Complications of deep anterior lamellar keratoplasty: Avoid, recognize and treat!

Penetrating keratoplasty was the first transplantation performed by humans and is in use since over 100 years to treat diseases of the transparent foremost avascular part of the eye – called CORNEA.

The cornea has the function of a physiological windscreen and can be divided into three layers: A highly proliferating covering cell layer, called corneal *epithelium*, a robust and simultaneously optically transparent layer, enabled by an extraordinary arrangement of collagen fibres, called *stroma*, and the corneal *endothelium* attached to the *backside of the corneal stroma. The latter permanently* dehydrates the cornea by pumping fluid out of the stroma into the adjacent anterior chamber. This continuous dehydration process is important for the corneal transparency.

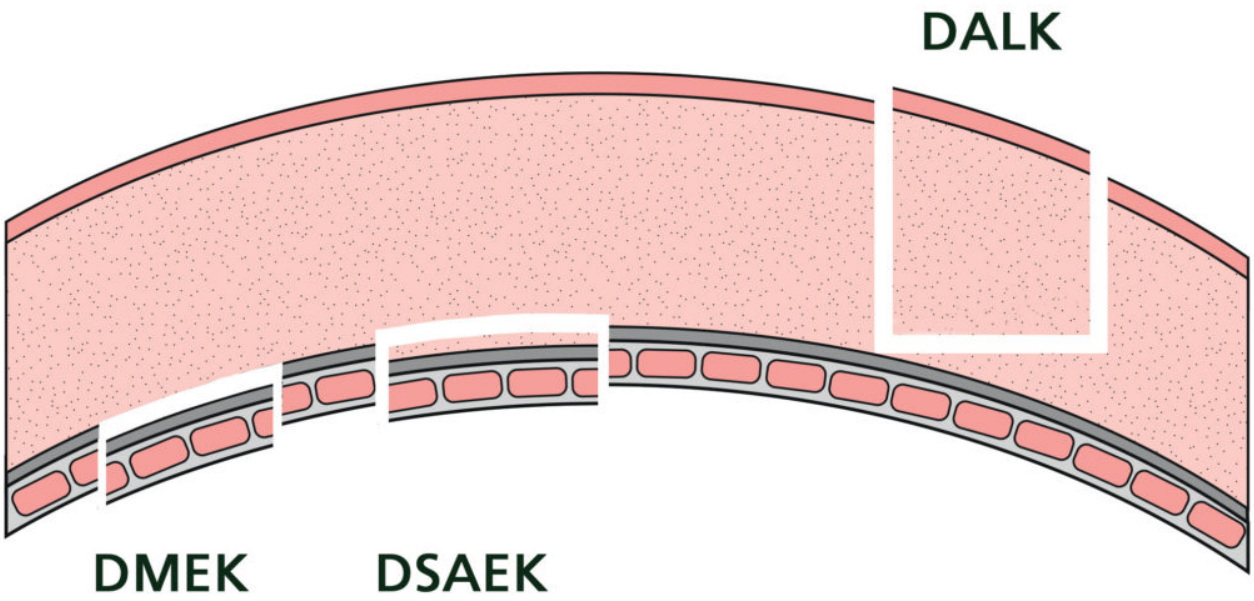

Fig. 1. Schematic illustration of different lamellar keratoplasties. DALK = Deep anterior lamellar keratoplasty. Epithelium and complete stroma is transplanted. DMEK = Descemet membrane endothelial keratoplasty. Endothelium and Descemet's membrane are transplanted. DSAEK = Descemet's stripping automated endothelial keratoplasty. Endothelium, Descemet's membrane and thin layer of corneal stroma is transplanted. With friendly permission of MedizinFotoKoeln.

Due to a physiological suppression of the immune system of the anterior segment of the eye, penetrating keratoplasty (PK) is very successful and represents the most frequent solid tissue transplantation worldwide. However, some patients will experience graft rejection with consecutive graft failure in about 25 % within 6 years after PK. The risk of graft failure is even more pronounced in prevascularized so called high-risk corneas and can be as high as 62 % within 6 years after PK.

In recent years, ophthalmic surgeons increasingly started to split corneal grafts in different layers, not only to improve the visual outcome after surgery but also to reduce the risk of graft failure. New techniques allow for a microinvasive surgical treatment of corneal disorders to selectively replace the affected or opacified corneal layer only and preserve unaffected corneal layers of the recipient's cornea.

In this context, three different techniques for lamellar keratoplasty have established as standard procedure during the last decade for replacing diseased layers of the cornea, namely Deep Anterior Lamellar Keratoplasty (DALK), Descemet's stripping Automated Endothelial Keratoplasty (DSAEK) and Descemet Membrane Endothelial Keratoplasty (DMEK) (Fig. 1.).

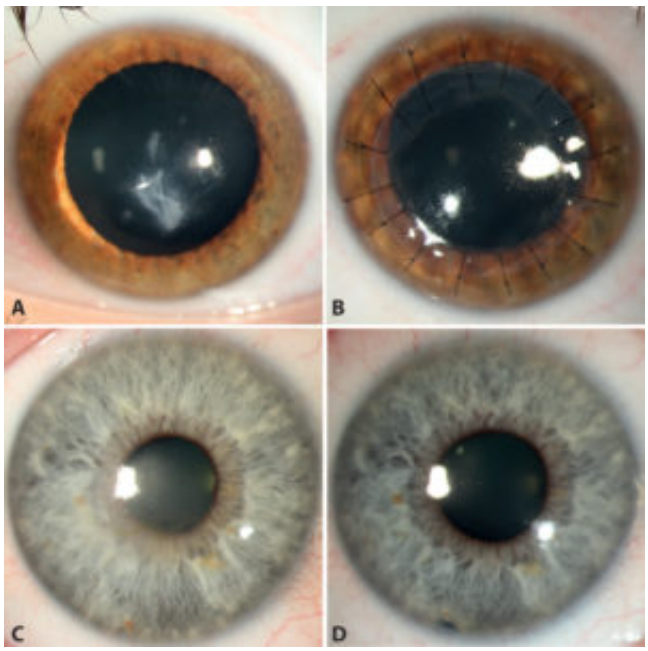

Fig. 2. Examples of anterior (A + B) and posterior (C+D) lamellar keratoplasties. A) A central scar in the anterior stroma is visible. B) After DALK surgery the scar is removed and the anterior stroma is optically clear. The transplant is fixed by sutures. C) A diffuse corneal opacification is visible secondary due to a corneal endothelial disease called Fuchs Endothelial Dystrophy. D Opacification has completely disappeared after the replacement of diseased corneal endothelial cells by healthy donor cells by DMEK. Notice: No sutures are necessary as the transplant carrying the endothelial cells is attached to the posterior stroma of the cornea intraoperatively just by an air

bubble injection.

Whereas DSAEK and DMEK are lamellar keratoplasties for the selective replacement of the posterior part of the cornea (diseased corneal endothelium and its underlying basement membrane called the Descemet's membrane; www.dmek.de), DALK has become an established method for the selective replacement of the corneal stroma.

Especially in situations, where only the corneal stroma is affected, DALK offers the patient an efficient alternative to PK, without the need to open the eye during the surgery and thus simultaneously reduces the risk of intraoperative hypotonia and postoperative intraocular infections (Fig. 2.). Since this technique preserves the patient's own corneal endothelial cells, no graft rejections against this delicate structure can occur.

Despite these advantages the number of DALK procedures performed each year remains constantly low in many countries. One reason could be that techniques for the complete removal of corneal stroma down to the level of Descemet's membrane comprises some complexity and at the same time intraoperative conversion to PK has to be performed in some cases due to intraoperative rupture of Descemet's membrane. Moreover, interface-related and DALK-specific complications exist which can contribute to an unfavorable visual outcome. Most of these complications, such as incomplete attachment of Descemet's membrane or opacifications within the interface between Descemet's membrane and the posterior corneal stoma can be resolved by adequate measures making PK for revision barely necessary. As visual acuity and the refractive outcome does not differ between PK and DALK, the benefits of DALK - lack of endothelial immune reaction, higher postoperative endothelial cell density and increased ocular stability during surgery - outweigh the risk of additional complications and DALK should therefore be performed whenever appropriate.

The grafted tissue in the two techniques of lamellar corneal transplantation, DALK and DMEK, show only little immunogenicity and therefore only few graft rejections as the leading cause for graft failure after corneal transplantation occur after these procedures.

In summary, lamellar keratoplasties, especially DMEK and DALK, are emerging micro-invasive and safe alternatives for PK offering excellent visual results by simultaneously reducing the rate of intra- and postoperative complications including graft rejections as the leading cause for graft failure.

Sebastian Siebelmann, Claus Cursiefen *and* ***Björn Bachmann***
Uniklinik Köln, Zentrum für Augenheilkunde, Köln, Germany

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