

## ORIGINAL RESEARCH

# FEMTOSECOND LASER ASSISTED DESCOMETRIC VERSUS PREDESCOMETRIC LAMELLAR KERATOPLASTY IN THE MANAGEMENT OF KERATOCONUS

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### ABSTRACT

**Introduction:** The objective of this study is to compare the outcomes of femtosecond laser assisted DALK with stromal dissection and femtosecond laser-assisted DALK without stromal dissection in the management of keratoconus.

**Materials and Methodology:** A total of 24 keratoconus affected eyes of 20 patients who had undergone femtosecond laser-assisted keratoplasty in the Department. Pre-descemetric group comprised of 13 eyes from 9 patients (8 males, 2 females) with the mean age of  $29.6 \pm 8.9$  years whereas in the descemetric group 11 eyes from 11 patients (8 males, 3 females). All those treated patients were clearly examined pre and postoperatively with respect to uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA).

**Results:** The differences of BCVA, corneal astigmatism, corneal curvature between the two groups were not statistically significant ( $p > 0.05$ ). Loss of endothelial cell density (ECD) was slightly higher in the descemetric group (6.6%) than the pre-descemetric group (4.8%). But the mean postoperative myopia was  $-9.45 \pm 7.47$  D in the pre-descemetric group when compared with  $-1.05 \pm 1.15$  D in descemetric group which was seemed to be statistically significant.

**Conclusion:** Femtosecond laser-assisted descemetric lamellar keratoplasty with big bubble technique has proved to be the alternative procedure to manage the patients with keratoconus when compared with femtosecond laser-assisted pre-descemetric lamellar keratoplasty.

**Keywords:** descemetric, pre-descemetric, femtosecond laser-assisted

### INTRODUCTION

Over the past few decades, the key procedure in managing the patient affected with keratoconus has been proved to be penetrating keratoplasty (PK).<sup>1</sup> Deep anterior lamellar keratoplasty (DALK) has been reported to be involving the removal of anterior diseased cornea while leaving the remaining deeper tissue intact and this procedure has been proved to be beneficial in reducing the major risks of graft rejection and various intraocular complications. But this has been seemed to be reporting with technically more challenging and might end up in loss of best corrected visual acuity (BCVA).<sup>2,3</sup>

Femtosecond laser technology is a procedure that possibly allows the corneal tissue to be cut without any thermal or shockwave damage involving the surrounding tissues. This treatment procedure has been introduced recently as the newer treatment procedure in treating the

corneal surgery. This newer technology has the major advantage of facilitating the preparation of donor and recipient tissue for the anterior, posterior and penetrating keratoplasty.<sup>4</sup> This technique has the greater precision and accuracy than any conventional and manual trephination techniques and it might end up in less irregularity of the interface and haze.<sup>5</sup> Several manual techniques that have been used to separate the planes between deep stroma and Descemet's membrane (DM). Therefore the significant topographical irregularities in the lamellar interface and poor visual acuity has been reported in some patients that were resulted from DALK procedure when compared with manually separating technique.<sup>6</sup> Therefore in this study, comparing the outcomes of femtosecond laser assisted descemetric versus predescemetric lamellar keratoplasty in the management of keratoconus.

## MATERIALS AND METHODOLOGY

A total of 24 keratoconus affected eyes of 20 patients who had undergone femtosecond laser-assisted keratoplasty in the Department of Institute. None of the patients included in the study were reported to be observed with no other ocular diseases. The donor tissues were obtained with 12 hours after the enucleated eyeballs from death of an individual due to accident. Inclusion criterial include those patients who are having moderate to advanced keratoconus without acute keratoconus. All the study participants were divided into femtosecond laser assisted DALK observed with 75% of stromal dissection (predescemetric) and using the big bubble technique with stromal resection (descemetric). Predescemetric group comprised of 13 eyes from 9 patients (8 males, 2 females) with the mean age of  $29.6 \pm 8.9$  years whereas in the descemetric group 11 eyes from 11 patients (8 males, 3 females). All those treated patients were clearly examined pre and postoperatively with respect to uncorrected visual acuity (UCVA) and best corrected visual acuity (BCVA). Slit-lamp examination, endothelial cell density (ECD), corneal topography and dilated fundus examination in dilated pupil were also equally assessed. Mean follow-up time that was followed in this study was up to 1 year. Statistical analysis was performed with SPSS software (Version 17, SPSS, Inc., Chicago, IL, USA). Data were calculated as mean  $\pm$  standard deviation differences of BCVA, myopia, corneal astigmatism, keratometry, central corneal thickness (CCT), and ECD between two groups were analysed using two independent samples t-test. A  $P < 0.05$  was defined statistically significant.

## RESULTS

The postoperative parameters between the two groups were summarized in table – 1. The differences of BCVA, corneal astigmatism, corneal curvature between the two groups were not statistically significant ( $p > 0.05$ ). Loss of endothelial cell density (ECD) was slightly higher in the descemetric group (6.6%) than the predescemetric group (4.8%). But the mean postoperative myopia was  $-9.45 \pm 7.47$  D in the predescemetric group when compared with  $-1.05 \pm 1.15$  D in descemetric group which was seemed to be statistically significant.

**Table - 1: The preoperative data in two groups**

Parameters	Predescemetric (n=13)	Descemetric (n=11)	P - value
UCVA	$0.09 \pm 0.08$ (0.01-0.21)	$0.06 \pm 0.05$ (0.01-0.12)	0.179
BCVA	$0.42 \pm 0.31$ (0.13-1.0)	$0.09 \pm 0.07$ (0.02-0.13)	0.001
Keratometry (D)	$56.08 \pm 10.93$ (40.68-70.72)	$63.79 \pm 10.33$ (48.59-75.61)	0.997
Corneal astigmatism (D)	$6.89 \pm 5.53$ (1.95-	$8.93 \pm 6.95$ (1.85-	0.433

	18.48)	25.51)	
<b>Corneal thickness (µm)</b>	393.96±49.89 (319-454.7)	361.87±51.57 (280.2-429.8)	0.779
<b>ECD (cells/mm<sup>2</sup>)</b>	2713.5±300.7 (2198.7-3295.6)	3011.1±353.22 (2400-3635)	0.851

**Table - 2: The postoperative data in two groups at the last examination**

<b>Parameters</b>	<b>Predescemetric (n=13)</b>	<b>Descemetric (n=11)</b>	<b>P - value</b>
<b>UCVA</b>	0.29±0.18 (0.07-0.63)	0.23±0.09 (0.13-0.42)	0.447
<b>BCVA</b>	0.53±0.25 (0.22-1.0)	0.51±0.21 (0.33-0.82)	0.761
<b>Myopia (D)</b>	-9.45±7.47 (0-20.2)	-1.05±1.15 (0-2.52)	0.03
<b>Keratometry (D)</b>	44.32±4.95 (40.93-49.52)	42.23±2.84 (37.25-46.54)	0.209
<b>Corneal astigmatism (D)</b>	3.75±2.57 (1.46-8.73)	3.23±3.13 (0.49-9.77)	0.685
<b>Corneal thickness (µm)</b>	484.42±53.73 (389-598.2)	472.41±41.73 (431.22-550)	0.592
<b>ECD (cells/mm<sup>2</sup>)</b>	2589.2±398.2 (2172.5-3324.2)	2817.8±494.6 (1915.1-3501)	0.261
<b>Loss of ECD (%)</b>	4.8	6.5	0.261

## DISCUSSION

Keratoconus has gained wide acceptance that the lamellar keratoplasty (LK) is mandatory for the effective treatment of moderate to advanced keratoconus and the acute advanced keratoconus with the ruptured DM is necessary to be treated with PKP. The major benefit of this lamellar keratoplasty is the very minimal risk of having endothelial rejection.<sup>7,8</sup> In the earlier studies, UCVA and BCVA have been relatively enhanced by femtosecond laser assisted predescemetric for patients affected with moderate to advanced keratoconus. In patients whose stroma is found to be unhealthy in patients with keratoconus, the treatment mode has been changed from predescemetric to descemetric keratoplasty with big bubble technique.<sup>9</sup>

Anwar and Teichmann in the year 2002 was the first to perform DALK with big bubble technique. In this procedure, 60-80% thickness of the cornea was efficiently removed at first and air was injected between the deep stroma and descemetric membrane in order to separate the cornea with the added advantages of reduced surgical time, minimising the risk of perforation and eventually exposing the smooth surface. In this study, the difference of BCVA, corneal astigmatism, keratometry, and loss of ECD between the two groups was observed to be not statistically significant. ( $p>0.05$ ) The results that were obtained at the post-operative BCVA are similar to the values obtained from the study conducted by researchers like *Abdelkader* and *Kaufman*<sup>10</sup>, *Sarnicola*<sup>7</sup> and *Schiano-Lomoriello*<sup>11</sup> in which have indicated that no difference in BCVA between the predescemetric and the descemetric group while the visual recovery time is relatively faster in the descemetric than predescemetric group.

The preoperative mean thinnest corneal thickness, evaluated with ultrasound corneal pachymetry and with anterior segment OCT, was  $393.96 \pm 49.89 \mu\text{m}$  (range, 319.0–454.7  $\mu\text{m}$ ) in the predescemetic group and  $361.87 \pm 51.57 \mu\text{m}$  (range, 280.2–429.8  $\mu\text{m}$ ) in the descemetic group. The postoperative corneal mean thickness was  $484.42 \pm 53.73 \mu\text{m}$  (range, 389–598.2  $\mu\text{m}$ ) and  $472.41 \pm 41.73 \mu\text{m}$  (range, 431.20–550  $\mu\text{m}$ ) in the predescemetic group and descemetic group, respectively. Although there was no statistically significant difference in the CCT of the two groups, both groups have an improvement of thickness and restoring the corneal optical integrity and structure. The mean postoperative myopia is  $-9.45 \pm 7.47\text{D}$  in the predescemetic group and  $-1.05 \pm 1.15\text{D}$ . The results of descemetic group are in concordance with *Buzzonetti et al*<sup>12</sup> who have reported the mean postoperative myopia was  $-1.50 \pm 1.70\text{D}$  at 12 months after surgery following the 60-kHz IntraLase femtosecond laser-assisted DALK with big-bubble technique for keratoconus.

*Girard et al*<sup>13</sup> observed that the postoperative myopia has been relatively decreased when the diameter of donor graft is 0.25 mm smaller than the recipient graft in PKP for keratoconus. *Doyle et al*<sup>14</sup> quoted that the postoperative refraction could be manipulated toward acceptable ametropia with altering the size of the donor graft button. *Wang et al*<sup>15</sup> in their study who performed predescemetic LK and big-bubble descemetic LK for keratoconus manually, which there was no significant difference of postoperative myopic diopter between two groups ( $P > 0.05$ ). It was relatively from our results while it was possible to be significant difference of postoperative myopic diopter between predescemetic and descemetic groups using femtosecond laser as the postoperative corneal pattern is better in the patients with total stromal resection.

## CONCLUSION

To conclude, femtosecond laser-assisted descemetric lamellar keratoplasty with big bubble technique has proved to be the alternative procedure to manage the patients with keratoconus when compared with femtosecond laser-assisted predescemetric lamellar keratoplasty.

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