Effect of paired radial incision orientation relative to DMEK scroll axis on the likelihood of triple scroll formation in young donor tissue

Peter Bedard, MS1, Christopher LaGassie, CEBT2, Mark Hansen, MD2, David Hardten, MD2, Joshua H. Hou, MD1,3
1Lions Gift of Sight
2Minnesota Eye Consultants
3University of Minnesota, Department of Ophthalmology & Visual Neurosciences

INTRODUCTION

Descemet’s Membrane Endothelial Keratoplasty (DMEK) is the preferred surgical treatment for endothelial diseases such as Fuchs’ dystrophy and bullous keratopathy. However, intraocular unscrolling of DMEK grafts can be challenging, particularly with younger donor tissue (age <50).1 Paired radial incisions, placed 120° apart, have been used to ease unscrolling in young donor tissue by encouraging grafts to adopt an open triple scroll conformation rather than a natural double or single scroll (Fig 1). 2

METHODS

• Human corneas with research consent from donors < 65 years old were obtained from the Lions Gift of Sight.
• Donor characteristics, including age, gender, death to preservation time, and diabetes status were recorded.
• For in vitro testing, pairs of 1mm long radial incisions spaced 120° apart were made with “Deep Well Trifold Cover” (Moria SA, Antony, France) after SCUBA peeling and trephination. Incisions were placed on opposing sides of the S-I axis (at 60° & 240°) or the N-T axis (at 120° & 300°) for mated pairs with donor age ≤65.
• Triple scroll formation was compared between S-I and N-T groups after grafts were submerged in saline and encouraged to triple scroll.
• Paired radial incisions location relative to donor eye orientation was recorded for in vivo testing of young (age <50) preloaded transplant DMEK tissues.
• Surgical videos from young donor tissue DMEK cases were reviewed. Triple scroll formation and unscrolling times were compared for grafts with S-I incisions vs. N-T incisions.

RESULTS

In Vitro DMEK scroll testing

Paired Peripheral Incisions in Descemet’s Membrane Endothelial Keratoplasty Grafts to Improve Graft Triple Scroll Formation

<table>
<thead>
<tr>
<th>Scroll Axis</th>
<th>Triplet scroll</th>
<th>No triplet scroll</th>
<th>% Triplet scroll</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical</td>
<td>3</td>
<td>5</td>
<td>37.5%</td>
</tr>
<tr>
<td>Horizontal</td>
<td>6</td>
<td>2</td>
<td>75.0%</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>7</td>
<td>56.3%</td>
</tr>
</tbody>
</table>

Fig 4. In vitro testing: Triple scroll formation by scroll axis

In Vivo surgical video review

DISCUSSION

• DMEK grafts strongly prefer to scroll around the vertical (S-I) axis.
• Stable triple scroll conformation is more likely to form when small paired incisions are aligned with horizontal (N-T) axis vs. vertical (S-I) from in vitro scroll submersion testing. Difference is not statistically significant (75% vs. 36%, Fisher exact test, p=0.314)
• The most likely triple scroll formation came from placing the incision in the nasal quadrant (4/6). The least likely was superior quadrant (1/4)
• The trend for a stable triple scrolls to form more easily with horizontal vs. vertically aligned paired incisions was reflected in vivo (100% vs 67%, respectively) based on review of DMEK surgical videos.
• Paired incisions assisted in holding the graft open in a triple scroll conformation 83% of the time in surgery.
• Surgical unrolling times were similar between horizontal and vertically aligned paired incision groups (5m:10s vs. 4m:26s, respectively)
• The DMEK scroll axis may vary slightly by donor, but eye orientation is a fixed visual cue that can be referenced for incision placement prior to scrolling of the free-floating DMEK graft.
• Placement of incisions on the horizontal axis is a simple intervention that could increase ease of using younger donor tissue.
• All attempted sub-50 yr old DMEK tissues were unscrolled in under 8 minutes, demonstrating it is feasible to use younger donor tissue. Adding 41-50 year olds would increase eligible donor pool by 15% (54,315 vs. 47,230). 4
• DMEK tissues from young donors can be prepared by eye banks with good success. In a larger unpublished case study of >50 donor DMEK transplant tissue preparations (which this study was part of) the source eye bank had 1 failure in 15 attempts, and the failure was with diabetic tissue, a known cause of tissue prep failure.

REFERENCES


4798 - B0091