IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 3 Ser. 6 (March. 2019), PP 67-73
www.iosrjournals.org

To Evaluate the Differences in Visual Field Patterns of Primary Open Angle Glaucoma and Normal Tension Glaucoma

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Abstract:
Aim: *Different pathogenesis of primary open angle glaucoma (POAG) and normal tension glaucoma (NTG) has lead to dichotomy of views about the difference between visual field patterns of two. One group of ophthalmologists believe that the visual field defects in NTG are steeper, focal and closer to fixation; while other groups believe that there is no significant difference between the two. Since the data on Indian population is lacking, we have devised this study to evaluate the visual field differences between primary open angle glaucoma (POAG) and normal tension glaucoma (NTG).*
Materials and Methods: *This prospective cross-sectional study included glaucoma patients, which were segregated into- primary open angle and normal tension glaucoma group, each group having 25 eyes. Patients of two groups (after matching based on severity of disease) were compared point-to-point wise for pattern standard deviation (PSD) values. The glaucoma hemifields were also matched for pattern standard deviation (PSD) values.*
Results: *The age, refractive error, mean deviation and central corneal thickness of POAG and NTG group was 63.2±10.9 and 60.5±11.4 years, 1.73±3.05 and 1.56±2.53 diopters, -7.65±5.93 and -6.25±6.12 decibels and 0.571±0.031 and 0.562±0.033 mm respectively. Cup to disc ratio for POAG and NTG group is 0.568±0.151 and 0.516±0.158 respectively. None of the values were significant. Other fundus findings were also not found to be significant. Patients were then recruited into groups based on perimetric findings. Mean deviation of mild defects were -4.7±0.862 and -4.92±0.79, moderate defects were -7.04±1.06 and -7.12±0.98 and severe defects were -12.34 and -12.17±0.165 in POAG and NTG groups respectively. None of the values were significant. Then the pattern standard deviation values were compared between two groups and only one point located superior to blind spot came out to be significant. Rest was non-significant. Further on comparing the glaucoma hemifields, none of the area came out to be significant between POAG and NTG group.*
Conclusion: *No significant difference between visual field defects of POAG and NTG were found, suggesting that NTG is continuum of the spectra of POAG, rather than totally different entity.*
Clinical significance: *To know whether normal tension glaucoma is different from primary open angle glaucoma?*
Keywords: *normal tension glaucoma, pattern standard deviation, primary open angle glaucoma, visual field defects*

Date of Submission: 25-02-2019 Date of acceptance: 11-03-2019

I. Introduction

Historically glaucoma was believed to be the disease of raised intraocular pressure (IOP), it was Von Graefe who first postulated that glaucoma could occur without raised IOP. (1) Baltimore Eye Survey has since revealed that normotensive eye disease may be more common than previously thought. (2) Therefore, two separate entities came into being. Primary open angle glaucoma (POAG) has elevated intraocular pressure (that is outside 97.5th percentile) whereas normal tension glaucoma (NTG) is considered to be singular subtype of POAG where IOP is never found to be elevated, that is never more than 21mmHg. (3) IOP is considered the main risk factor for POAG whereas IOP independent risk factors are considered for NTG, such as vascular dysregulation causing the reperfusion injury (4)

Differences in pathogenesis of two entities have lead to dichotomy. Some authors believe that POAG and NTG not only have difference in optic nerve head changes but also difference of visual field patterns whereas others believe them to be the continuum of same spectra of open angle glaucomas. (5) Some authors

believe that NTG patients have visual field changes nearer to fixation, deeper and more focal as compared to POAG. [6] Despite these differences, reported clinical observations of POAG and NTG are conflicting, suggesting that there is likely some overlap of the underlying mechanism of glaucomatous optic neuropathy in the spectrum between these two entities. [5]

Since the data on Indian population is lacking, we have devised this study to evaluate the differences in visual field patterns of primary open angle glaucoma and normal tension glaucoma.

II. Materials And Methods

This is a prospective study conducted in Department of Ophthalmology, Government Medical College and Rajindra Hospital Patiala, following the tenets of Declaration of Helsinki. Informed consent was taken from the patients visiting the outdoor patient department (OPD). Study was conducted from June 2016 to December 2018 and patients were divided into two groups- primary open angle glaucoma group and normal tension glaucoma group, each having 25 eyes. NTG patients had IOP <21mmHg on diurnal tension curve as well as had no recordable history of IOP >21mmHg. POAG group had IOP >21mmHg without any treatment in last three measurements. The Institutional Ethics Committee approved the study.

Patients were further defined as having POAG/NTG, if they had abnormal optic nerve head changes visualized on 90D Volk lens (discussed below), abnormal visual fields (criteria discussed below) using 30-2 program of automated humphrey field analyzer, open angles on gonioscopy and no clinically apparent secondary cause for glaucoma.

Disc changes persistent with glaucomatous damage included splinter hemorrhages, localized optic disc notch or thinning of the rim, non-maintenance of ISNT rule (inferior>superior>nasal>temporal rim thickness), an asymmetry of cup/disc ratios by > 0.2 between both eyes and/or retinal nerve fiber layer defect. [7] Subjects were classified as having abnormal visual fields if they had atleast (a) 3 consecutive points depressed by 5 dB with one of the points being depressed by at least 10 dB, (b) 2 adjacent points depressed by 10 dB, or (c) a 10 dB difference across the nasal horizontal meridian in 2 adjacent points. All these findings are to be verified on at least three visual fields. Only reliable fields were included in the study, that is, false positive and false negative responses <30% and fixation losses <10%. [8]

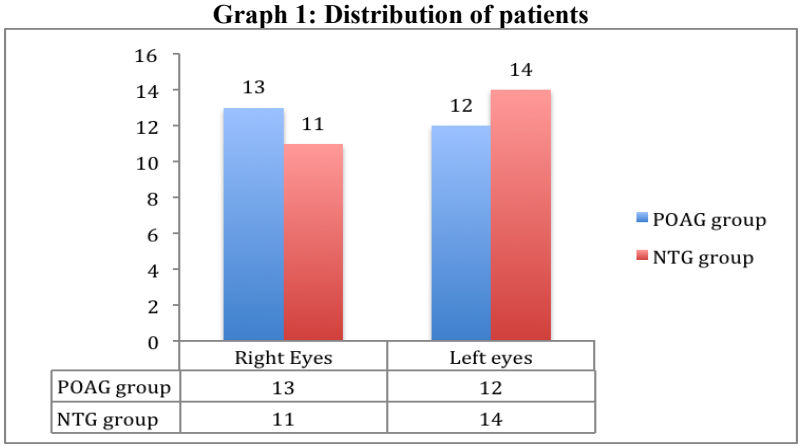
No patient was excluded on the basis of age, gender and race. No patient had refractive error more than ±7 diopters (sphere equivalent). Central corneal thickness was also measured, using an ultrasound pachymeter. IOP was adjusted accordingly. Patients with ocular/systemic diseases potentially associated with optic neuropathy were excluded (i.e., anterior ischaemic optic neuropathy or any other hemodynamic crises). Visual acuity had to be better than 20/40 in all patients.

Included patients were then categorized as mild, moderate and severe glaucomatous defect on the basis of visual field findings. Mild defect had mean deviation (MD) better than -6.00 dB, with 25 % of points having P value 5%, less than 10 points having P value 1% and no point in central degree had sensitivity less than 15 decibels (dB). A moderate defect exceeded 1 or more criteria required to keep it early defect. A severe defect had MD worse than -12dB, >50% of point in total deviation plot having P value 5%, >20 points depressed at P value 1% and a point in central 5 degrees with 0 dB sensitivity or points closer than 5 degrees having 15 dB sensitivity in both upper and lower hemifields. [9] Patients were then group matched and conscious effort was taken to include almost similar number of eyes in each group.

III. Statistical Analysis

Each group had 25 eyes. Graph 1 shows the distribution of patients in each group.

Graph 1: Distribution of patients



	Right Eyes	Left eyes
POAG group	13	12
NTG group	11	14

The mean, standard deviation and p-value of age, refractive error and central corneal thickness are tabulated in table 1. (P value <0.05 is taken to be significant)

Table 1

	NTG (n=25)		POAG (n=25)		
	Mean	Standard deviation	Mean	Standard deviation	p- value
AGE (years)	60.5	11.4	63.2	10.9	0.22 Non-significant
REFRACTIVE ERROR (diopters)	1.56	2.53	1.73	3.05	0.76 Non-significant
CENTRAL CORNEAL THICKNESS (in mm)	0.562	0.033	0.571	0.031	0.16 Non-significant

These patients were then evaluated for disc changes. Cup to disc ratio findings of both groups are shown in table 2

Table 2: Cup to disc ratio

Cup to Disc Ratio	POAG Group (number of eyes)	NTG Group (number of eyes)
0.3	2	3
0.4	4	5
0.5	10	8
0.6	5	6
0.7	1	2
0.8	2	1
0.9	1	0
Mean	0.568	0.516
Standard Deviation	0.151	0.158
p-value	0.09	
Significance	Statistically non-significant	

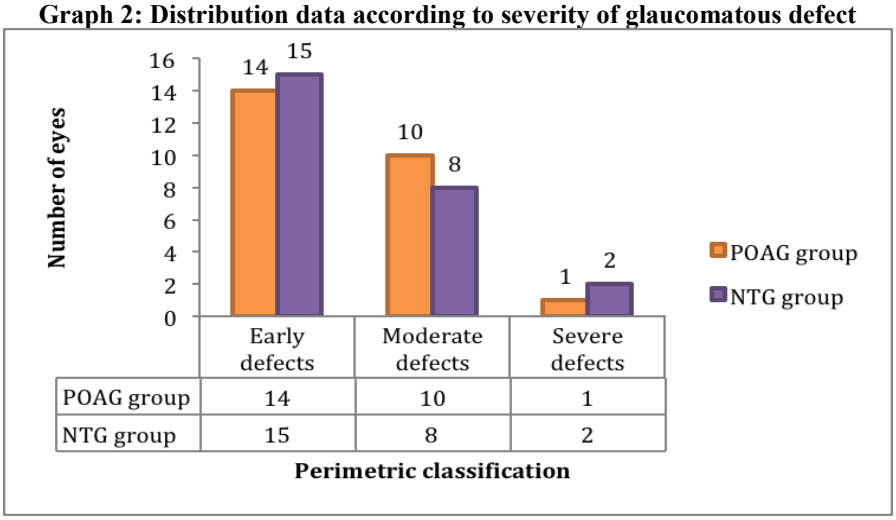
Other fundus findings of both groups are shown in table 3.

Table 3: Fundus Findings

	Peripapillary atrophy		ISNT rule		Splinter hemorrhage		RNFL defect	
Number of eyes	POAG	NTG	POAG	NTG	POAG	NTG	POAG	NTG
Present	14	9	2	1	8	7	7	8
Absent	11	16	23	24	17	18	18	17
Chi square Test	0.735		1.04		0.173		0.046	
p-value	0.391		0.307		0.676		0.828	
Significance	Non- significant		Non- significant		Non- significant		Non- significant	

After fundus examination, patients were grouped according to the severity of glaucoma on the basis of perimetric findings. Graph 2 shows number of eyes in each group.

Graph 2: Distribution data according to severity of glaucomatous defect



After this, the visual field maps (using pattern standard deviation) were compared point-wise between POAG and NTG. The data is shown in figure 1

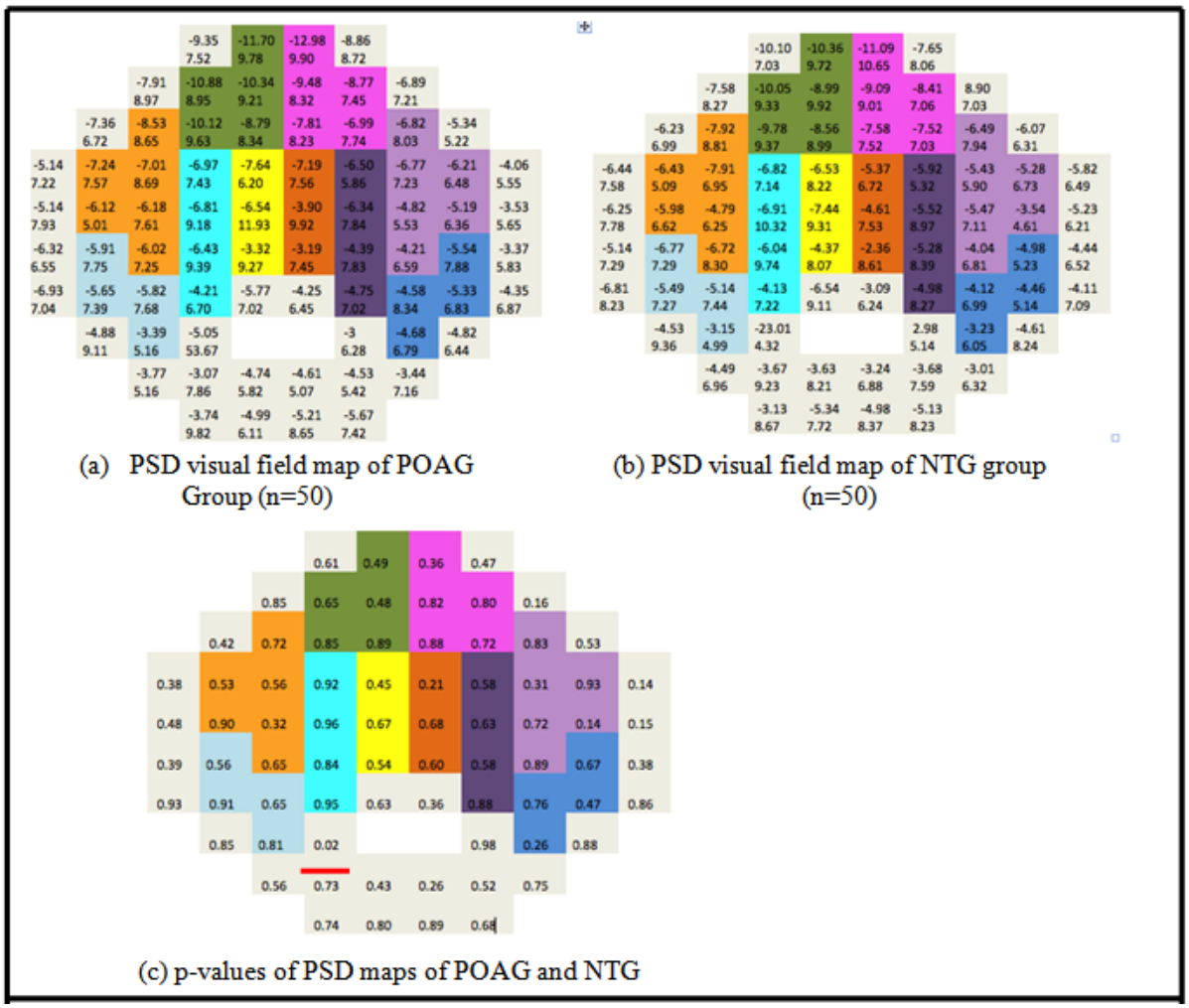


Figure 1: Point wise comparison between POAG and NTG on 30-2 SITA STANDARD automated Humphrey Visual Field Analyser

The visual field map (a) of figure 1 denotes mean as well as standard deviation values of pattern standard deviation of 25 eyes included in POAG group. The upper value denotes mean of PSD and is negative, whereas lower value denotes standard deviation of PSD. Similar is for visual field map (b) that denotes mean and standard deviation PSD values of NTG group. The visual field map (c) denotes the p-values of both the fields compared. It is to be noted that all values are non-significant (p-value <0.05 is taken significant) except one point above blind spot (underlined in red).

To avoid loosing the spatial information, the same data was analyzed by dividing the visual field maps into ten different areas using the glaucoma hemifield (GH) tests. The values of ten glaucoma hemifields were calculated using the pattern standard deviation values of both groups. The data is shown in figure 2.

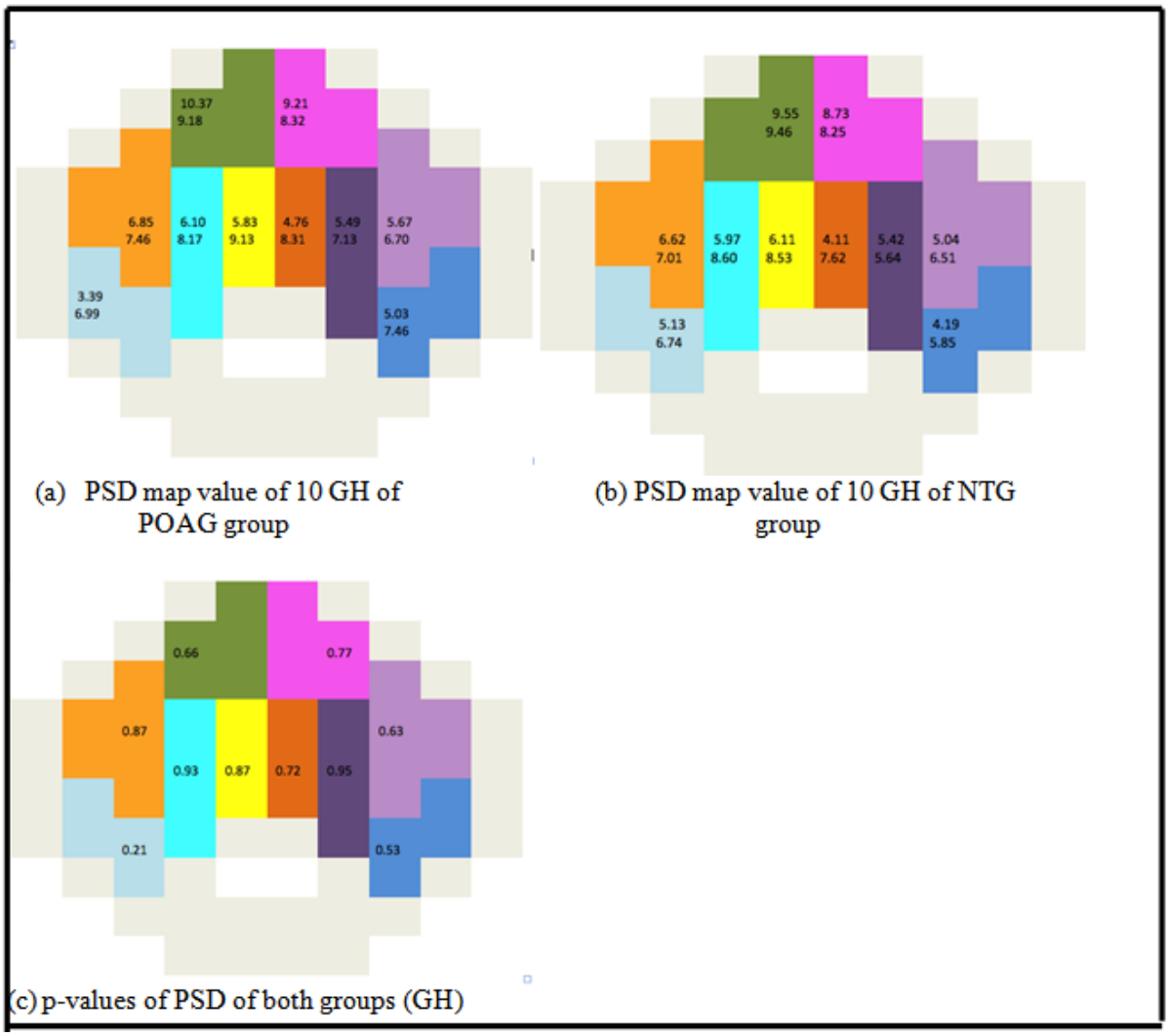


Figure 2: GHT comparison between POAG and NTG on 30-2 SITA STANDARD automated Humphrey Visual Field Analyser

Figure 2 (a) and (b) denotes PSD of both POAG and NTG group respectively of 10 glaucoma hemifields (GH). Upper value denotes mean whereas lower value denotes standard deviation of PSD of 10 GH. Map (c) denotes p-values of the same. No GH was found to be significant.

IV. Results

25 eyes each were recruited in both- POAG and NTG groups. The age of POAG and NTG groups was 63.2±10.9 and 60.5±11.4 years respectively. The refractive error of POAG and NTG groups was 1.73±3.05 and 1.56±2.53 diopters respectively. CCT of both groups was 0.571±0.031 and 0.562±0.033 mm respectively. After evaluating the fundus changes and finding them non-significant between both groups, pattern standard deviation of both groups was compared point wise for 30-2 humphrey fields. Cup to disc ratio for POAG and NTG group is 0.568±0.151 and 0.516±0.158 respectively. Patients were then recruited into groups based on perimetric findings. Mean deviation of mild defects were -4.7±0.862 and -4.92±0.79, moderate defects were -7.04±1.06 and -7.12±0.98 and severe defects were -12.34 and -12.17±0.165 in POAG and NTG groups respectively. All findings were non-significant. Only one eye was recruited in severe POAG group.

After that, when the pattern standard deviation maps were analyzed point wise (figure 2), only one point located superior to blind spot came out to be significant. Rest other points were non-significant. Out of the 76 analyzed points, result of difference between POAG and NTG was positive for 24 points. Rest was negative.

When the 10 different GH areas were compared for PSD values, none of the area came out to be significant between POAG and NTG group (figure 3).

V. Discussion

There remains a considerable disagreement between the ophthalmologists as to the possible difference between optic nerve head and visual field changes in POAG and NTG. (4) Caproli and Spaeth showed that scotomas in NTG were closer to fixation, were deep and had steeper slope. [(10)]

Greve and Geijsen also supported the similar findings. They concluded that in NTG larger defects were found in upper half of visual field. [(11)]

But researchers like Bjerrum, Sjogren and Drance did not find any significant difference between two entities. [(12-13)]

The different findings might be ascertained to the fact that NTG is detected late. Due to normal IOP, NTG gets ignored and gets detected only when significant ONH damage had already occurred or, when significant visual field impairment becomes apparent. Furthermore it becomes more apparent in patients of NTG to seek physicians where visual field defects lead to visual impairment or when they were closer to fixation. Whereas, POAG cases mostly gets detected on the basis of objective IOP measurement and not mainly by scotomatous defects. This could be one reason for the different variations of scotomas between POAG and NTG found in the literature. [(14)]

In this study, 74 PSD points of visual fields were compared between POAG and NTG. Except for one point above blind spot, rest all points were found to be statistically insignificant. This finding could be ascertained to the fact that when so many points (74 points) were compared, due to mathematical probability, it could have been possible to get significant result in one of them. Second, if we applied the binomial (sign) test to the pattern of the mean changes across the points and the test assumed that point data were mutually independent, under the hypothesis of zero difference, the positive and negative point data are likely to be equal.

Huang P et al conducted a study to evaluate visual field differences between POAG, NTG and chronic angle closure glaucoma (CACG). It was found that no significant visual field difference was observed between NTG and POAG. These results are consistent with the results of our study. [(15)]

Risk factors like migraine, low blood pressure, and vasospastic phenomenon were not included in our study. It is possible to better classify patients into NTG and POAG if these factors were also included. If data from both functional and structural analysis were considered, one might presume that NTG and POAG are same. NTG is a spectrum of POAG where IOP is not the main risk factor for causing glaucomatous damage. [(16)]

So it is concluded that NTG neither have steeper defects nor the defects are closer to fixation. Results also showed that visual field defects have no preference for any sector of fields, as compared to POAG. The difference between visual field defects of POAG and NTG was found to be insignificant. From the discussion it could also be concluded that NTG is a spectrum of POAG where the only difference is that, IOP is not a risk factor for glaucomatous damage in NTG.

VI. Conclusion

Visual field defects of POAG and NTG are insignificantly different suggesting that NTG is continuum of the spectra of POAG, rather than totally different entity. The difference in visual field defects between two entities (found in literature) could be ascertained to the fact that since NTG patients have normal IOP, the disease becomes apparent only when there is decreased visual acuity or defects are closer to fixation. Whereas, POAG are detected easily due to raised IOP and the intervention start earlier in this group, halting the progression.

CLINICAL SIGNIFICANCE:

The clinical significance of study is to know whether normal tension glaucoma is different from primary open angle glaucoma?

Acknowledgements

We would like to thank the participants for the study as well as staff of Dept. of Ophthalmology, Government Medical College & Rajindra Hospital, Patiala.

Funding: None
Conflict of interest: None

References

[1]. Von Graefe A. Amaurose mit sehnervenexcavation. Graefes Arch Clin Exp Ophthalmol 1857; 3: 484-488.
[2]. Tielsch JM, Katz J, Singh K, Quigley HA, Gottsch JD, Javitt J, Sommer A. A population-based evaluation of glaucoma screening: the Baltimore Eye Survey. Am J Epidemiol. 1991; 134(10): 1102-1110.
[3]. Bathija R, Gupta N, Zangwill L, Weinreb RN. Changing definition of glaucoma. J Glaucoma 1998; 7: 165–169.
[4]. Anderson DR. Glaucoma, capillaries and pericytes. Ophthalmologica. 1996; 210(5): 257-262.

[5]. Shields MB. Normal-tension glaucoma: is it different from primary open-angle glaucoma? Curr Opin Ophthalmol. 2008; 19(2): 85-88.
[6]. Chauhan BC, Drance SM, Douglas GR, Johnson CA. Visual field damage in normal-tension and high-tension glaucoma. Am J Ophthalmol. 1989; 108(6): 636-642.
[7]. M. Iester, N. V. Swindale, and F. S. Mikelberg. Sector-based analysis of optic nerve head shape parameters and visual field indices in healthy and glaucomatous eyes. Journal of Glaucoma 1997; 6(6): 371–376.
[8]. Ocular Hypertension Treatment Study: Manual of Procedures. Version 2.0 Available at url: https://ohts.wustl.edu/wp-content/uploads/2017/02/OHTS- III-12-17-15.pdf (Last Assessed 10 May, 2017)
[9]. Hodapp E, Parrish RK II, Anderson DR. Clinical decisions in glaucoma. St Louis: The CV Mosby Co; 1993. pp. 52–61.
[10]. J. Caprioli and G. L. Spaeth. Comparison of visual field defects in the low-tension glaucomas with those in the high-tension glaucomas. American Journal of Ophthalmology 1984; 97(6): 730–737.
[11]. E. L. Greve and H. C. Geijssen. Comparison of glaucomatous visual field defects in patients with high and with low intraocular pressures. Documenta Ophthalmologica Proceedings Series 1983; 35: 101–105.
[12]. H. Sjogren. A study of pseudoglaucoma. Acta Ophthalmologica 1946; 24: 239-244.
[13]. B. C. Chauhan, S. M. Drance, G. R. Douglas, and C. A. Johnson. Visual field damage in normal-tension and high-tension glaucoma. American Journal of Ophthalmology 1989; 108(6): 636–642.
[14]. Michele Lester, Fabio De Feo, Gordon R. Douglas. Visual Field Loss Morphology in High- and Normal-Tension Glaucoma. Journal of Ophthalmology Volume 2012: 101-109.
[15]. Huang P1, Shi Y, Wang X, Liu M, Zhang C. Interocular asymmetry of the visual field defects in newly diagnosed normal-tension glaucoma, primary open-angle glaucoma, and chronic angle-closure glaucoma. J Glaucoma. 2014; 23(7): 455-460.
[16]. M. T. Nicolela, T. A. McCormick, S. M. Drance, S. N. Ferrier, R. P. LeBlanc, and B. C. Chauhan. Visual field and optic disc progression in patients with different types of optic disc damage: a longitudinal prospective study. Ophthalmology 2003; 110(11): 2178–2184.

Dr. Harsimran Singh. "To Evaluate the Differences in Visual Field Patterns of Primary Open Angle Glaucoma and Normal Tension Glaucoma." IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 3, 2019, pp 67-73.