High accuracy single-pass Ultrathin DSAEK (UT-DSAEK) with the SLc Expert Microkeratome®

F. Schaub, S. Roters, P. Enders, C. Cursiefen, B.O. Bachmann
Department of Ophthalmology, University of Cologne, Cologne, Germany

Purpose
"Descemet Stripping Automated Endothelial Keratoplasty" (DSAEK) and "Descemet Membrane Endothelial Keratoplasty" (DMEK) are established lamellar techniques for corneal replacement in endothelial pathologies requiring keratoplasty. Combining the benefits of both techniques (DMEK and DSAEK), ultrathin microkeratome-assisted DSAEK (UT-DSAEK) allows grafting in eyes with complex disorders of the anterior segment like in DSAEK while approaching functional results and eventually also low immunogenicity of that of DMEK. First experiences with this novel and innovative technology are represented (SLc Expert Mikrokkeratom® (Gebauer, Neuhausen, Germany)).

Materials and Methods
Patients (n = 5):
- Complex anterior segment pathologies (n = 5).
- Corneal endothelial decompensation after graft failure after perforating keratoplasty (n = 3), bullous keratopathy related to glaucoma surgery (n = 2).
- Extracorneal limitations of visual acuity (n = 3).

Follow up examinations:
- Day 1-3, 1 month, 3 months.
- Parameters: Visual acuity, endothelial cell density, corneal thickness (anterior segment OCT (AS-OCT)), graft thickness (AS-OCT), rebubbling-rate.

SLc Expert Microkeratome®:
- Stainless steel and polyetheretherketone (PEEK),
- Oscillation speed 3000 U/min,
- Cutting speed 0.7 mm/s,
- Vacuum 0.9 mbar.

Interventions:
- Day 1: Preparation of UT-DSAEK graft with the SLc Expert Microkeratome®,
- Day 2: Transplantation of UT-DSAEK graft.

AS-OCT examinations:
- Measurements of pre- and postoperative central and peripheral corneal/graft thickness.

Results
All donor preparations were performed without complications.
In all cases the deviations in central graft thickness to targeted thickness were less than 20 µm at each time point (average deviation to target thickness directly after preparation: 13.36 ± 6.61 µm, p = 0.445; at 1 month: 4.0 ± 5.73 µm, p = 0.222; at 3 months: 5.53 ± 6.63 µm, p = 0.097).
- Peripheral graft thickness showed uniformity in relation to cutting direction (p = 0.146).
- In two patients one additional rebubbling was necessary due to partial graft detachment.

Table 1: UT-DSAEK graft thickness directly after preparation and central and peripheral thickness in recipient eyes during the observation period. Target thickness (µm) is compared with the central and peripheral thickness of UT-DSAEK grafts directly after preparation as well as 1 and 3 months after transplantation (± SD). Measurements were obtained by anterior-segment optical coherence tomography examinations (AS-OCT). P-values of performed students t test are given (p < 0.05 was considered as statistically significant).

<table>
<thead>
<tr>
<th>Target central graft thickness (µm)</th>
<th>Intraoperatively</th>
<th>1 month postoperatively</th>
<th>3 months postoperatively</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>central graft thickness (µm)</td>
<td>peripheral graft thickness (µm)</td>
<td>central graft thickness (µm)</td>
</tr>
<tr>
<td>1</td>
<td>80</td>
<td>62.25 (± 4.65)</td>
<td>119.38 (± 14.78)</td>
</tr>
<tr>
<td>2</td>
<td>78</td>
<td>58.5 (± 7.94)</td>
<td>79.38 (± 22.01)</td>
</tr>
<tr>
<td>3</td>
<td>70</td>
<td>72.0 (± 10.42)</td>
<td>121.50 (± 11.98)</td>
</tr>
<tr>
<td>4</td>
<td>60</td>
<td>77.0 (± 3.56)</td>
<td>97.25 (± 12.23)</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
<td>52.75 (± 6.08)</td>
<td>113.13 (± 14.24)</td>
</tr>
<tr>
<td>Mean (± SD)</td>
<td>65.6 (± 12.92)</td>
<td>64.5 (± 9.88)</td>
<td>106.13 (± 4.07)</td>
</tr>
<tr>
<td>p-value</td>
<td>0.445</td>
<td>0.011</td>
<td>0.022</td>
</tr>
</tbody>
</table>

Table 1: UT-DSAEK graft thickness directly after preparation and central and peripheral thickness in recipient eyes during the observation period. Target thickness (µm) is compared with the central and peripheral thickness of UT-DSAEK grafts directly after preparation as well as 1 and 3 months after transplantation (± SD). Measurements were obtained by anterior-segment optical coherence tomography examinations (AS-OCT). P-values of performed students t test are given (p < 0.05 was considered as statistically significant).

Conclusion
Graft preparation with the SLc Expert Microkeratome® is reliable with high accuracy, and transplantation of these very thin grafts can be performed without incident even in patients with complex anterior segment pathologies.

The SLc Expert Microkeratome® reliably cuts ultrathin grafts in thickness between 50 – 80 µm in a single-pass technique of so far unsurpassed accuracy.

Conflicts of interest: none.
We thank Gebauer Medizintechnik GmbH (Neuhausen, Germany) for providing the SLc Expert Microkeratome®.

Figure 1: Preparation of UT-DSAEK lamella by SLc Expert Microkeratome®.
a) The central and peripheral corneal thickness of the donor cornea is determined by Visante-OCT® (Anterior Segment Model 1000, Zeiss, Jena, Germany); b) Preparation of the donor cornea with the SLc Expert Microkeratome® with a single cut adjusted in depth to the donor corneal thickness. Vacuum (0.9 mbar) to the anterior surface is applied via a tube (arrow) during cutting ensuring a firm position in relation to the cutting blade; c) after preparation the thickness of the resulting lamella was controlled by AS-OCT (Visante-OCT® Anterior Segment Model 1000, Zeiss, Jena).

Figure 2: Anterior segment optical coherence tomography (AS-OCT) examinations of corneal thickness and graft thickness of donor button and recipients eye. a) Central corneal thickness of the donor button before preparation (Visante-OCT® Anterior Segment Model 1000, Zeiss, Jena); b) Central graft thickness directly after UT-DSAEK graft preparation (Visante-OCT® Anterior Segment Model 1000, Zeiss, Jena); c) Total corneal thickness and graft thickness in a recipients eye 1 month after UT-DSAEK (SPECTRALIS® Anterior Segment Modul, Spectral-Domain OCT, Heidelberg Engineering GmbH, Heidelberg, Germany).