Choroidal Thickness Changes in Eyes with Idiopathic Macular Hole After Pars Plana Vitrectomy and Gas Endotamponade

Ahmet ALTUN[1]

ABSTRACT

Purpose: To investigate the change in subfoveal choroidal thickness (SFCT) in eyes that underwent pars plana vitrectomy (PPV) for idiopathic macular hole (IMH).

Material and Methods: Eyes with unilateral IMH diagnosis and no other retinal pathology (Group 1) were included in this prospective and controlled study. The control group (Group 2) was formed with the healthy fellow eyes of the patients. PPV operation, inverted internal limiting membrane (ILM) flap technique and intraocular sulfur hexafluoride (SF_6) gas implantation were applied to eyes with IMH. SFCT was measured by optical coherence tomography with the enhanced depth imaging method in all eyes during the 6-month follow-up period at the first, second, third and sixth months.

Results: Sixty-four eyes of 32 patients were included in the study. The mean age of the patients was 67.3 years. The success rate in closing the macular hole was 93.75%. In the preoperative period, the mean SFCT in Group 1 (211.8 µm) was statistically significantly thinner than Group 2 (245.0 µm) ($p < 0.012$), and this difference became more pronounced after PPV in the 6-month postoperative follow-up period ($p < 0.000$)

Conclusion: Choroidal thickness in eyes with IMH may be thinner than in healthy fellow eyes, and this thinness may deepen after macular surgery and gas endotamponade application.

Keywords: Choroidal thickness, Macular hole, Vitrectomy, Sulfur hexafluoride, Enhanced depth imaging.

INTRODUCTION

Idiopathic macular hole (IMH), which was defined by Knapp for the first time in history and whose prevalence was reported to be 3.3 per thousand, develops due to traction at the vitromacular interface during posterior vitreous detachment.[1] Many treatment alternatives have been defined for IMH today. Pars plana vitrectomy (PPV), gas endotamponade, prone position, peeling of internal limiting membrane (ILM) or inverted ILM flap are the main treatment methods.[2, 3] Optical coherence tomography (OCT) enhanced depth imaging provides important information for clinicians in evaluating the structure and thickness of the choroid.[4] Changes in subfoveal choroidal thickness (SFCT) could be used to help diagnosing ocular diseases and to monitor their progression.[5] In this study, we aimed to investigate the change in SFCT in eyes that underwent PPV operation due to IMH, with inverted ILM flap technique and intraocular gas endotamponade. Before the study, we hypothesized that SFCT could get thinner due to the possible pressure of the gas endotroponade on the choroid.

MATERIAL AND METHODS

Patients who presented to our clinic between January 2018 and September 2019 and were diagnosed with unilateral IMH were included in this prospective and controlled study. Before the study, the approval of the Health Sciences University Ethics Committee and the informed consent of the patients were obtained and it was conducted in accordance with the principles of the Declaration of Helsinki.

1- Yrd. Doç. Dr., Bahcesehir University, Department of Ophthalmology, Istanbul, Turkey.

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Correspondence Adress:
Ahmet ALTUN
Bahcesehir University, Department of Ophthalmology, Istanbul, Turkey

Phone: +90 506 366 2876
E-mail: aaltun06@gmail.com

Eyes with retinal pathology other than IMH, previous vitreoretinal surgery, corneal pathology or cataract, and a history of uveitis or glaucoma, and patients with diabetes mellitus were excluded from the study (Grup 1). The control group (Group 2) was formed with the fellow healthy eyes of the patients. The macular hole was classified according to International Vitreomacular Traction Study Classification, that is small ≤250 µm, medium between >250 and ≤400 µm, and large >400 µm.[6] Eyes with large macular holes and recurrent cases where surgery failed were excluded from the study. Patients with diabetes mellitus, cataract, previous intraocular surgery history, or retinal pathology other than IMH were alson excluded from the study.

SFCT thickness was measured with the same device (Topcon 3D OCT 2000FA plus, Topcon, Tokyo, Japan) and by the same technician (AK). We measured choroidal thickness in the center of the fovea, as well as in the temporal and nasal regions 500 microns away from the foveola using enhanced depth imaging OCT. We determined SFCT by the average of these three measurements. We measured the distance between the outer edge of the hyperreflective band of the retinal pigment epithelium and the inner bordary of the scleral hyperreflectivity. All measurements were made between 11.00-13.00 hours to prevent diurnal differences. Group 1 eyes underwent 25 gauge PPV operation with inverted ILM flap technique and implantation of intraocular 20% SF_6 gas endotamponade. The patients were asked to be in the prone position for 5 days postoperatively. All vitroretinal surgeries were performed by the same surgeon (AA) that used same device (Constellation, Alcon, USA). Complete ophthalmologic examinations of the patients were performed before the study and monthly during the 6-month follow-up period. Best corrected visual acuity (BCVA) was measured with the Snellen chart and converted to logMAR (Logarithm of the Minimum Angle of Resolution) equivalents for statistical analysis.

The distribution of variables was measured by the Kolmogorov Simirnov test. Mann-Whitney U test was used to analyze quantitative independent data. Chi-square test was used in the analysis of qualitative independent data. Wilcoxon test was used to analyze dependent quantitative data. Statistical significance level was set at $p < 0.05$. SPSS 26.0 program was used in the analyzes.

RESULTS

A total of 64 eyes of 32 patients were included in the study. All patients had Caucasian race. The mean age of the patients was 67.3 ± 4.6 years and the F: M ratio was 21:11. While IMH was in the right eye in 18 of the patients, it was in the left eye in 14 of them. Fourteen of the patients were using 100 mg of acetylsalicylic acid for coronary artery disease, and 6 of them were using 0.4 mg of tamsulosin for benign prostatic hyperplasia. Eighteen of the patients had previously undergone bilateral cataract surgery with phacoemulsification technique and posterior capsulotomy with Nd: YAG laser. There was no development of cataract in any of the phakic eyes during the 6-month follow-up period. The success rate in closing the macular hole was 93.75% during the follow-up period. None of the eyes included in the study developed retinal detachment, uncontrolled increased intraocular pressure, hypotonia, macular edema, or retinal tears during the follow-up period. Two patients with recurrence of macular hole after the operation were excluded from the study.

The mean preoperative BCVA in Group 1 and Group 2 was 0.62 ± 0.17 and 0.11 ± 0.03 logMAR, respectively. Mean BCVA level was 0.32 ± 0.14, 0.28 ± 0.11 and 0.25 ± 0.08 logMAR in Group 1, and 0.10 ± 0.02, 0.11 ± 0.01 and 0.10 ± 0.02 logMAR in Group 2 at the postoperative first, third and sixth months, respectively. While the mean BCVA in the postoperative period improved at a statistically significant level in Group 1 compared to the preoperative period ($p < 0.05$), there was no significant change in Group 2 ($p > 0.05$). Mean BCVA level was statistically higher in Group 1 compared to Group 2 in both preoperative and postoperative 6-month follow-up period ($p < 0.01$) (Table 1).

Table 1: *Change in best corrected visual acuity of the groups.*

	Group 1 (eyes with IMH)		Group 2 (healthy fellow eye)		p
	Mean±SD	Median	Mean±SD	Median	
BCVA (logMAR)					
Preoperative	0.62 ± 0.17	0.69	0.11 ± 0.03	0.09	0.000 [m]
Postoperative 1st month	0.32 ± 0.14	0.39	0.10 ± 0.02	0.09	0.000 [m]
Postoperative 3rd month	0.28 ± 0.11	0.39	0.11 ± 0.01	0.09	0.000 [m]
Postoperative 6th month	0.25 ± 0.08	0.39	0.10 ± 0.02	0.09	0.000 [m]

[m] Mann-Whitney U test, **SD:** Standard deviation, **BCVA:** Best corrected visual acuity, **IMH:** Idiopathic macular hole, **logMAR:** Logarithm of the minimum angle of resolution

In the preoperative period, the mean SFCT in Group 1 and Group 2 was 211.8 ± 30.2 and 245.0 ± 50.6 µm, respectively. The mean SFCT in the postoperative period was 193.8 ± 25.9, 188.3 ± 21.7 and 187.4 ± 20.6 µm in Group 1, at the first, third and sixth months, respectively, while it was 243.8 ± 51.2, 245.1 ± 50.1 and 245.3 ± 50.5 µm in Group 2. In the preoperative period, the mean SFCT in Group 1 was statistically significantly thinner than Group 2 ($p < 0.012$), and this difference became more pronounced in the 6-month postoperative follow-up period ($p < 0.000$) (Table 2).

DISCUSSION

In our study, the mean SFCT in the preoperative period was significantly thinner in eyes with IMH compared to healthy fellow eyes. Zhang et al. reported in their meta-analysis study that SFCT was decreased in eyes with unilateral IMH compared to the control group.[7] Ahn et al. investigated the choroidal thickness at the fovea and at 1 and 3 mm superior, inferior, temporal, and nasal to the fovea after vitrectomy in eyes with IMH and idiopathic epiretinal membrane, and reported that in eyes operated for IMH position-dependent changes in choroidal thickness may develop in the early postoperative period due to gas endotamponade.[8] Zeng et al. investigated SFCT in eyes with unilateral IMH, and compared to healthy fellow and different control eyes in their cross-sectional study, and reported that SCFT was significantly thinner in eyes with IMH and fellow eyes compared to the control group, and claimed that these results may be due to the effect of choroidal perfusion in the pathogenesis of IMH.[9]

Another important factor on SFCT in vitrectomized eyes may be the type of endotamponade used and its possible pressure on the choroid. Odrobina et al. retrospectively investigated the change in choroidal thickness after vitrectomy and implantation of silicone endotamponades in eyes with proliferative vitropatinopathy, and reported that a reduction in choroidal thickness in eyes with silicone endotamponade.[10] Sayman Mutlubas et al. retrospectively investigated the change in SFCT in eyes treated with PPV and silicone endotamponade for the treatment of rhegmatogenous retinal detachment, and reported that the mean SCFT was thicker in the preoperative period compared to the healthy fellow eyes, but this increase regressed after PPV and the increase in thickness may have been caused by the uveoscleral outflow of the aqueous humor.[11] Giacuzzo et al. investigated the change in SFCT by dividing eyes into three groups, macula-on, paracentral macula-on and macula-off, that were underwent PPV and silicone endotamponade for the treatment of rhegmatogenous retinal detachment, and reported thickening in the macula-on group but thinningin paracentral macula-on and macula-off groups in SFCT.[12] Mirza et al. also investigated the change in SFCT in eyes that underwent PPV with silicone endotamponade for the treatment of regrmatogenous retinal detachment, and reported thinning in SFCT three months after PPV which is deepened one month after silicone removal, and the change in SFCT was not correlated with the amount of argon endolaser performed during surgery.[13] In our study, the mean SCFT in the preoperative period was thinner than healthy fellow eyes. In the 6-month follow-up period after PPV and intraocular SF_6 gas endotamponade implantation, the mean SFCT in eyes with IMH was statistically significantly thinner than in healthy fellow eyes. This deepened thinning we observed in our study may be due to the compression of the SF_6 endotamponade used during surgery on the choroid.

CONCLUSION

Subfoveal choroidal thickness in eyes with idiopathic macular hole is thinner than healthy fellow eyes, inverted ILM flap and SF_6 gas application may deepen thinning postoperatively

Table 2: *Change in subfoveal choroidal thickness of the groups.*

	Group 1 (eyes with IMH)		Group 2 (healthy fellow eye)		p
	Mean±SD/n-%	Median	Mean±SD/n-%	Median	
SFCT (µm)					
Preoperative	211.8 ± 30.2	227.0	245.0 ± 50.6	254.0	0.012 [m]
Postoperative 1st month	193.8 ± 25.9	212.0	243.8 ± 51.2	253.0	0.000 [m]
Postoperative 3rd month	188.3 ± 21.7	210.0	245.1 ± 50.1	252.0	0.000 [m]
Postoperative 6th month	187.4 ± 20.6	209.0	245.3 ± 50.5	253.0	0.000 [m]

[m] Mann-Whitney U test, **SFCT:** Subfoveal chroroidal thickness, **SD:** Standard deviation, **µm:** micrometer, **IMH:** Idiopathic macular hole

Competing Interest

The author declares that he has no conflict of interest.

Financial Disclosure

The author declares that he has no relevant or material financial interests that relate to the research described in this paper.

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