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# Study on IMAGE to Assess Optic Disc Pallor in Traumatic Optic Neuropathy

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**Abstract**
Optical coherence tomography (OCT), which is objective, quantifiable and reproducible, is commonly used to measure RNFL lossOCT can be useful to quantify optic atrophy. In the afflicted eye, all patients demonstrated relative afferent pupillary abnormalities. A dysmorphic optic disc, a history of optic neuropathy, prior intra ocular surgery (such as cataract removal)the use of glaucoma medications were among the exclusion criteria. The research included 45 individuals in total-36 men and 9 women. The age range of the participants was 5 to 63 years, with a mean of 35.7±16.1 years. RNFL thickness anomalies were substantially linked with optic disc pallor in TONNE, as measured by ImageJ. OCT RNFL studies confirm that ImageJ disc pallor assessments may be helpful in assessing RNFL thinning.

## INTRODUCTION

Ophthalmoscopy-measured changes in optic disc pallor are correlated with the weakening of the retinal nerve fibre layer (RNFL) and the reorganisation of the remaining disc astrocytes into thick, parallel layers across the optic nerve head[1-3]. Optic disc pallor may also be brought on by vascular dysregulation[4]. RNFL loss is frequently measured using optical coherence tomography (OCT), which is objective, quantifiablerepeatable. OCT may also be helpful in quantifying optic atrophy[5,6]. Even though optic disc pallor is presently a subjective, comparative assessment, it is an essential characteristic of optic neuropathy. A number of studies have used various methods (such as fundus reflectometry and scanning micro densitometry) to objectively assess optic disc pallor[7,8]. Regretfully, these methods call for certain tools. Previously, we used fundus photography and the free image analysis programme ImageJ (US National Institutes of Health, Bethesda, MD, USA) to show quantitative optic disc pallor analysis. Optic disc colour was evaluated objectively and with great reproducibility using these easily accessible instruments[9].

Any injury that mainly affects the anterior visual pathway causes loss of retinal ganglion cells, which leads to optic atrophy. Transsynaptic degeneration resulting from involvement of the posterior visual pathway may also induce atrophy[10]. Optic disc pallor on fundoscopy is a common clinical presentation for ophthalmologists, who may be unsure of how to handle the patient and determine the cause of this clinical manifestation. Disc pallor is a result of nerve fibre loss and an indication of either partial or complete optic atrophy. Traditionally, optic atrophy has been divided into two categories: primary and secondary. A lesion affecting the visual pathway from the optic nerve head to the lateral geniculate body is the cause of primary optic atrophy. In these situations, the disc has pale, flat edges that are well defined. Secondary optic atrophy, which appears as a dirty white to grey disc with ill-defined edges, is preceded by disc edoema[11]. In a vast majority of instances, competent study may identify the cause of inexplicable disc pallor. This was shown in a multi center research where the unaccounted-for instances of optic atrophy accounted for just 8% of all cases. In twenty percent of these patients, further direct tests, such as neuroimaging, yielded an etiological diagnosis. This research bolsters the idea that all instances of unexplained optic atrophy should be diagnosed using neuroimaging[12]. Since various optic nerve illnesses behave differently and have variable treatment results, a clear diagnosis is necessary in each instance with disc pallor. While certain conditions, like toxic neuropathies, are somewhat reversible, others, like optic neuritis, are self-limiting but may reoccur. With very few exceptions, hereditary optic atrophies are progressive and do not improve. If left untreated, ischemic optic neuropathy, like arteritic AION, may quickly spread to the other eye. In toxic optic neuropathy, removal of the offending chemical may prevent further damage to a nerve[11].

## MATERIALS AND METHODS

In the afflicted eye, all patients demonstrated relative afferent pupillary abnormalities. A dysmorphic optic disc, a history of optic neuropathy, prior intralobular surgery (such as cataract removal)the use of glaucoma medications were among the exclusion criteria. The eyes in the control group showed normal visual fields, best-corrected visual acuity of =20 / 25no RNFL loss as determined by OCT. The usual range of optic disc brightness (within the 95% confidence intervals) was determined by measuring and analysing optic disc colour in age-and health-matched, healthy controls. all protocols complied with the Declaration of Helsinki criteria.

The ImageJ programme, which transforms grayscale pictures to intensity per pixel to generate brightness values, was used to convert colour optic disc images to grayscale images and assess the overall disc brightness. The following formula[5] was used to convert each RGB picture into a grey scale value for colour photographs in order to create a grey scale histogram: V = 0.299R+0.587G+0.114B (where V stands for value, R for red, G for greenB for blue).

An investigation was conducted on the relationship between the average OCT RNFL thickness in each quadrant and the optic disc brightness score. Additionally, the entire grey scale value of the optic disc as shown in fundus photos was compared to the average RNFL thickness. In order to assess the statistical significance of the association, the Spearman correlation coefficient was computed using SPSS ver. 15.0 (SPSS Inc., Chicago, IL, USA) for data analysis. For statistical significance, a $p<0.05$ was used.

## RESULTS AND DISCUSSIONS

A total of 45 patients (36 male, 9 female) were enrolled in the study. The mean participant age was 35.7±16.1 years (range, 5-63 years) (Table 1).

Table 2 shows the average optic disc brightness score in both the control and TON groups. In the 45 control patients, the temporal quadrant had the highest brightness score, followed by the superior, inferior nasal quadrants (5.05, 4.41, 3.913.30 respectively). The optic disc brightness score significantly differed between the control and TON groups, except in the nasal quadrant (temporal quadrant, p = 0.029, superior quadrant, p = 0.037, inferior quadrant, p = 0.030, nasal quadrant, p = 0.056).

According to OCT findings, 6 patients had decreased RNFL thickness levels below the normative

**Table 1: A total of 45 patients (36 male, 9 female) were enrolled in the study. The mean participant age was 35.7±16.1 years (range, 5-63 years) (Table 1)**

| | TON group | Controls | p-value |
|---|---|---|---|
| Sex (M : F) | 32 : 2 | 32 : 1 | - |
| Age (yr) | 35.7 ± 16.01 | 37.8 ± 13.02 | 0.658 |
| Mean visual acuity (logMAR) | 2.20 ± 0.35 | 0.08 0.05 | <0.001 |
| Refractive errors (spherical equivalent, diopters) | 3.73 ± 2.21 | 4.02 ± 2.06 | 0.176 |

**Table 2. Optic disc brightness score of the control and TON groups**

| | Control group | | | TON group | | |
|---|---|---|---|---|---|---|
| | Mean | SD | Upper 95 % CI | Mean | SD | p-value* |
| Total disc | 3.61 | 2.61 | - | - | - | - |
| Temporal quadrant | 4.64 | 3.73 | 5.51 | 6.91 | 5.03 | 0.029 |
| Superior quadrant | 3.81 | 3.07 | 4.50 | 5.41 | 4.41 | 0.037 |
| Nasal quadrant | 3.41 | 2.51 | 3.91 | 4.83 | 3.30 | 0.056 |
| Inferior quadrant | 3.69 | 2.63 | 4.21 | 5.05 | 3.91 | 0.030 |

**Table 3. The number of quadrants that fell outside of the 95th percentile for RNFL thickness and optic disc brightness**

| | RNFL thickness less than 95 percentile (n=45) | Optic disc brightness score over than 95 percentile (n=45) |
|---|---|---|
| Temporal quadrant | 19 (42.2) | 9 (20) |
| Superior quadrant | 28 (62.2) | 11 (24.4) |
| Nasal quadrant | 9 (20) | 11 (24.4) |
| Inferior quadrant | 30 (66.6) | 14 (31.1) |

95th percentile. Thinning of the RNFL was most commonly observed (28 of 35 eyes) in the inferior quadrant, which corresponded to a brighter optic disc score (greater than the normative 95th percentile) in the inferior quadrant (Table 3).

Reproducibility of spectral domain measurements of RNFL thickness OCT in eyes with and without glaucoma was good.2. In addition, OCT may be utilised to evaluate and track axonal damage after TONNE[13]. Nevertheless, depending on the circumstance, computerised analysis may provide inaccurate data[14]. When the whole retina was analysed in this research, 6 of 35 patients (17%) had reduced RNFL thickness, however, not every quadrant was impacted. Since trauma damage mostly affects the inferior portion of the optic nerve, the RNFL thickness in the inferior quadrant most commonly went below the 95th percentile of normal eyes. This might be because of the normal histopa-thology of the optic disc, which causes the nerve fibres to have less mechanical support[15].

Our earlier research shown that ImageJ has a good level of inter- and intra-observer repeatability and is a valuable, objective tool for optic disc colour investigation[9]. The greatest inferior retinal vein's grey scale value in this report had a lower standard deviation than the brightest cupping centre and the nasal rim. The brightness value in each quadrant was normalised by dividing it by the biggest inferior retinal vein grey scale value in order to reduce intra observer bias. The temporal quadrant often had the greatest optic disc brightness, which somewhat correlated with assessments of RNFL thickness. In healthy individuals, the inferior quadrant had the highest RNFL thickness, followed by the nasal, temporal superior quadrants. Furthermore, according to Budenz et al. 2 measures of OCT RNFL thickness, the nasal quadrant exhibited the highest degree of variability. Our study's order was determined by assuming that the nasal quadrant's findings would likewise be changeable. With the exception of the nasal quadrant, the TONNE group's average optic disc brightness score was significantly greater than the controls'. There was an inverse correlation between the RNFL thickness measurements and the optic disc brightness score, with the optic disc brightness increasing as the RNFL thickness dropped. Because the optic disc's colour is influenced by the optic disc rim, which is mostly made up of retinal ganglion cell axons, optic disc pallor results from axon degeneration.

The optic disc pallor and RNFL thickness readings were both between 28.0%-39.3%, which is the 95th percentile of normal patients. The standard deviation was larger than in other OCT RNFL thickness investigations findings were extremely variable even though all control eyes had normal optic disc brightness values. In contrast to our research, which found standard deviations between 60% and 70% of mean values, Lee[16] study, which showed normal RNFL thickness values in Koreans, had standard deviations less than 20% of mean values. As a result, further normative data would be required and our 95th percentile range of optic disc brightness, as shown above, may not be totally correct. Furthermore, the two tests' concordance rates varied from 28.0% to 39.3%, which could be explained by the limited number of controls.

## CONCLUSION

In contrast, patients with various aetiologies who presented with a pale optic disc exhibited no improvement in visual acuity over six months. Patients with optic neuritis, tumours, or trauma aetiology had a one-line improvement in visual acuity on the Snellen chart. A patient's eyesight may be in danger due to a pale optic disc; however, by promptly addressing the underlying systemic reasons, the patient's vision and

vision-threatening symptoms may be saved. Furthermore, identifying and treating the aetiology helps prevent further injury to the optic nerve.

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