplantation in Deutschland

ORGAN DONORS EUROPE



Reference:EDQM VOL.23 / 2018 / International figures on donation an transplantation 2017

FIGURES AND FACTS

About 9,000 corneal transplantations per year are performed in Germany, making corneal transplantation the most frequent tissue transplantation in humans. Its frequency exceeds that of all other organ transplantations (liver, kidney etc) together.

Following corneal transplantation it can take many weeks or months until the visual acuity slowly improves while the cornea heals. Spectacle glass needed for best correction of the visual acuity after corneal transplantation may completely differ from that used pre-operatively. Within the first weeks and months these values are still subject to change in many cases.

Suture removal: The fine sutures used for suturing of the cornea (in case of a penetrating as well as anterior lamellar keratoplasty) must remain in the eye for a number of months, in some cases for up to 1 – 2 years.

Please feel free to contact Hornhautbank Muenchen. We will be glad to send you an organ donor card and/or provide you with detailed information.

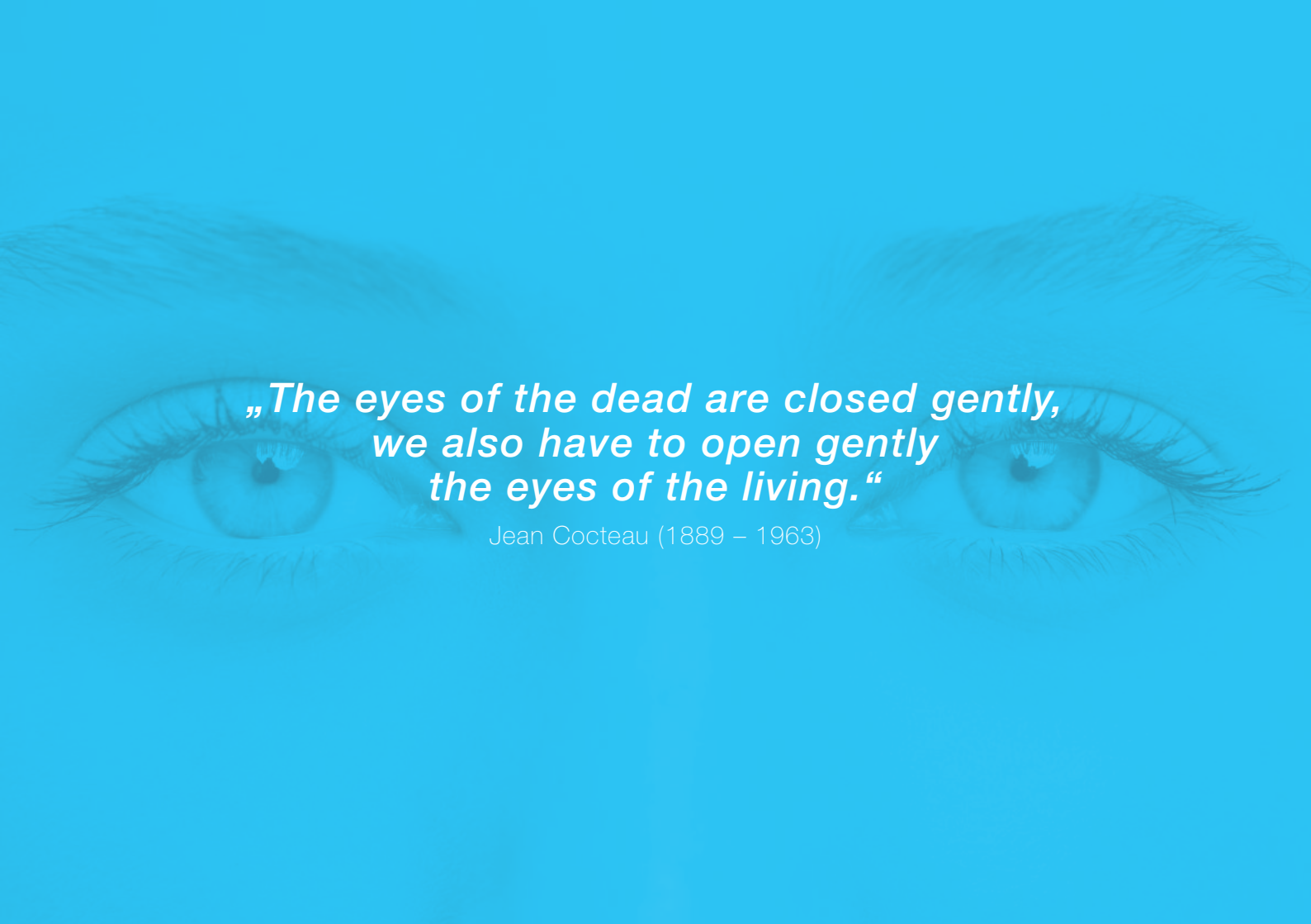
NEVER FORGET

Corneal transplantation completely depends on the gift of a deceased person. While he or she was still alive, this person made a decision is favor of this act of extraordinary generosity. Each and every one of us might need these gifts someday.

Please help and also make your environment aware.

MAKE YOUR DECISION NOW

An early decision can make you and also your family feel good and reassured. Regardless of potential complications it is a fact that corneal transplantation has become an operation with extraordinarily big chances of success.


„The eyes of the dead are closed gently,
we also have to open gently
the eyes of the living.“
Jean Cocteau (1889 – 1963)

Hans-Stützle-Str. 21
81249 München, Germany

Tel.: +49 (0) 89 132910
Fax: +49 (0) 89 132911

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