

Evaluation of central macular thickness after penetrating keratoplasty

Nagehan Can¹, Mete Guler¹, Elif Yusufoglu¹, Fatih Celik¹, Fatih Cem Gul¹, Ercan Ozsoy²

¹Elazig Training and Research Hospital, Department of Ophthalmology, Elazig, Turkey

²Haseki Training and Research Hospital, Department of Ophthalmology, Istanbul, Turkey

Abstract

Aim: To evaluate the changes in central macular thickness after penetrating keratoplasty.

Material and Methods: A total of 24 eyes of 24 patients who had undergone penetrating keratoplasty were included in the study. This study was performed retrospectively by reviewing the charts of the patients. Postoperative 1st week, 1st month, 3rd month, 6th month and 12th month mean total macular volume, central macular thickness, parafoveal area and perifoveal area thickness and retinal nerve fiber layer (RNFL) thickness results obtained with optic coherence tomography were compared. ANOVA test was used for statistical analysis.

Results: The postoperative 1st week, 1st month, 3rd month, 6th month and 12th month mean total macular volume measurements were $7.03 \pm 0.2 \text{ mm}^3$, $7.05 \pm 0.4 \text{ mm}^3$, $7.0 \pm 0.6 \text{ mm}^3$, $7.02 \pm 0.5 \text{ mm}^3$ and $6.12 \pm 0.6 \text{ mm}^3$, respectively. Mean central macular thickness measurements were $227.6 \pm 4.6 \mu\text{m}$, $228.7 \pm 5.5 \mu\text{m}$, $227.2 \pm 4.6 \mu\text{m}$, $227.5 \pm 7.1 \mu\text{m}$, $226.3 \pm 5.1 \mu\text{m}$ respectively; mean parafoveal area thickness measurements were $290.2 \pm 3.7 \mu\text{m}$, $289.9 \pm 7.8 \mu\text{m}$, $288.7 \pm 6.3 \mu\text{m}$, $288.8 \pm 4.7 \mu\text{m}$, $288.6 \pm 8.3 \mu\text{m}$ respectively, mean perifoveal area thickness measurements were $261.1 \pm 4.2 \mu\text{m}$, $261.4 \pm 1.9 \mu\text{m}$, $260.4 \pm 3.6 \mu\text{m}$, $259.8 \pm 2.7 \mu\text{m}$, $259.3 \pm 4.7 \mu\text{m}$ respectively, and mean RNFL thickness measurements were $106.54 \pm 11.28 \mu\text{m}$, $107.28 \pm 8.75 \mu\text{m}$, $107.45 \pm 13.64 \mu\text{m}$, $105.62 \pm 9.27 \mu\text{m}$, $105.16 \pm 12.74 \mu\text{m}$; respectively.

Conclusion: No significant change was seen in macular thickness after penetrating keratoplasty. Although the macular thickness increases in the early postoperative stage, it decreases in time.

Keywords: Penetrating Keratoplasty; Central Macular Thickness; Optic Coherence Tomography.

INTRODUCTION

Corneal disorders are the second most common cause of blindness in developing countries (1). Corneal disorders requiring corneal transplantation (CT) vary from region to region. Keratoconus is the most common cause of transplantation in some countries and bullous keratopathy in some others (2). CT is the most common organ transplantation (3). CT has a higher success rate than other organ transplantations because of the avascular structure and immunological characteristics of the cornea (4). Keratoplasty is the only treatment for blindness due to corneal disorders (5).

Postoperative macular edema is a well-known complication of cataract surgery. Although the pathogenesis of post-surgical macular edema is not fully clear, there is a strong relationship with the manipulations and prostaglandin secretion during surgery (6,7). Macular edema is a cause of decreased vision after penetrating keratoplasty (PK) (8,9).

Optic coherence tomography (OCT) is a fast and non-invasive diagnostic method used to evaluate macular thickness and postoperative macular edema (10,11).

We aimed to evaluate the changes in postoperative central macular thickness with OCT in patients who had undergone PK at our clinic in this study.

MATERIAL and METHODS

The 24 eyes of 24 patients who had undergone PK due to various reasons between November 2014 and September 2015 at the Elazig Training and Research Hospital were included in the study. Written informed consent had been obtained from the patients. This study was performed retrospectively by reviewing the charts of the patients. The data obtained from the records were gender, age, follow-up duration, complications, graft transparency and OCT results at various intervals. Patients who did not come to postoperative follow-ups and who developed graft rejection were not included in the study. Patients

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Corresponding Author: Ercan Ozsoy, Haseki Training and Research Hospital, Department of Ophthalmology, Istanbul, Turkey
E-mail: ercanozy@hotmail.com

with diseases such as diabetes and uveitis that may affect macular thickness and patients with a history of trauma or vitreoretinal surgery were not included in the study. Total macular volume, central macular thickness, parafoveal area and perifoveal area thicknesses and retinal nerve fiber layer (RNFL) thickness OCT (Optovue, Inc., Fremont, CA) results of all patients at the 1st week, 1st month, 3rd month, 6th month and 12th month were evaluated. The quality of pre-operative OCT images was not good due to the corneal disorders, therefore preoperative values were not included in the study. All OCT images were obtained by the same person after pupillary dilation with tropicamide. Fovea centred macular thickness and volume maps were established with the MM5 protocol. (Figure 1).

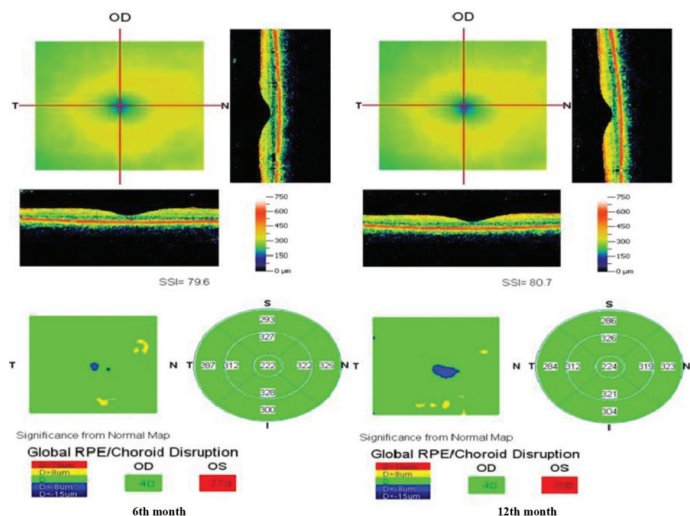


Figure 1. OCT image showing post-operative 6th and 12th month central macular thickness of a patient who underwent right keratoplasty.

The measurements were analysed and total macular volume, central macular thickness, parafoveal and perifoveal area thicknesses and RNFL thickness values were calculated.

Statistical evaluation was performed using the SPSS 20.0 (SPSS Inc., Chicago, IL, USA) program. The results were expressed as mean ± standard deviation. The normality test was performed for each variable. Since the data were compliant with a normal distribution, the One way ANOVA parametric test was used.

RESULTS

The patients included in the study consisted of 10 males and 10 females and the mean age was 39.42±6.5 years. The patients included in the study had been followed-up for a mean duration of 19.4±3.5 months. We found that 8 (33.3%) eyes had undergone surgery due to keratoconus hydrops sequelae, 7 (29.1%) eyes due to bullous keratopathy, 3 (12.5%) eyes due to corneal dystrophy, 3 (12.5%) eyes due to graft rejection and 3 (12.5%) eyes due to leukoma. Post-operative 1st week, 1st month, 3rd month, 6th month and 12th month mean total macular volume measurements were 7.03±0.2 mm³, 7.05±0.4 mm³, 7.0±0.6 mm³, 7.02±0.5 mm³ and 6.12±0.6 mm³, respectively. The mean central macular thickness measurements were 227.6±4.6 µm, 228.7±5.5 µm, 227.2±4.6 µm, 227.5±7.1 µm, 226.3±5.1 µm respectively; mean parafoveal area thickness measurements were 290.2±3.7 µm, 289.9±7.8 µm, 288.7±6.3 µm, 288.8±4.7 µm, 288.6±8.3 µm respectively, mean perifoveal area thickness measurements were 261.1±4.2 µm, 261.4±1.9 µm, 260.4±3.6 µm, 259.8±2.7 µm, 259.3±4.7 µm respectively, and mean RNFL thickness measurements were 106.54±11.28 µm, 107.28±8.75 µm, 107.45±13.64 µm, 105.62±9.27 µm, 105.16±12.74 µm, respectively (Table 1).

No significant difference was seen with the 1st week, 1st month, 3rd month, 6th month and 12th month comparisons of total macular volume, central macular thickness, parafoveal area thickness, perifoveal area thickness and RNFL thickness (p>0.05).

Table 1. Post-operative mean total macular volume, central macular thickness, parafoveal area thickness, perifoveal area thicknesses and RNFL thickness

	1st week	1st month	3rd month	6th month	12th month	P
Total macular volume (mm ³)	7.03±0.2	7.05±0.4	7.0±0.6	7.02±0.5	6.12±0.6	0.189
Central macular thickness (µm)	227.6±4.6	228.7±5.5	227.2±4.6	227.5±7.1	226.3±5.1	0.245
Parafoveal area thickness (µm)	290.2±3.7	289.9±7.8	288.7±6.3	288.8±4.7	288.6±8.3	0.288
Perifoveal area thickness (µm)	261.1±4.2	261.4±1.9	260.4±3.6	259.8±2.7	259.3±4.7	0.237
RNFL thickness (µm)	106.54±11.28	107.28±8.75	107.45±13.64	105.62±9.27	105.16±12.74	0.316

RNFL: Retinal Nerve Fiber Layer

DISCUSSION

Macular edema is one of the potential complications after keratoplasty. It can also develop due to various reasons

such as diabetic retinopathy, uveitis, retinal vascular occlusions and cataract surgery. Whatever the reason, macular edema can result in decreased vision if not diagnosed and treated. Although biomicroscopy, fundus

photography and fluorescein angiography are commonly used for the diagnosis of macular edema, the evaluation of their results may vary from person to person, and small changes in the early stages of macular edema may also be overlooked (12).

OCT is a non-invasive and non-contact imaging method that can measure retinal thickness and volume quantitatively. OCT can provide images of the vitreous, retina and choroid structure that cannot be obtained with other non-invasive methods. Besides, the retinal thickness measurements obtained with OCT are objective (13).

A study on postoperative macular thickness with OCT following deep anterior lamellar keratoplasty (DALK) or PK for keratoconus found that mean macular thickness increased after PK with a peak value around the 1st month and then decreased and returned to preoperative values at the 6th month. The same study found no change in macular thickness after DALK. They stated that the more stable macular thickness after DALK could be due to less manipulation compared to penetrating keratoplasty (14).

A study evaluated 43 PK and 19 DALK patients, who had undergone keratoplasty and combined surgeries for various reasons, regarding macular edema development with OCT and concluded that the surgical technique did not have any effect on macular edema development (15).

Another study compared the macular thickness with OCT between two groups at the post-operative 1st, 3rd and 6th month following PK and DALK for keratoconus and no significant difference was found. Although the post-operative 1st, 3rd and 6th month central macular thickness values were higher than the pre-operative values in both groups, but this increase was not statistically significant. The authors believed that the lack of a significant difference between the two groups although DALK was performed in a closed system were due to the fact that the big-bubble technique can disrupt the blood-retina barrier as much as PK and the long duration of DALK surgery (16).

While a significant macular thickness increase was present with OCT in the post-operative period after combined cataract surgery and Descemet's stripping automated endothelial keratoplasty (DSAEK), no significant change was observed in the patients who underwent DSAEK only in another study where DSAEK was performed by itself or combined with cataract surgery for Fuchs dystrophy or pseudophakic bullous keratopathy (17).

No significant change was found in central macular thickness after PK in our study. No significant change was also found in total macular volume, parafoveal area and perifoveal area thicknesses and RNFL thickness. Our study had a longer follow-up duration than other studies. The results of our study are also consistent with other studies.

Our limitations include the low number of patients, the various indications for PK and not including the preoperative macular thickness in the evaluation.

CONCLUSION

No significant change is seen in macular thickness after

PK. Although the macular thickness increases in the early postoperative stage, it decreases over time.

Conflicts of interest, The authors declare that there is no conflicts of interest.

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