

Original Article

# Morphometric changes of corneal endothelial cells following intracameral air for micro perforation of the Descemet Membrane during big-bubble deep anterior lamellar keratoplasty



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## Abstract

**Aim:** The aim of this study was to assess the effect of intracameral air on the endothelial cell morphometrics.

**Patients and methods:** This is a retrospective controlled interventional cohort study of 26 patients (18 males and 8 females) who underwent unilateral deep anterior lamellar keratoplasty (DALK) for moderate keratoconus. The DALK patients were divided into two groups: a treatment group (14), which had micro perforations of the Descemet Membrane (DM) intraoperatively and received intracameral air at the end of the surgery; and an independent control group (12), which had no micro perforation and thus no intracameral air was injected. Postoperative best corrected visual acuity (BCVA), sphere, cylinder, spherical equivalent (SEQ), central corneal thickness, and endothelial cell morphometric features consisted of the endothelial cell density (ECD), polymegathism, and pleomorphism were compared between treatment and control groups.

**Results:** The mean BCVA was  $0.36 \pm 0.36$  logMAR in the treatment group and  $0.17 \pm 0.11$  logMAR in the control group ( $p = 0.081$ ), and the mean corneal thickness was  $507.86 \pm 62.69$   $\mu\text{m}$  in the treatment group and  $525.67 \pm 37.54$   $\mu\text{m}$  in the control group air ( $p = 0.399$ ). Furthermore, the mean sphere was  $-5.14 \pm 4.17\text{D}$  and  $-1.02 \pm 3.29\text{D}$ , the mean cylinder was  $-3.16 \pm 2.20\text{D}$  and  $-2.88 \pm 1.21\text{D}$ , and the mean SEQ was  $-6.72 \pm 4.66\text{D}$  and  $-2.46 \pm 3.14\text{D}$  and in the treatment and control groups respectively ( $p = 0.011$ ,  $0.693$ , and  $0.013$ ). As to morphometric features, the mean ECD was  $2176.76 \pm 549.18$  cell/ $\text{mm}^2$  and  $2257.30 \pm 436.12$  cell/ $\text{mm}^2$  in the treatment and control groups respectively ( $p = 0.686$ ), and the mean pleomorphism  $0.48 \pm 0.09$  and  $0.54 \pm 0.10$  in the treatment and control groups respectively ( $p = 0.139$ ). In contrast, the mean polymegathism was  $0.37 \pm 0.06$  and  $0.31 \pm 0.05$  in the treatment and control groups respectively ( $p = 0.009$ ).

**Conclusion:** The presence of air inside the anterior chamber for a short term may not cause further endothelial cell loss and can be safely performed to prevent postoperative Descemet Membrane detachment in case of micro perforations.

**Keywords:** Keratoconus, Keratoplasty, Endothelial cell density, Polymegathism, Pleomorphism

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## Introduction

Endothelial Cell Density (ECD) plays a major role in the survival of keratoplasty procedures, whether therapeutic<sup>1</sup> or optical, penetrating or partial thickness and anterior<sup>2-4</sup> or posterior.<sup>5</sup> Hence, much research has focused on ECD as an important factor when comparing survival of various types of keratoplasties.<sup>6-8</sup> Deep Anterior Lamellar Keratoplasty (DALK) is a relatively newer surgical technique as compared to Penetrating Keratoplasty (PKP), usually performed in diseases of the cornea with stromal disease and a healthy endothelium. Various studies have demonstrated a low rate of endothelial cell loss in DALK compared to PKP.<sup>7,9-14</sup> However, the surgical technique of DALK is very delicate and, surgery may be complicated by micro perforation of the DM in 9.3% up to 32% of the cases.<sup>15,16</sup> Micro perforation may occur during dissection of the host cornea, or while suturing of the donor graft. The micro perforation of the DM during DALK is often salvaged by intracameral injection of sterile air,<sup>17</sup> 20% sulfur hexafluoride (SF<sub>6</sub>),<sup>18</sup> perfluoropropane (C<sub>3</sub>F<sub>8</sub>),<sup>19</sup> or room air at the end of the surgery, which might prevent the DM detachment postoperatively in many cases. However, in spite of sealing of micro perforation, use of intracameral air could increase the risk of further loss of endothelial cells. In other circumstances, macroperforation of the DM due to excessive air injection or improper surgical maneuvers may warrant conversion of the DALK into PKP.<sup>20</sup>

A few studies have compared features of endothelial cells in Patients that had DALK with and without intracameral air. Moreover, endothelial cell morphometrics have remained unstudied in the literature.

The aim of our study was to compare endothelial cell morphometric changes between Patients that underwent DALK with intracameral air for micro perforation and those that had surgery without any air injection.

## Materials and methods

In this controlled retrospective interventional cohort study at a tertiary care eye hospital, patients that had unilateral DALK by the first author between October 2010 and June 2014 were evaluated. The preoperative indication for DALK was moderate keratoconus. This study was approved by Institutional Review Board of the hospital and adhered to the principles of the Declaration of Helsinki.

The DALK patients were divided into two groups based on whether micro perforation of the DM occurred and intracameral air was injected at the end of the surgery (Treatment group) or no micro perforation occurred and thus no intracameral air was injected (Control group).

Retrieved data consisted of age at the time of surgery, gender, intraoperative injection of intracameral air for micro perforation of the DM, preoperative and postoperative sphere, cylinder, spherical equivalent (SEQ), and best corrected distant visual acuity (BCVA) (Converted to LogMAR). In addition, optical central corneal thickness (CCT) and endothelial cell morphometrics of both Patients were collected postoperatively which included ECD, cell size, coefficient of variation (related to polymegathism: a variation in size), and percent of hexagonal cells or hexagonality (inversely related to pleomorphism: a variation in shape), together with the time of endothelium specular microscopy. The mean

endothelial cell area is related to ECD via the equation:  $10^6 / \text{ECD}$ ; consequently, a loss in the ECD causes enlargement of the mean endothelial cell area. On the other hand, the equation used to calculate pleomorphism is standard deviation divided by mean area of the endothelial cells. Patients with a reliable specular photomicrograph and sample size of more than 30 were included in the study. Endothelial cell microscopy and optical pachymetry of CCT were conducted using noncontact semi-automated specular microscopy (SP-3000P, Topcon Medical Systems, Oakland, NJ, USA) by moving the instrument forward to backward and right to left to get three-dot mires in focus; then the instrument would take the endothelial image and analyze it automatically. In specular microscopy, the light does not pass through the cornea; instead, the light is reflected from the cornea in a mirror-like fashion. The examined eye is not touch in the noncontact microscopy; therefore, it is comfortable for the patient. Nonetheless, the noncontact microscopy yields a lower magnification compared to the contact microscopy but a larger field which makes non-contact microscopy suitable for counting cells.

## Surgical technique

All patients signed informed consent to undergo DALK with slight modifications by the first author. All surgeries were performed under general anesthesia. Trephination was carried out with Hessburg-Barron trephines (Katena Products, Denville, NJ, USA). Donor was punched with diameter 0.25 mm more than the recipient diameter. Recipient was trephined from 60% to 80% of its thinnest corneal thickness. More than 50% of the corneal stroma was removed using a crescent blade. A Sarnicola blunt spatula (Asico Westmont, IL United States) was used to dissect corneal stroma and make a stromal track for air injection. A Sarnicola cannula was then used to inject room air using the same track made by the blunt spatula to form a big bubble, as originally described by Sarincola and Toro.<sup>23</sup> Injection was stopped as air approached the trephination site. Peripheral paracentesis was performed to lower the intraocular pressure raised by the presence of the big bubble in the anterior chamber. Superficial cut was performed to collapse the bubble and the stroma was excised with corneal scissors. The punched donor tissue was prepared by manually removing the DM with the help of trypan blue dye and dry Weck-Cel sponges. The graft was secured via 16 interrupted 10-0 nylon sutures or 8 bite continuous and 8 interrupted suture combinations. In the intracameral air DALK group, two cases received interrupted sutures and twelve cases received combination of interrupted and continuous sutures. In non-intracameral air DALK group, six cases received interrupted sutures, four cases received combination of interrupted and continuous sutures, and two cases were not documented. The Big bubble was achieved in all cases and manual dissection to reach the Descemet Membrane was not performed in any case.

If micro perforation of the DM was noticed during dissection of anterior lamella, the surgery was continued and completed as usual. However, unfiltered room air was injected to fill approximately 60% of the anterior chamber with an air bubble to help seal the perforation. In cases of macroperforation of the DM, where a gush of aqueous was released and anterior chamber shallowed, the surgery was converted

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