

## Review Article

# Corneal Endothelial Cell Loss in Glaucoma Treatment Procedures: A Brief Review

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### Abstract

Glaucoma surgeons should be careful about damage to the corneal endothelial cells during glaucoma surgeries particularly during glaucoma drainage device implantation. The patients should be monitored for possible corneal decompensation. Also shunt procedures should be performed with a wider tube corneal angle to avoid possible endothelial cell damage. Here we briefly review corneal endothelial cell loss in different glaucoma treatment methods.

**Keywords:** Cornea; Endothelial Cell Loss; Glaucoma; Review.

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## Introduction

Glaucoma surgeries cause a reduction in endothelial cell density but occasionally corneal decompensation may occur<sup>1</sup>. This is more important considering that glaucoma patients have lower endothelial cell count in comparison with normal individuals<sup>2</sup>. The amount of endothelial cell loss can be influenced by previous corneal diseases, severity and duration of high intraocular pressure and history of other intraocular procedures<sup>1</sup>. Here we briefly review corneal endothelial cell loss in different glaucoma treatment methods.

### *Endothelial cell loss in trabeculectomy*

Endothelial cell loss after trabeculectomy is reported to be 4.9 % to 10.5 %<sup>3-5</sup>. One-site approach for trabeculectomy causes less endothelial cell loss compared to two site approach. Viscoelastic materials can reduce the toxic effects of antiproliferative agents used in trabeculectomy<sup>1,6</sup>. Overhanging blebs are more susceptible to corneal decompensation<sup>1</sup>. Corneal endothelial cell loss happens after conventional trabeculectomy with or without anti-fibrotic agents, but it is more profound after surgery with anti-fibrotic agents<sup>3,7,8</sup>. The endothelial cell loss may be local to Mitomycin C application site<sup>9</sup>. Considering the type of glaucoma; trabeculectomy in uveitic glaucoma or pseudoexfoliation syndrome is more susceptible to corneal endothelial cell loss<sup>10</sup>.

### *Endothelial cell loss in phacotrabeculectomy*

Endothelial cell loss after phacotrabeculectomy is reported to be between 6.1% to 15%<sup>4,11</sup>. The rate of endothelial cell loss is lower in one step phacotrabeculectomy in comparison with two step surgery (trabeculectomy few months

after phacoemulsification)<sup>4,5,11</sup>. Corneal endothelial cell loss seems to be higher in the two-site method in comparison with one-site method<sup>11-13</sup>.

### *Endothelial cell loss in shunt surgery*

Corneal endothelial cell loss in the shunt implantation is greater and more progressive than trabeculectomy independent of whether the tube is touching the cornea or not<sup>14,15</sup>. Corneal endothelial cell loss after Ahmed glaucoma valve implantation has been reported to be 5.8 % at 1 month, 11.5 % at 6 months, 15.3 % at 12 months, 16.6 % at 18 months, and 18.6 % at 24 months after surgery with higher endothelial cell loss at the tube insertion quadrant of the cornea<sup>16,17</sup>. Exfoliation glaucoma and narrower tube-corneal angle are the risk factors for higher endothelial cell loss<sup>17</sup>.

Contrary to other glaucoma surgeries, shunt procedures can cause progressive endothelial cell loss, especially in children due to higher probability of tube endothelial touch<sup>1</sup>. There is no difference considering endothelial cell loss between different types of shunt devices, but corneal edema has been reported to be more frequent when using silicone plates compared to polypropylene in some studies<sup>18,19</sup>. Inflammation or its sequelae, such as peripheral anterior synechiae (PAS), may be a risk factor for endothelial cell loss<sup>20,21</sup>. One theory regarding the cause of endothelial cell loss in shunt surgery is aqueous movement toward tube and changes in environment around it<sup>20</sup>. This theory is supported by the fact that endothelial cell loss is more prominent around the tube insertion point and the finding that tubes closer to the corneal endothelium cause more endothelial cell loss<sup>16,22</sup>. The tube as a foreign body in the anterior chamber can touch

the cornea during blinking or lid squeezing<sup>19</sup>. So tube insertion in the vitreous cavity or ciliary sulcus may cause less endothelial cell loss compared to insertion in the anterior chamber<sup>23</sup>.

#### *Endothelial cell loss in deep sclerectomy*

Because of lower probability of Descemet's membrane detachment during deep sclerectomy and viscocanalostomy, corneal edema especially in a localized pattern is expected with a lower rate after these surgeries in comparison to trabeculectomy<sup>24-26</sup>.

#### *Endothelial cell loss in micro invasive glaucoma surgeries (MIGS)*

The endothelial cell loss after phacoemulsification combined with MIGS is comparable to the cataract surgery alone<sup>27</sup>. Endothelial cell loss following phacoemulsification becomes stable after 3 months while when combined with micro invasive glaucoma surgeries the loss might continue up to 5 years postoperatively<sup>28</sup>.

#### **Discussion**

Endothelial cell loss after glaucoma surgery is a serious problem in patients undergoing

glaucoma treatment procedures especially when a drainage device is used<sup>14</sup>.

Tube versus Trabeculectomy (TVT) study have shown comparable results considering the endothelial cell loss between trabeculectomy and aqueous shunts, but the corneal decompensation occurred more frequently after shunt procedures<sup>29</sup>.

The proximity of the tube to the corneal endothelium, surgical trauma, narrow tube corneal angle and presence of exfoliation glaucoma are the risk factors for higher endothelial cell loss<sup>17</sup>. It is safer to insert the tube far from the corneal endothelium and with a higher tube-cornea angle<sup>30</sup>.

#### **Conclusion**

The degree of corneal endothelial cell loss after glaucoma treatment procedures is not similar. The surgeon should consider this fact when choosing the surgical method for treatment of their patients.

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#### Footnotes and Financial Disclosures

#### Conflict of Interest:

The authors have no conflict of interest with the subject matter of the present study.