



# Deep anterior lamellar keratoplasty for keratectasia after laser in situ keratomileusis

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**PURPOSE:** To assess the efficacy of deep anterior lamellar keratoplasty (DALK) for treating post-LASIK keratectasia.

**SETTING:** Poostchi Eye Research Center, Shiraz University of Medical Sciences, Shiraz, Iran.

**DESIGN:** Retrospective interventional cases series.

**METHODS:** The same surgeon performed all DALK procedures using the Melles manual technique. The preoperative and postoperative corrected distance visual acuity (CDVA), spherical equivalent (SE) refraction, keratometry (K) readings, and endothelial cell profiles were compared.

**RESULTS:** The cohort comprised 20 eyes of 18 patients (72% women) with a mean age of 29 years  $\pm$  4 (SD). The mean follow-up was 31.8  $\pm$  17.0 months (range 6 to 60 months). The mean Snellen CDVA improved significantly from 20/191 before DALK to 20/23 after DALK ( $P < .001$ ). The mean of the modulus of SE refraction was 11.9  $\pm$  6.6 diopters (D) and 11.4  $\pm$  4.3 D, respectively ( $P = .446$ ). The mean K value was 52.2  $\pm$  7.0 D before DALK and 46.0  $\pm$  1.9 D after DALK ( $P = .001$ ); the mean apical K value, 59.5  $\pm$  5.1 D and 49.9  $\pm$  2.8 D, respectively ( $P < .001$ ); and the mean keratometric astigmatism, 4.3  $\pm$  2.4 D and 1.9  $\pm$  1.2 D, respectively ( $P = .003$ ). The endothelial cell profile did not change significantly, and no major complications related to DALK occurred. Twelve eyes had additional refractive procedures to correct residual ametropia.

**CONCLUSION:** Deep anterior lamellar keratoplasty using the Melles manual technique was effective and safe in restoring CDVA in patients with post-LASIK keratectasia; however, high residual ametropia was a common finding.

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Corneal ectasia after laser in situ keratomileusis (LASIK) refers to postoperative progressive stromal thinning and anterior and posterior corneal steepening that leads to progressive increases in myopia, irregular astigmatism, visual distortion, and loss of corrected distance visual acuity (CDVA).<sup>1,2</sup> Excimer laser surgery is a subtractive corneal procedure that violates the structural stability of the cornea and induces postoperative corneal weakening, which can lead to keratectasia in susceptible patients.<sup>1,3</sup> Risk factors for this complication include subnormal tensile strength of the cornea (eg, undiagnosed forme fruste

keratoconus), low residual stromal bed thickness, and multiple enhancement procedures.<sup>4</sup>

Based on the severity of the condition, spectacles, rigid gas-permeable (RGP) contact lenses,<sup>5</sup> and surgical interventions such as riboflavin and ultraviolet-A collagen crosslinking,<sup>6</sup> corneal flap suturing,<sup>7</sup> and intrastromal corneal ring segment implantation<sup>8,9</sup> have been put to promising use. Until recently, penetrating keratoplasty (PKP)<sup>10,11</sup> was the only definitive treatment for post-LASIK ectasia; however, because of potential serious complications, such as endothelial graft rejection, it was reserved for the most advanced cases.

Deep anterior lamellar keratoplasty (DALK), a partial-thickness graft that preserves the host endothelium and Descemet membrane, was introduced and has been used successfully as an alternate approach to treating corneal ectatic disorders and anterior corneal opacities.<sup>12,13</sup> Although interface haze and irregularities have generated concern about the visual outcomes of this procedure, it has the major advantage of leaving the healthy endothelial cells in place, thus avoiding endothelial graft rejection.

There are few reports of the use of DALK for the treatment of post-LASIK ectasia.<sup>14-16</sup> In 2 of them<sup>14,15</sup> (total of 7 eyes), DALK with the Melles manual technique was used, whereas in the other study<sup>16</sup> (11 eyes), the Anwar big-bubble technique was used. Although seemingly promising, the small cohorts, particularly in the studies using the Melles manual technique, prohibit valid intragroup statistical analysis of the visual and topographic outcomes.

In the present study, we evaluated the outcomes of DALK with the Melles manual technique for the treatment of post-LASIK ectasia in a larger cohort with long-term follow-up in some cases.

## PATIENTS AND METHODS

In this interventional case series, the medical charts of patients who had DALK for post-LASIK ectasia were retrospectively reviewed. Post-LASIK keratectasia was defined as a progressive decrease in visual acuity; the regression of myopia, astigmatism, or both after successful LASIK; and topographic changes indicating ectasia, including irregular astigmatism and inferior corneal steepening. Indications for DALK were poor CDVA, RGP contact lens intolerance, or inappropriate contact lens fit. The Ethics Committee, Shiraz University of Medical Sciences, approved the study protocol.

### Measurements

A complete ophthalmic evaluation, including Snellen CDVA, slitlamp biomicroscopy, tonometry, dilated fundus

examination, manifest refraction, and corneal topography, was performed before surgery. The central corneal thickness (CCT) and corneal endothelium were evaluated using a noncontact autofocus specular microscope (Topcon SP2000p, Topcon Corp.).<sup>17</sup>

Follow-up examinations were performed 3, 6, and 12 months after DALK as well as every 12 months thereafter. The postoperative assessment comprised CDVA, manifest refraction, tonometry, corneal topography, and specular microscopy. Intraoperative and postoperative complications were recorded. When additional surgical interventions such as phakic intraocular lens (pIOL) implantation were required, the results before the intervention were used in the analysis.

The main outcome measures were CDVA, spherical equivalent (SE) refraction, and keratometric astigmatism. Secondary outcome measures included mean keratometry (K) values, apical K values, CCT, endothelial cell density, mean cell area, the standard deviation of the mean cell area, and the coefficient of variation of the cell area.

### Surgical Technique

The same experienced anterior segment surgeon (R.S.) performed all DALK procedures using general anesthesia and a technique reported by Melles et al.<sup>18</sup> In brief, after a localized peritomy was performed 1.0 mm behind the superior limbus, a 5.0 mm incision (350  $\mu$ m depth) was created with a diamond knife. The aqueous humor was replaced with air through a self-sealing side port to help the surgeon gauge the depth of the corneal lamellar dissection. The corneal dissection was initially made with a diamond crescent knife; subsequently, deep dissection was continued with a deep lamellar corneal dissector (#6-607, Duckworth & Kent). Next, the scleral tunnel was sutured with 10-0 nylon and the corneal pocket filled with an ophthalmic viscosurgical device. Then, the cornea was trephined with a Hessburg-Barron suction trephine and the Descemet membrane was bared using curved microscissors.

Human cadaver donor eyes stored in cold-storage medium (Optisol) were obtained from the central eye bank of Iran. An 8.00 to 8.75 mm trephine was used to punch a 0.25 mm oversized donor button. The Descemet membrane with endothelium was gently stripped from the donor button using a cellulose sponge and a fine forceps. The donor button was sutured to the recipient stromal bed with 8 interrupted sutures and 2 rows of no-torque running 10-0 nylon sutures (Sharpoint, Angiotech).<sup>17</sup>

After surgery, patients were instructed to instill topical prednisolone acetate 1.0% 4 times daily during the first 2 weeks after surgery followed by a weekly tapering dose over the next 2 weeks. Subsequently, the patients received fluorometholone acetate 0.1% or loteprednol etabonate 0.5% 2 times daily for the next 3 months and then once daily thereafter until 12 months postoperatively. Topical chloramphenicol 0.5% was used 4 times daily during the first postoperative week, and topical lubricants were used as needed for several months.

To account for surgery-induced corneal astigmatism, the interrupted sutures on the steep meridian (determined by corneal topography) were removed at the 3-month follow-up examination. Loose sutures or sutures with associated abscesses were removed on diagnosis. The running sutures were left in place until 18 to 24 months after surgery, when all sutures were removed.

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