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The effect of nasal steroids on retinal nerve fiber layer in patients with a family history of glaucoma

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ABSTRACT

Objectives: We aimed at analyzing the effect of nasal steroids on intraocular pressure (IOP) and retinal nerve fiber layer thickness (RNFL) in patients with a family history of glaucoma who also use fluticasone propionate (FP group) and mometasone furoate (MF group).

Methods: Patients with a family history of glaucoma and suitable for using nasal steroids were included in the study population. IOP, anterior chamber depth (ACD), axial length (AL) and central corneal thickness (CCT) and RNFL thickness measurements of the patients were carried out. Measurements were done on 3 levels, namely, one before starting the medication, the other 1 month after starting the medication and the last one 3 months after the medication. 3 groups were established in our study: patients who are using MF group and FP group and also C group (control group; healthy individuals who have a family history of glaucoma but not using any medication).

Results: The average age of patients in our study who were under medication was 33.2 ± 8.9 years. The study consisted of a total of 46 patients, 32 of whom were using nasal steroids and 14 belonging to the C group. It was found that global value in MF group decreased from 100.9 ± 7.7 to 99.6 ± 7.6 in the 3rd month and ACD in MF group decreased from 3.2 ± 0.4 mm to 2.9 ± 0.4 mm in the 1st month, both to be found statistically significant (p = 0.037 and p = 0.001 respectively). During the RNFL thickness measurements of patients, it was found that Temporal (T) segment in FP group decreased from 82.1 ± 13.8 to 81.7 ± 13.3 in the first month and T segment in MF group decreased from 72.8 ± 12.0 to 71.3 ± 10.2 in 3 months, both decreases to be found statistically significant (p = 0.047 and p = 0.003 respectively). It was found that IOP in FP group increased from 15.3 ± 3.6 mm Hg to 17.7 ± 4.1 mm Hg in the 3rd month hence found to be statistically significant (p = 0.006). CCT in FP patients was found to be significantly higher in the 3rd month (p = 0.025).

Conclusions: As a result of our study, it was found that nasal steroid usage in patients with a family history of glaucoma may cause an increase in IOP and thinning of the RNFL.

Keywords: Mometasone furoate, fluticasone propionate, intraocular pressure, retinal nerve fiber layer thicknes

Corticosteroids have been used in allergic rhinitis treatment first in 1950 in systemic and then in 1974 in intranasal topical form. Today, corticosteroids in the form of intranasal sprays are being used for various diseases such as allergic asthma, allergic rhinitis and nasal polyposis. The most commonly used second

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generation topical steroids are mometasone furoate (MF), budesonide, beclomethasone dipropionate (BP), fluticasone propionate (FP) and triamcinolone. Nasal congestion, nasal flow, sneezing and respiratory disorder complaints, which are typical symptoms of allergic rhinitis decline upon use of these molecules [1-4]. Among the nasal steroids, MF and FP are synthetic glucocorticosteroids [2-5].

In healthy people intraocular pressure (IOP) varies between 11-21 mm Hg based on the balance between production and drainage of aqueous humour. IOP has a diurnal rhythm, where values are higher in the mornings and relatively low in the afternoons and night time. In healthy individuals these fluctuations are lower than 5 mm Hg. Although the upper limit of normal IOP is 21 mm Hg, rim loss or visual field loss in the optic disc can be seen in cases of normotensive glaucoma even with values lower than 21 mm Hg. Steroids happen to be one of the external factors that might defect this balance. The changes in IOP depends on the way steroids are being used as well as their structure, duration of use and also the thickness of the cornea. Besides that, family history of glaucoma is the most important personal risk factor. It is suggested that even a low potent steroid may cause changes in the intraocular pressure within an average of 3-4 weeks of use [2, 5-8]. Generally accepted "cut-off" value in order to identify the IOP increase due to steroid use is defined as; an increase of 6 mm Hg in IOP since the beginning of steroid use or a IOP measurement higher than 21 mm Hg either before or after steroid and a subsequent decrease in IOP when the medication is discontinued [9]. Vision loss is important since it is related to IOP increase. Ischemic and mechanic theories are valid in the etiology of the retinal nerve fiber damage in cases of glaucoma. Ischemia of the optic nerve head and vascular pathologies dominate the ischemic theory whereas in mechanic theory, emphasis is on the direct damaging of retinal nerve fibers by the elevated IOP. This results with ganglion cell death in retina which in return causes optic nerve head cupping. All these eventually lead to vision loss or even blindness [10-13].

The most common side effect of steroids used as both systemic and topical eye drops is elevated IOP. It is known that similar side effect is seen during the use of steroids through intranasal or inhalation channels [10]. However, no previous study was done where the use of intranasal FP and MF medications on healthy individuals with no family history of glaucoma were compared. Therefore, in our study, we aimed to analyze the effect of nasal steroid treatment, both FP and MF, on IOP and retinal nerve fiber levels (RNFL) of patients who are diagnosed with nasal polyposis and allergic rhinitis and have a family history of glaucoma.

METHODS

In this prospective study, a total of 32 patients and 14 control patients using FP and MF nasal steroids were analyzed. Our study was conducted with the cooperation of clinic of ophthalmology and the clinic of otolaryngology, and all stages of the study were carried out in accordance with the Declaration of Helsinki. Düzce University, Medical Faculty Ethic Council approval was granted (Ethic Council number 20-15-37). Each patient was informed in detail before the study and related consent forms were approved. Patients who were found appropriate to use nasal steroids for at least 3 months due to their nasal polyposis or allergic rhinitis and had a family history of glaucoma were diverted to ophthalmology by the clinic of otolaryngology. Out of the total 49 patients, 18 patients were excluded from the study because 16 of them did not show up for the controls and 2 of them did not use the medication on a routine basis. All required measurements were completed before the medication.

Patients with a history of eye or nose surgery, retina or disc disease, smoking or drinking habit, systemic disease such as diabetes or hypertension, an intraocular pressure of 21 mm Hg or higher, amblyopia, diplopia and refractive defect of 1,5 D or higher as well as patients who are using systemic medication for the past 6 months due to allergies or using contact lenses were not included to the study. Right eye is used for all measurements. It is suggested that including both eyes of the patient into the study is not statistically appropriate considering the positive correlation of the results [14]. A single experienced ophthalmologist performed all the measurements in order to avoid any discrepancies. Each patient went through a detailed eye examination where corrected best visual acuity, dilate fundus examination with 90 (D) lens, IOP with Goldman applanation tonometry (GAT)

(mmHg), anterior chamber depth (ACD) (mm), axial length (AL) (mm), central cornea thickness (CCT) (μm) and RNFL(μm) assessment measurements were done on 3 levels, namely, one before starting the medication, the other 1 month after starting the medication and the last one 3 months after the medication. Patients were fully informed about the measurement method before the GAT measurement process where one drop of 0.5% proparacaine hydrochloride was applied to the eye and lower lid fornix was touched with the fluoresceine paper followed by asking the patient to look right across and while the cobalt blue light was in 60 degrees angle position, the knob on the device was turned by using the GAT mounted onto the biomicroscope until the inner sections of all circles were overlapping. IOP was then calculated by multiplying the result by 10 mmHg. This process was repeated for 3 times and the mean of all 3 was taken as the final result. (Considering that IOP might differ among the groups and individuals based on their CCT, "corrected IOP" values according to the CCTs were taken into account). ACD, AL and CCT measurements were done with Echoscan US 500 system (Nidek Co., Ltd., Aichi, Japan) device whereas retinal nerve fiber layer measurements were done with spectral domain optic coherence device (SD-OCT, Heildelberg Engineering, Heildelberg, Germany). All measurements were done between the hours of 9.00-11.00 in order to avoid any diurnal discrepancies. RNFL thickness was assessed through 7 points by manually drawing the optic disc outline (μm). RNFL thickness measurements were defined as global (G), temporal (T), superotemporal (ST), superonasal (SN), nasal (N), inferotemporal (IT) and inferonasal (IN). (Fig. 1). Reference points were adjusted during the first measurements where "register" specification of the device was used and recording was done after controlling that the reference line passes through the center of macula. Progression analysis was performed in the consecutive measurements by means of the device specifications hence preventing any inter measurement errors. All measurements were repeated for 3 times in order to avoid bias and reference points were taken into account in repeated measurements, entering the data based on the assumption that these reference points were correct. Segmentation of all shots were done by someone familiar with OCT reading. Ultimately, the mean of all 3 measurements were taken hence, securing the standardization in measurements.

3 groups were established in our study: (1) MF group: patients using MF; (2) FP group: patients using FP; and (3) C group: control group consisting of healthy individuals who are not on medication but have a family history of glaucoma.

Statistical Analysis

The results of the study were analyzed by SPSS 25.0 version software program. The distribution of data was displayed by descriptive analysis parameters (mean, standard deviation, minimum, maximum, frequency and percentage). Kolmogorov-Smirnov test was employed to analyze whether the data is consistent with the normal distribution. In comparison of the dependent groups based on time variable, ANOVA test was used for repeated measurements. In comparison of means between more than two independent groups, ANOVA test was used for data distributed evenly and Kruskal Wallis H Test was used for data not distributed evenly. In case any discrepancies were found in ANOVA and Kruskal Wallis H Test, Bonferroni Post Hoc test was employed in order to identify the group which was causing the discrepancy.

There were no previous studies on the effect of MF and FP medication on RNFL therefore it was not possible to calculate the sample size based on literature. However, an appropriate sample size was taken with respect to Cohen's description of standardized effect size as medium and large. When 0.3 was taken as the medium size standardized effect size and (α) 5% as risk of making a Type 1 error and (1-ß) %80 as power of the test, it was found out that 34 samples should be in the MF and FP medication groups. But when effect size was taken as 0.8 which is large standardized effect size, 16 samples were sufficient for the MF and FP medication groups [15].

There are three groups in the study as Fluticasone, Mometozone and Control groups. In the evaluation of the difference between the three groups as in the literature; In case the data are normally distributed, one-way analysis of variance (ANOVA), which is the parametric test, is used, and if the data is not normally distributed, the nonparametric Kruskal Wallis H test is used. The Mann Whitney U test requested by me is a nonparametric test used in comparisons between 2 groups and is not suitable for this study. If a significant difference is found as a result of one-way analysis of

variance and Kruskal Wallis H Test, the groups causing the difference are determined with the Posthoc test. In our study, the Bonferroni Posthoc test was used because the variances were homogeneous between the groups.

RESULTS

Table 1 shows the demographic data of the patients. The mean age of the patients in our study which are under medication is 33.2 ± 8.9 years. Our study consisted of 46 patients, 20 (43.5%) male and 26 (56.5%) female, which were distributed as 16 in MF group, 16 in FP group and 14 in C group.

Changes in FP, MF and C groups over time are shown in Table 2. It was found that global value in MF group decreased from 100.9 ± 7.7 to 99.6 ± 7.6 in the 3rd month and ACD in MF group decreased from 3.2 ± 0.4 mm to 2.9 ± 0.4mm in the 1st month, both to be found statistically significant (p = 0.037 and p = 0.001 respectively). According to the results, T segment of FP group during RNFL thickness measurements before the medication are higher than the MF group in a statistically significant level (before medication, p = 0.023). During the RNFL thickness measurements of patients, it was found that Temporal (T) segment in FP group decreased from 82.1 ± 13.8 to 81.7 ± 13.3 in the first month and T segment in MF group decreased from 72.8 ± 12.0 to 71.3 ± 10.2 in 3 months, both decreases to be found statistically significant (p = 0.047 and p = 0.003 respectively).

When Table 2 is reviewed, it was found that IOP in both MF and FP groups have increased in the 1st and 3rd months but this increase was not statistically significant. On the other hand, there was no increase in the control group. IOP in the FP group increased from 15.3 ± 3.6 mm Hg to 17.7 ± 4.1 mmHg in the 3rd month hence found to be statistically significant (p = 0.006; Table 3).

It was found that CCT of patients using FP was higher than the ones using MF in a statistically significant level (p = 0.06). CCT of patients using FP were found to be higher in the 3rd month compared to the ones using MF in a statistically significant level (p = 0.025). (IOP values adjusted to CCT was taken into consideration during IOP measurements of FP group since these patients start with an already high CCT which might affect IOP).

At the end of first month, it was found that AL of MF group were lower than the ones in C group in a statistically significant level (p = 0.033). At the 3rd of medication, AL parameter in FP and MF groups were found to be lower than C group in a statistically significant level (p = 0.013). As far as the other parameters are concerned, no further differences were found within the groups in a statistically significant level. Furthermore, no differences were found in AL parameter within the groups over time. In other words, when table was interpreted in terms of basal values of groups, it was found that AL value didn't show any statistically significant difference.

Table 1. Demographic specifications

	Data
Age (years) Mean ± SD (min-max)	**33.2 ± 8.9 (20-50)**
Gender, n (%)	
Male	20 (43.5)
Female	26 (56.5)
Group, n (%)	
Fluticasone	16 (34.8)
Mometasone	16 (34.8)
Control Group	14 (30.4)

DISCUSSION

Nasal steroids which are commonly used by people who have allergic asthma or allergic rhinitis reach eyes after being used, even before they are broken down in the kidneys or liver [16]. The effect of systemic use of steroids on the intraocular pressure is much less compared to the topical use of steroid eye drops. However, the rate of steroid use is quite high due to the high number of allergic asthma or allergic rhinitis patients, therefore, steroid-IOP relation is important [16]. Diverse theories are suggested for the mechanism of high IOP or glaucoma as a result of steroid use. Steroids cause electrolyte imbalance after binding to the steroid receptors in the cells of trabecular meshwork. Even-

Table 2. The alteration of parameters over time

	Group	Time			F	*p value*
		Premedication	1st month	3rd month		
		Mean ± SD	Mean ± SD	Mean ± SD		
T (µm)	**Fluticasone**	82.1 ± 13.8	81.7 ± 13.3	84.1 ± 13.9	0.238	0.790
	Mometasone	70.8 ± 9.5	72.8 ± 12.0	71.3 ± 10.2	1.033	0.349
	Control	71.6 ± 9.4	71.6 ± 9.4	69.2 ± 11.5	1.125	0.340
ST (µm)	**Fluticasone**	140.5 ± 29.0	150.5 ± 15.6	150.4 ± 16.8	1.736	0.205
	Mometasone	145.4 ± 15.9	145.1 ± 15.8	146.1 ± 16.2	0.423	0.659
	Control	140.1 ± 14.7	140.1 ± 14.7	139.4 ± 14.6	10.848	0.458
SN (µm)	**Fluticasone**	117.3 ± 17.5	116.4 ± 14.5	115.5 ± 20.1	11.267	0.146
	Mometasone	114.5 ± 19.1	115.2 ± 20.2	115.4 ± 19.0	3.396	0.271
	Control	113.5 ± 22.4	113.5 ± 22.4	113.6 ± 20.7	0.024	0.214
N (µm)	**Fluticasone**	77.8 ± 17.0	77.5 ± 15.3	74.7 ± 21.1	42.467	0.397
	Mometasone	74.9 ± 13.2	74.0 ± 14.7	75.2 ± 14.6	6.271	0.385
	Control	78.4 ± 15.4	78.4 ± 15.4	79.2 ± 15.2	3.090	0.063
IN (µm)	**Fluticasone**	104.4 ± 25.6	104.1 ± 20.6	107.2 ± 27.7	43.289	0.184
	Mometasone	112.6 ± 13.8	110.3 ± 16.4	113.2 ± 16.2	54.163	0.912
	Control	109.1 ± 20.8	109.1 ± 20.8	108.9 ± 20.3	0.214	0.218
IT (µm)	**Fluticasone**	142.3 ± 38.2	154.1 ± 23.4	150.9 ± 25.8	1.131	0.314
	Mometasone	142.4 ± 17.2	143.3 ± 17.7	142.5 ± 17.1	1.016	0.374
	Control	140.6 ± 11.8	140.6 ± 11.8	137.4 ± 14.0	0.830	0.447
G (µm)	**Fluticasone**	101.4 ± 14.9	105.3 ± 9.3	97.6 ± 25.5	0.750	0.442
	Mometasone	100.7 ± 7.3	100.9 ± 7.7	99.6 ± 7.6	4.531	**0.037**
	Control	99.1 ± 9.4	99.1 ± 9.4	92.1 ± 24.1	1.119	0.342
IOP (mmHg)	**Fluticasone**	15.3 ± 3.6	16.9 ± 3.7	17.7 ± 4.1	3.076	0.062
	Mometasone	14.8 ± 3.8	15.1 ± 3.9	15.5 ± 3.2	0.650	0.529
	Control	14.5 ± 1.0	14.0 ± 1.8	13.7 ± 1.9	1.049	0.365
CCT (µm)	**Fluticasone**	565.3 ± 48.2	562.4 ± 51.1	563.5 ± 52.2	0.092	0.779
	Mometasone	528.4 ± 40.6	518.1 ± 42.1	521.9 ± 43.3	1.710	0.198
	Control	546.3 ± 18.2	546.4 ± 18.1	546.3 ± 18.2	1.000	0.336
ACD (mm)	**Fluticasone**	3.2 ± 0.4	3.1 ± 0.4	3.0 ± 0.5	2.996	0.066
	Mometasone	3.2 ± 0.4	2.9 ± 0.4	2.9 ± 0.4	9.688	**0.001**
	Control	3.0 ± 0.5	3.0 ± 0.5	3.0 ± 0.5	0.204	0.817
AL (mm)	**Fluticasone**	22.4 ± 0.8	22.3 ± 0.8	22.3 ± 0.9	0.253	0.778
	Mometasone	22.3 ± 0.9	22.2 ± 0.8	22.1 ± 0.8	2.597	0.091
	Control	22.8 ± 0.7	22.8 ± 0.7	23.0 ± 0.7	2.125	0.140

IOP = Intraocular Pressure, ACD = Anterior Chamber Depth, AL = Axial Length, CCT = Central Cornea Thickness, RNFL = Retinal Nerve Fiber Level Thickness, G = Global, T = Temporal, ST = Superotemporal, SN = Superonasal, N = Nasal, IT = Inferotemporal, IN = Inferonasal, SD = standard deviation

Table 3. The assessment of the parameter differences within the 3 groups

	Time	Group			F/X2	*p value*	Difference
		Fluticasone Mean ± SD	Mometasone Mean ± SD	Control Mean ± SD			
T (µm)	**Premed.**	82.1 ± 13.8	70.8 ± 9.5	71.6 ± 9.4	7.564	**0.023**	FP-MF
	1st month	81.7 ± 13.3	72.8 ± 12.0	71.6 ± 9.4	3.280*	**0.047**	FP-MF FP- Control
	3rd month	84.1 ± 13.9	71.3 ± 10.2	69.2 ± 11.5	6.711*	**0.003**	FP-MF FP- Control
ST (µm)	**Premed.**	140.5 ± 29.0	145.4 ± 15.9	140.1 ± 14.7	0.843	0.656	-
	1st month	150.5 ± 15.6	145.1 ± 15.8	140.1 ± 14.7	4.045	0.132	-
	3rd month	150.4 ± 16.8	146.1 ± 16.2	139.4 ± 14.6	3.085	0.214	-
SN (µm)	**Premed.**	117.3 ± 17.5	114.5 ± 19.1	113.5 ± 22.4	0.806	0.958	-
	1st month	116.4 ± 14.5	115.2 ± 20.2	113.5 ± 22.4	0.149	0.928	-
	3rd month	115.5 ± 20.1	115.4 ± 19.0	113.6 ± 20.7	0.275	0.872	-
N (µm)	**Premed.**	77.8 ± 17.0	74.9 ± 13.2	78.4 ± 15.4	0.229*	0.796	-
	1st month	77.5 ± 15.3	74.0 ± 14.7	78.4 ± 15.4	0.361*	0.699	-
	3rd month	74.7 ± 21.1	75.2 ± 14.6	79.2 ± 15.2	0.298*	0.744	-rd
IN (µm)	**Pre-med**	104.4 ± 25.6	112.6 ± 13.8	109.1 ± 20.8	0.624*	0.540	-
	1st month	104.1 ± 20.6	110.3 ± 16.4	109.1 ± 20.8	0.441*	0.646	-
	3rd month	107.2 ± 27.7	113.2 ± 16.2	108.9 ± 20.3	0.310*	0.735	-
IT (µm)	**Pre-med**	142.3 ± 38.2	142.4 ± 17.2	140.6 ± 11.8	1.634	0.442	-
	1st month	154.1 ± 23.4	143.3 ± 17.7	140.6 ± 11.8	2.237*	0.119	-
	3rd month	150.9 ± 25.8	142.5 ± 17.1	137.4 ± 14.0	1.757*	0.185	-
G (µm)	**Pre-med**	101.4 ± 14.9	100.7 ± 7.3	99.1 ± 9.4	0.170*	0.844	-
	1st month	105.3 ± 9.3	100.9 ± 7.7	99.1 ± 9.4	1.916*	0.160	-
	3rd month	97.6 ± 25.5	99.6 ± 7.6	92.1 ± 24.1	1.621	0.445	-
IOP (mmHg)	**Premed.**	15.3 ± 3.6	14.8 ± 3.8	14.5 ± 1.0	0.466	0.792	-
	1st month	16.9 ± 3.7	15.1 ± 3.9	14.0 ± 1.8	2.760*	0.075	-
	3rd month	17.7 ± 4.1	15.5 ± 3.2	13.7 ± 1.9	5.705*	**0.006**	FP-Control
CCT (µm)	**Pre-med**	565.3 ± 48.2	528.4 ± 40.6	546.3 ± 18.2	3.610*	**0.036**	FP-MF
	1st month	562.4 ± 51.1	518.1 ± 42.1	546.4 ± 18.1	5.445	0.066	-
	3rd month	563.5 ± 52.2	521.9 ± 43.3	546.3 ± 18.2	4.051*	**0.025**	FP-MF
ACD (mm)	**Premed.**	3.2 ± 0.4	3.2 ± 0.4	3.0 ± 0.5	1.083*	0.348	-
	1st month	3.1 ± 0.4	2.9 ± 0.4	3.0 ± 0.5	0.562*	0.574	-
	3rd month	3.0 ± 0.5	2.9 ± 0.4	3.0 ± 0.5	0.355*	0.703	-
AL (mm)	**Premed.**	22.4 ± 0.8	22.3 ± 0.9	22.8 ± 0.7	4.644	0.098	-
	1st month	22.3 ± 0.8	22.2 ± 0.8	22.8 ± 0.7	6.796	**0.033**	MF- Control
	3rd month	22.3 ± 0.9	22.1 ± 0.8	23.0 ± 0.7	4.788*	**0.013**	FP- Control MF- Control

IOP = Intraocular Pressure, ACD = Anterior Chamber Depth, AL = Axial Length, CCT = Central Cornea Thickness, RNFL = Retinal Nerve Fiber Level Thickness, G = Global, T = Temporal, ST = Superotemporal, SN = Superonasal, N = Nasal, IT = Inferotemporal, IN = Inferonasal, Premed = premedication, SD = standard deviation

tually, mucopolysaccharide accumulates on trabecular meshwork and results in vasoconstriction of the episcleral veins. It is considered that this impact mechanism may lead to IOP increase [17].

There is no clear consensus in the literature related to the effect of nasal steroids on the IOP. Some studies show that the IOP increases whereas, some show that there was no alteration at all. Nasal steroids access the eye in 2 ways; namely direct access and indirect access. In direct access, metabolite absorbed from nasal mucosa reach and effect the final organ before it is broken down whereas in indirect access, steroids absorbed from the gastrointestinal system are broken down in liver hence a limited amount of active metabolite reaches the final organ. Various studies suggest that it reaches the eyes through both ways, causing an increase in IOP [17-19].

Some studies in literature suggest that BP increases IOP [12, 20, 21]. On the other hand, it was found that IOP did not change in the studies made by Öztürk *et al*. [18]with budesonide nasal spray and BP, Martino *et al*. [19] with dexamethasone and Yuen *et al*. [20] with beclomethasone. As a result of their 18-patient study with intranasal budesonide irrigation, Seiberling *et al*. [22] found that there was no increase in IOP with the exception of one patient.22 In their study with FP, MF and BP, Mohd Zain *et al*. [23] found that, similar to our study, IOP of the group under medication was higher in a statistically significant level when compared to the C group. Şimşek *et al*. [17], in their study with FP and MF users, found no statistically significant difference between two groups throughout the 24 week period. However, in our study, IOP of the patients under FP medication were found to be higher than the ones in C group in the 3rd month. Bross-Soriano *et al*. [24] who has used similar active agents as our study, found that there was no significant difference in IOP. However, the findings may naturally differ since not only the steroids being used but the reaction of the patients in each study also may vary hence effecting the results [25].

Only one single study related to the RNFL thickness measurement for the similar age group was found in the literature. In their study covering patients who are using nasal steroids, Marzouki *et al*. [26] found no statistically significant difference between the RNFL thickness and IOP values. The study generally based the comparisons on corticosteroids (patients under FP and MF medication have been analyzed in our study). Although the study was different from ours since it did not include the analysis of sub-segments of the RNFL, they both were still similar with respect to the final results. Furthermore, there was no difference in our studies in terms of C group with respect to the glaucoma optic disc values. The difference in our study was the variance in T segment of RNFL at the beginning of the study. We believe that this variance is the outcome of relatively small number of the study group as well as intragroup differences.

In our study, we found out significant differences in terms of CCT over time. Not only there were no studies in the literature on this subject covering the similar age group but the number of studies made on cornea was also very limited. In their studies conducted with children, Özkaya *et al*. [27] and Alsaadi *et al*. [7], similar to our study, suggested that there were no significant differences. We believe that the effect was not efficient since the steroid doses taken as nasal were insufficient to initiate any effect on the receptors of cornea.

In our study, we found that there was no statistical difference in terms of ACD parameter between 3 groups but there was a decrease in the MF group over time. We found that there was no significant difference in terms of AL in between 3 groups but over time, the AL parameter of MF group was lower than the C group in statistically significant level in 1st month and the AL parameters of the FP and MF groups were lower than the C group in statistically significant level in the 3rd month. Although no comparisons were done since there were no studies on ACD and AL in the literature, we assumed that the difference is the outcome of relatively small number of the study group as well as the variances among the groups in the beginning.

The strong aspect of our study is, being the first study in literature in terms of RNFL, ACD, AL and CCT with patients within the analyzed age group and who are using FP and MF and have a family history of glaucoma. On the other hand, the relatively limited number of patient group as well as relatively short monitoring period were the restricting aspects.

CONCLUSION

In our study, we analyzed adult individuals who do not

have systemic or ocular diseases but using FP and MP, in terms of IOP, RNFL thickness, ACD, CCT and AL. As a result of our study, we learned that FP and MF nasal steroids can be used safely for glaucoma in the short term, but the risk increases when the duration of use is prolonged. Therefore, if individuals with a family history of glaucoma are subject to long-term medication, we suggest that they continue their treatment under ophthalmologist control. Furthermore, an additional study with a high number of participants and a longer monitoring time would enable to reach a much more accurate, precise and reliable review.

Authors' Contribution

Study Conception: MTE; Study Design: MTE; Supervision: MTE, İÜ; Funding: İÜ; Materials: İÜ; Data Collection and/or Processing: İÜ, MTE; Statistical Analysis and/or Data Interpretation: MTE; Literature Review: MTE; Manuscript Preparation: MTE, İÜ and Critical Review: İÜ, MTE.

Conflict of interest

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