RESEARCH ARTICLE / *Araştırma Makalesi*

Optical Coherence Tomography Findings of Nonarteritic Ischemic Optic Neuropathy

Nonarteritik İskemik Optik Nöropatide Optik Koherens Tomografi Bulguları

Sedat Özmen, Emine Doğan, Burçin Çakır, Nilgün Özkan Aksoy, Erkan Çelik

University Medical Education and Research Hospital, Department of Ophthalmology, Sakarya, Turkey

Yazışma Adresi / *Correspondence:*
Sedat Özmen

Sakarya University Medical Education and Research Hospital, Department of Ophthalmology, Sakarya, Turkey
T: **+90 505 916 76 24** E-mail **: drsozmen@gmail.com**

Geliş Tarihi / Received : **04.04.2021** Kabul Tarihi / Accepte: **25.02.2022**

Orcid :
Sedat Özmen https://orcid.org/0000-0002-6675-7132
Emine Doğan https://orcid.org/0000-0002-6505-3328
Burçin Çakır https://orcid.org/0000-0001-7816-0627
Nilgün Özkan Aksoy https://orcid.org/0000-0003-1107-9546
Erkan Çelik https://orcid.org/0000-0002-8681-7868

(Sakarya Tıp Dergisi / ***Sakarya Med J*** **2022, 12(1):140-145) DOI: 10.31832/smj.909319**

Öz

Objective	Nonarteritik iskemik optik nöropatiye (NAİON) ve glokoma ikincil optik atrofi gelişmiş olgularda optik sinir başı parametrelerinin optik koherens tomografi (OKT) ile değerlendirilmesi.
Materials and Methods	Glokom (Grup 1) ve NAİON (Grup 2) nedeniyle optik atrofi gelişen olguların dosyaları geriye dönük olarak tarandı. Olguların en iyi düzeltilmiş görme keskinliği (EİDGK), göz içi basıncı (GİB), merkezi kornea kalınlığı, OKT ile retina sinir lif tabakası (RSLT) ve ganglion hücre kompleks kalınlığı parametreleri kaydedildi. Ortalama ve bölgesel (üst, üst temporal, alt, alt temporal, temporal, nazal, üst nazal, ve alt nazal) RSLT ve ganglion hücre kompleks kalınlıkları gruplar arasında karşılaştırıldı.
Results	Grup 1'de yer alan 30 (14 kadın, 16 erkek) olgunun yaş ortalaması 66.2±12 iken, Grup 2'de yer alan 36 (16 kadın, 20 erkek) olgunun 61.6±13.05 idi. EİDGK Grup 1'de 0.43±0.3, Grup 2'de 0.16±0.1 olup; gruplar arasında istatistiksel fark mevcuttu (p <0.01). Ortalama RSLT Grup 1'de 50.8±10 µ, Grup 2'de 59.05±11 µ olup; iki grup arasında istatistiksel olarak anlamlı fark yoktu. (p:0.21). Ortalama ganglion hücre kompleksi kalınlığı gruplarda sırasıyla 50.2±10.4, 48±15 µ olup; NAİON daha düşük bulundu (p:0.04). Alt kadran RSLT kalınlığı Grup 1'de daha düşüktü (p:0.02). Grup 1'de alt temporal kadran ganglion hücre kalınlığı, Grup 2'de üst kadran ganglion hücre kalınlığı belirgin olarak düşük bulundu (p <0.01, p:0.09). Diğer kadranlarada iki grup arasında anlamlı fark yoktu.
Conclusion	The mean ganglion cell complex thickness was found to be thinner in the NAION group. This may indicate that the ganglion cell complex is more susceptible to ischemia-related damage.
Keywords	Optic neuropathy; Retinal nerve fiber layer; Ganglion cell layer

Abstract

Amaç	*Nonarteritik iskemik optik nöropatiye (NAİON) ve glokoma ikincil optik atrofi gelişmiş olgularda optik sinir başı parametrelerinin optik koherens tomografi (OKT) ile değerlendirilmesi.*
Gereç ve Yöntemle	*Glokom (Grup 1) ve NAİON (Grup 2) nedeniyle optik atrofi gelişen olguların dosyaları geriye dönük olarak tarandı. Olguların en iyi düzeltilmiş görme keskinliği (EİDGK), göz içi basıncı (GİB), merkezi kornea kalınlığı, OKT ile retina sinir lif tabakası (RSLT) ve ganglion hücre kompleks kalınlığı parametreleri kaydedildi. Ortalama ve bölgesel (üst, üst temporal, alt, alt temporal, temporal, nazal, üst nazal, ve alt nazal) RSLT ve ganglion hücre kompleks kalınlıkları gruplar arasında karşılaştırıldı.*
Bulgular	*Grup 1'de yer alan 30 (14 kadın, 16 erkek) olgunun yaş ortalaması 66.2±12 iken, Grup 2'de yer alan 36 (16 kadın, 20 erkek) olgunun 61.6±13.05 idi. EİDGK Grup 1'de 0.43±0.3, Grup 2'de 0.16±0.1 olup; gruplar arasında istatistiksel fark mevcuttu (p <0.01). Ortalama RSLT Grup 1'de 50.8±10 µ, Grup 2'de 59.05±11 µ olup; iki grup arasında istatistiksel olarak anlamlı fark yoktu. (p:0.21). Ortalama ganglion hücre kompleksi kalınlığı gruplarda sırasıyla 50.2±10.4, 48±15 µ olup; NAİON daha düşük bulundu (p:0.04). Alt kadran RSLT kalınlığı Grup 1'de daha düşüktü (p:0.02). Grup 1'de alt temporal kadran ganglion hücre kalınlığı, Grup 2'de üst kadran ganglion hücre kalınlığı belirgin olarak düşük bulundu (p <0.01, p:0.09). Diğer kadranlarada iki grup arasında anlamlı fark yoktu.*
Sonuç	*RSLT kalınlık ortalaması açısından gruplar arasında fark bulunmazken alt kadran RSLT kalınlığı glokomatöz gözlerde daha ince bulundu. Ortalama ve üst kadran ganglion hücre kompleks kalınlığı NAİON grubunda daha düşük tespit edildi.*
Anahtar Kelimeler	*Optik nöropati; Retina sinir lifi tabakası; Ganglion hücre tabakası*

INTRODUCTION

Nonarteritic ischemic optic neuropathy (NAION) is an ischemic optic neuropathy caused by the occlusion of the short posterior ciliary artery that supply the anterior part of the optic nerve head.[1] It is characterized with acute unilateral painless vision and visual field loss. Risk factors such as hypertension, atherosclerosis, prothrombotic conditions, systemic arterial hypotension and previous intraocular surgery plays role in the development of NAION.[2] In addition, the structure of the optic nerve head plays an important role in the pathology of NAION. Optic disc features such as small optic disc, small physiological cupping, and vascular branching anomalies increase the risk for NAION.[3] In NAION sectoral or diffuse optic disc edema occurs initially, and progresses to optic disc pallor with sectoral or diffuse atrophy.[4]

Glaucoma which is an optic neuropathy with progressive degeneration of retinal ganglion cells causes progressive visual field defect. The most important risk factor in glaucoma is high intraocular pressure (IOP), but progressive optic nerve damage may occur even with the normal pressure. In glaucoma, degeneration of retinal ganglion cells causes a decrease in the neuroretinal rim and an increase in physiological pitting of the optic disc.[5] Optical coherence tomography (OCT) has an important role in the diagnosis and follow-up of glaucoma patients by providing information about the retinal nerve fiber layer (RNFL) and ganglion cell complex thickness. In both glaucoma and NAION, optic atrophy develops in the late stages; however, there are differences in the appearance of optic nerve head in these cases. In glaucomatous optic atrophy, prominence of lamina cribrosae and excavation with enlargement of the cup occur; in NAION cupping and pitting is not expected, and the pallor of the optic disc is more prominent.

In our study, we aimed to evaluate and compare the optic nerve head parameters in patients with NAION and glaucomatous optic atrophy.

MATERİALS and METHODS

This is a descriptive, cross sectional and retrospective study. Data of patients diagnosed with glaucomatous optic atrophy (Group 1) and NAION (Group 2) between 2017-2020 were retrospectively analyzed. The study was carried out in accordance with the Declaration of Helsinki. This study was conducted at Sakarya University Education and Research Hospital. Prior approval was received from the Institutional Review Board 71522473/050.01.04/168 and written informed consent was obtained from each subject.

Group 1 was consisted of 30 patients diagnosed with advanced stage primary open angle glaucoma and Group 2 consisted of 36 patients diagnosed with NAION.

Patients with a history of previous eye surgery, refraction defects greater than ± 3 diopters, and a history of ocular or systemic disease that may affect the optic nerve head were excluded from the study. Best corrected visual acuity (BCVA) of all cases were evaluated according to the Snellen chart, IOP measurements with Goldmann applanation tonometer, and detailed fundus examination findings were examined. Retinal nerve fiber layer (RNFL) thickness measurements were obtained with the Cirrus EDI-OCT (Carl Zeiss Meditec Dublin. CA, USA). All OCT scans were performed by the same experienced examiner and scans with signal strength of ≥8 were used for analysis. In each case, it was checked whether the device correctly perceived the borders of RNFL and optic nerve head structures. RNFL and ganglion cell complex thickness analysis results were recorded by determining mean and regional (superior, superotemporal, inferior, inferior temporal, temporal, nasal, superonasal, and inferonasal) values for each eye and compared between groups.

Statistical Analysis

The analysis of the data was performed using the SPSS (Statistical Package for Social Sciences) 22.0 program (SPSS Inc. Chicago, USA). The suitability of variables to normal distribution was examined by analytical methods

(Kolmogorov-Smirnov / Shapiro-Wilk tests). It is given by using means and standard deviations for normally distributed variables by descriptive analysis. Normally distributed data were compared between groups using Student T test. Differences were considered statistically significant when the p value was less than 0.05.

RESULTS

The mean age of 30 patients (14 female, 16 male) in Group 1 was 66.2 ± 12 years and 36 (16 female, 20 male) patients in Group 2 was 61.6 ± 13.05 years. The groups were similar regarding to age and gender (p=0.25). BCVA was 0.43 ± 0.3 in Group 1 and 0.16 ± 0.1 in Group 2, and statistically significant difference was found between the groups (p <0.01).

The mean RNFL was 50.8 ± 10 µ in Group 1 and 59.05 ± 11 µ in Group 2 and there was no statistically significant difference (p:021). The mean ganglion cell thickness was 50.2 ± 10.4 µ and 48 ± 15 µ in groups, respectively and it was significantly thinner in the NAION group (p:0.04). Inferior quadrant RNFL thickness was 53.96 ± 13 µ, 74.18 ± 23 µ in the groups, respectively and it was significantly thinner in Group 1 (p:0.02). There was no significant difference in the other quadrants between the groups (Table 2). The inferotemporal quadrant ganglion cell thickness was significantly (p <0.01) thinner in Group 1 and the superior quadrant ganglion cell thickness was significantly thinner in Group 2 (p: 0.09) (Table 3).

Table 1: Demographic and Clinical Findings of Patients

	Group 1	Group 2	p
Average Age(year)	66.2±12	61.6±13.05	0,257
Gender (K/E)	14/16	16/20	p<0,01
BCVA	0,43±0,15	0,16±0,32	0,010

BCVA:Best Corrected Visual Activity, There was no statistical difference between the two groups in terms of age and gender. BCVA was found to be lower in ischemic optic neuropathy than in glaucomatous optic atrophy.(p:0,010)

Table 2: Average and Different Quadrant of Retinal Nerve Fiber Layer Thickness of Glaucoma and Ischemic Optic Neuropathy (RNFL)

	Group 1	Group 2	p
Average Total RNFL	50,83±10	59,05±15	0,210
Average Superior Quadrant RNFL	56,66±16	64,55±22	0,273
Average İnferior Quadrant RNFL	53,96±13	74,19±23	0,020
Average Temporal Quadrant RNFL	39,20±10	47,47±10	0,070
Average Nasal Quadrant RNFL	52,50±12	51,50±12	0,944

(RNFL: Retinal Nerve Fiber Layer) There was no statistical difference between the two groups in retinal nerve fiber thicknesses in the average, superior, temporal and nasal quadrant. In glaucomatous optic atrophy, retinal nerve fiber thickness in the ınferior quadrant was statistically thinner than in ischemic optic neuropathy)

Table 3: Average and Different Quadrant of Ganglion Cell Thickness of Glaucoma and Ischemic Optic Neuropathy (GCT)

	Group 1	Group 2	p
Average Total GCT	50,26±10	48,88±15	0,04
Average Superior Quadrant GCT	51,40±12	47,38±18	0,65
Average Inferior Quadrant GCT	49,26±10	51,97±16	<0,01
Average Superotemporal Quadrant GCT	49,86±12	47,66±16	0,7
Average Inferotemporal Quadrant GCT	48,86±110	55,00±19	0,01
Average Superonasal Quadrant GCT	49,90±13	50,94±16	0,94
Average Inferonasal Quadrant GCT	50,96±11	51,44±14	0,98

(GCT:Ganglion cell thicness) There was no statistical differences between superior, superotemporal, superonasal and inferonasal quadrant of ganglion cell thicknesses of two groups. Inferior and inferotemporal quadrant of ganglion cell thicknesses in glaucoma was lower than ischemic optik neuropathy. Average ganglion cell thickness of ischemic optic neuropathy was lower than glaucoma.

DISCUSSION

In present study, although there was no significant difference between the groups in terms of mean RNFL thickness, the mean ganglion cell complex thickness was thinner in the NAION group. This results may indicate that the ganglion cell complex is more susceptible to ischemia-related damage. In addition, the superior quadrant ganglion cell thickness was significantly thinner in NAION group. This results suggest that ischemic damage due to NAION may affect certain locations in the optic nerve. Significant axonal and ganglion cell loss occurs in both NAION and glaucoma. NAION, which occurs as a result of occlusion of the short posterior artery is characterized by the development of sectoral or diffuse disc edema in the acute phase and the development of pallor and atrophy in the optic disc at the the later periods. The presence of pallor of the optic disc and the absence of pitting and excavation are in favor of NAION. However, thinning of the neuroretinal rim has been reported in some studies.[1] Glaucoma which is a progressive optic neuropathy with degeneration of retinal ganglion cells causes marked cupping of the optic disc. Glaucomatous cell damage begins primarily in the inferotemporal quadrant generally.

In literature, there are various studies comparing optic nerve head parameters in glaucoma and NAION patients and conflicting results were reported regarding these parameters. Resch et al. compared primary open angle glaucoma, NAION and control cases, and they reported that RNFL was thinner in glaucoma and NAION cases compared to the control group. However, no difference was reported between glaucoma and NAION.[7] Danesh Meyer et al.compared glaucoma and NAION cases who had similar visual field loss; and reported that RNFL thickness is thinner in glaucoma cases.[8] Saito et al. compared the RNFL thickness of unilateral NAION patients with their other non-affected eyes and reported that there was no significant difference between the two groups.[9] In a study, comparing glaucoma and NAION cases with similar visual field defects; it was reported that there was no significant difference between the two groups. However, when the quadrants were analyzed separately; quadrant correlation was more prominent in NAION cases.[10] In another study, it was reported that the superonasal quadrant RNFL thickness was thinner in the NAION group and the inferotemporal quadrant RNFL thickness was thinner in the glaucoma group. They concluded that this results may be related to the fact that the nasal quadrant is less sensitive in glaucoma and the superonasal quadrant is affected later during glaucoma progression. They also reported that superior quadrant is more sensitive to ischemic events in NAION group.[11] Similar to these results, in the present study, inferior quadrant RNFL thickness was significantly thinner in glaucoma cases, mean ganglion cell complex thickness was thinner in the NAION group. When the quadrants were analyzed, superıor quadrant ganglion cell thickness in the NAION cases and inferotemporal quadrant ganglion cell thickness in glaucoma cases was significantly thinner in our study. Similarly, Lee et al. compared the age, gender and mean RNFL thickness matched NAION, glaucoma and control cases. They reported that mean ganglion cell thickness was similar in NAION and glaucoma groups; however, in quadrants analysis ganglion cell thickness was significantly thinner in the NAION group in all quadrants except the inferior and inferotemporal quadrants.[6] They attributed these results to the fact that ischemic events affecting the superior quadrant more and glaucoma affecting the inferotemporal quadrant more. In another study, Fard et al. reported that the thickness of the parafoveal ganglion cell layer was thinner in the NAION group and also strongly correlated with visual acuity.[12] In our study, visual acuity was found to be significantly lower in the NAION cases. This result indicates that the ganglion cell complex thickness is more closely related to visual acuity than RNFL thickness. Decreased visual acuity in NAION cases may be related to the early affection of the papillomacular bundle. In glaucoma, the papillomacular bundle is not affected until the last period and the visual acuity can be preserved until late periods.

This study has several limitations. First of all, the visual fields of the patients could be analyzed and only cases with similar visual field loss could be included. However, we did not consider the visual field parameters due to the significantly decreased visual acuity in NAION cases. Another limitation of the study was the absence of a control group consisting of normal healthy individuals. However, since our study included cases with optic atrophy, comparison with normal healthy cases would not yield meaningful results.

In conclusion, the mean ganglion cell complex thickness was thinner in the NAION group. When the quadrants were examined, the superior quadrant ganglion cell thickness was significantly thinner in NAION cases and the inferotemporal quadrant ganglion cell thickness was significantly thinner in glaucoma cases. This result shows the difference in the mechanism of these diseases that can cause serious visual loss. It is possible to obtain more accurate clearer results with further studies involving more patients.

Acknowledgment

The authors declare no conflict of interest.

Disclosure statement

The authors received no financial support for the research and/or authorship of this article.

Ethic Committee Approval

This study was conducted at Sakarya University Education and Research Hospital. Prior approval was received from the Institutional Review Board 71522473/050.01.04/168 Date: 02.07.2018

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