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Stromal Bowman layer preparation and implantation: an alternative method to prevent further progression in advanced keratoconus

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Purpose

To present a novel method for harvesting Bowman layer (BL) grafts from corneo-scleral rims, enabling to perform two surgeries from one donor cornea, descemet membrane endothelial keratoplasty (DMEK) and BL transplantation. The BL grafts were used to reduce and stabilize ectasia in eyes with advanced keratoconus (KC) not eligible for UV-crosslinking, in order to postpone penetrating keratoplasty (PK) or deep anterior lamellar keratoplasty (DALK).

Background

In advanced cases of KC, UV-crosslinking to stabilize ectasia may not be an option due to excessive corneal thinning.[1] DALK and PK may be complicated in these cases due to wound healing- and suture related problems and allograft rejection.[2]
A stromal BL implant may serve as a an effective splint, stiffening the cornea enabling further contact lens wear and thereby postponing DALK or PK.

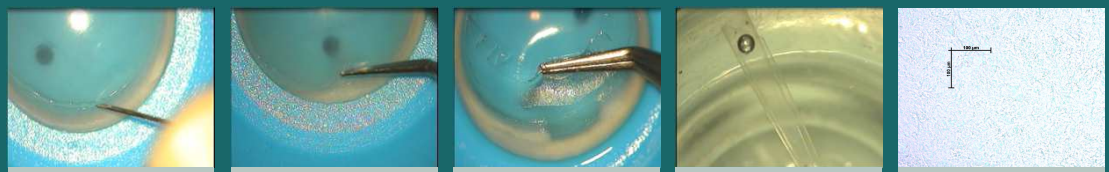
Materials & Methods

22 BL grafts, prepared from whole donor globes or donor corneas, were implanted in eyes with progressive advanced KC not eligible for UV crosslinking of 19 patients (17 to 72 years old).

Before and up to 36 months after BL transplantation (mean follow-up 21 (±7) months), best corrected visual acuity, corneal topography and complications were recorded.

Bowman layer preparation on artificial anterior chamber[3]

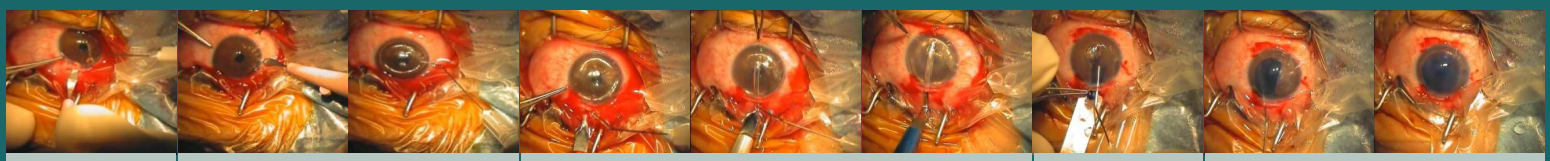
1. Mount anterior remnant on artificial anterior chamber
2. Remove epithelium
3. Prepare Descemet membrane for DMEK surgery
4. Score BL in periphery using 30g needle
5. Push the edge of BL using McPherson forceps
6. Grab and pull BL off the stroma in a circular motion



Marking | Push marked edge | Grab BL and pull | BL forms a roll | BL 100 x magnified

Bowman layer implantation[3]

A mid-stromal manual dissection was made and a donor Bowman layer graft was positioned into the stromal pocket.



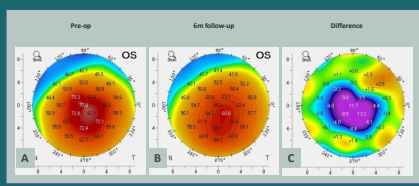
Scleral tunnel | Paracentesis | Air fill | Lamellar dissection | Implantation | Unrolling | Final position

Results

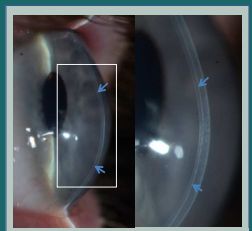
Preparation: No differences were observed between BL grafts prepared from whole donor eyes or from donor corneal scleral rims

Intervention: Two intra-operative perforations of Descemet membrane

Postoperative:
- → Mean best spectacle corrected visual acuity improved from before to 12 months after surgery (P<0.001)
- → Mean best contact lens corrected visual acuity remained stable (P=0.105)
- → Mean maximum keratometry decreased from 77.8 (±6.2) D to 70.3 (±4.5) D (P<0.001), and remained stable thereafter (P≤0.060)



Topography (A - B) and related difference map (C) of a cornea before (A) and at 6 months after BL transplantation (B).



Slit-lamp image of an eye at 6 months after BL transplantation. The BL transplant is visible within the recipient stroma (blue arrows). However, the cornea is clear, without any interface haze or stromal reaction.

Conclusion

Bowman layer transplantation may be safe and effective in halting the progression of ectasia in eyes with advanced keratoconus, and may therefore reduce or delay the need for penetrating or anterior lamellar keratoplasty and their associated complications.

References

1.Chan E, Snibson GR. Clin Exp Optom. 2013;96:155-64
2.Williams KA, Muehlberg SM, et al. Eye. 1995;9:219-27
3.van Dijk K, Parker J, et al. JAMA Ophthalmol 2014;132:495-501

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