

Normative Data of Optic Nerve Head in Nepalese Population by Confocal Scanning Laser Ophthalmoscopy

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Abstract

Purpose: The present study had an aim to ascertain normative data of Optic Nerve Head parameters by using Confocal Scanning Laser Ophthalmoscopy. These normal data can be used as baseline reading for future references; can be used for comparison with special cases like with those having high myopia, glaucoma and other pathologies.

Methods: The present study design was a cross-sectional descriptive study. Normal subjects who attended the eye clinic of B.P. Koirala Lions Center for Ophthalmic Studies, Institute of Medicine, Tribhuvan University Teaching Hospital, Kathmandu were recruited in the present study. All subjects completed an ophthalmological examination that included refraction, best corrected visual acuity, slit-lamp biomicroscopy, funduscopy, and standard white on white automated perimetry (Humphrey 24-2). Participants were then imaged with HRT II, with the scanner's focus being adjusted according to the patient's refraction and to obtain the best image.

Results: Fifty normal participants (100 eyes) were included in the study. There were 28 female (56%) and 22 males (44%). The mean \pm SD values of age, refractive error (SE) and IOP were 21.38 ± 3.849 years, -0.05 ± 0.174 D and 16.64 ± 2.285 mmHg respectively. Average CDR was 0.187 ± 0.010 ; mean disc area was 2.777 ± 0.641 mm²; mean cup area was 0.55 ± 0.356 mm²; mean cup depth was 0.205 ± 0.798 mm; mean RNFL thickness was 0.292 ± 0.061 mm.

Conclusion: All pathologies are due to deviation of normal anatomy and physiology. Hence, establishing normative data of optic nerve head worth a lot in glaucoma diagnosis and other optic nerve head pathology screening. HRT can detect optic disc topography abnormalities in glaucoma-suspect eyes before the development of standard achromatic Perimetry abnormalities.

Keywords: Optic Nerve Head; Confocal Scanning Laser Ophthalmoscopy; HRT; Glaucoma

Introduction

Glaucoma is one of the leading causes of blindness worldwide. It is characterized by retinal ganglion cell death that results in optic nerve damage and visual field loss. Distinguishing a normal from a glaucomatous optic nerve head is essential for making a diagnosis of glaucoma. Several characteristics of glaucomatous optic nerve head have been described in the literature [1-5], but distinction between normal and glaucomatous optic disc remains a matter of subjective clinical judgment. Currently, the authors have known that structural change of optic nerve head (ONH) usually precedes functional visual field loss [6-8].

The Heidelberg Retina Tomography (HRT II; Heidelberg Engineering, Heidelberg, Germany) is a semi-automated, confocal scanning laser system that provides reliable and reproducible three-dimensional imaging data of the ONH. To differentiate between normal and glaucomatous optic disc, normative data are required. The appearance of ONH can vary widely. Many reports demonstrated that there

were ethnic differences in ONH and emphasized the need for race-specific normal data [9,10]. Previous studies have shown that Afro-Americans have larger optic discs than white people [14-18]. Tsai, *et al.* [9] found that optic disc area was significantly larger in African-Americans than in Hispanics and Whites, and Asians have optic disc area nearly the same as Afro-Americans. Recent study from China demonstrated that Chinese people have larger disc area than white people by using optic disc photograph [11]. The present study was conducted to establish the normative data of optic disc stereometric parameters as for the reference in Nepalese population (Asians) with refractive error (SE ranging from 0.50D to -0.50D) by using HRT II measurement.

Material and Method

The present study design is a cross-sectional descriptive study. Normal subjects who attended the eye clinic of B.P. Koirala Lions Center for Ophthalmic Studies, Institute of Medicine, Tribhuvan University Teaching Hospital, Kathmandu, Nepal between 1st November, 2015 to 30th October, 2016 were recruited in the present study. Informed consents were obtained from all participants, and the institutional research ethics committee approved all methodology.

A detailed medical and ophthalmic history including information on systemic disease, family history of glaucoma, ocular trauma, and ocular surgery were recorded. Subjects were excluded if one of the following conditions was found: intraocular pressure (IOP) > 20 mmHg, history of glaucoma from any cause or on current anti-glaucoma treatment, evidence of uveitis, any disease of optic nerve or retina both congenital and acquired, history of refractive surgery, history of ocular surgery, or trauma.

All subjects completed an ophthalmological examination that included refraction, best corrected visual acuity, slit-lamp biomicroscopy, funduscopy, and standard white on white automated perimetry (Humphrey 24-2). Inclusion criteria for participants were: Nepalese people aged between 15 - 35 years, best corrected visual acuity of 20/30 or better, intraocular pressure (IOP) < 20 mmHg, refractive error of spherical equivalent ranging from 0.50D to -0.50D, open angles, normal slit-lamp biomicroscopy, and funduscopy. All subjects also had normal Humphrey visual field testing.

Participants were then imaged with HRT II, with the scanner’s focus being adjusted according to the patient’s refraction and to obtain the best image. The optic disc contour line in all cases were drawn by one well-trained investigator (RPS) to mark the edge of the optic disc using a digital photographic disc image to aid contour placement. HRT II then calculated disc area (square millimeters) and 10 further stereometric parameters. The average value of two eyes in the same subject was used as the unit of statistical analysis, then 11 optic disc parameters from 50 subjects i.e. 100 emmetropic eyes were statistically analyzed for the mean and standard deviation (SD) values, and 95% reference interval (95% RI).

Results

Fifty normal participants (100 eyes) were included in the study. There were 28 female (56%) and 22 males (44%).The mean ± SD values of age, refractive error (SE) and IOP were 21.38 ± 3.849 yrs, -0.05 ± 0.174D and 16.64 ± 2.285 mmHg respectively as depicted in table 1.

	Mean ± SD
Male/Female	22/28
Age, yr	21.38 ± 3.849
Refractive Error, D	-0.05 ± 0.174
Intra Ocular Pressure, mmHg	16.64 ± 2.285

Table 1: Demographic Data from 100 Normal Eyes with Emmetropia.
Data are expressed as the mean ± SD.

The mean disc area was $2.777 \pm 0.641 \text{ mm}^2$ (95% RI: 1.450, 3.893). The mean and 95% RI for all global parameters are presented in table 2.

Parameters	Mean \pm SD	95% RI	
		Lower	Upper
Disc Area, mm^2	2.777 ± 0.641	1.450	3.893
Cup Area, mm^2	0.550 ± 0.356	0.021	1.600
Rim Area, mm^2	2.227 ± 0.471	1.431	3.873
Cup Volume, mm^3	0.126 ± 0.121	0.013	0.521
Rim Volume, mm^3	0.675 ± 0.286	0.012	2.121
Cup to Disc Area Ratio	0.187 ± 0.010	0.010	0.412
Rim to Disc Area Ratio	0.814 ± 0.100	0.594	0.992
Mean Cup Depth, mm	0.205 ± 0.798	0.070	0.460
Cup Shape Measure	-0.201 ± 0.127	-0.352	-0.413
Height Variation Contour	0.450 ± 0.923	0.221	0.582
Mean RNFL Thickness, mm	0.292 ± 0.061	0.162	0.474

Table 2: Average HRT Parameters in 100 Emmetropic Eyes.

Data are expressed as the mean \pm SD and 95% RI (reference interval) of 11 HRT parameter

Discussion and Conclusion

The previous studies have shown that HRT II has poor sensitivity as a screening modality for glaucoma [12,13]. In contrast, other investigators have shown that HRT can detect optic disc topography abnormalities in glaucoma-suspect eyes before the development of standard achromatic perimetry abnormalities. These data support strongly the importance of optic disc examination for early glaucoma diagnosis [14]. The present study presents the normal range data for ONH parameters measured by HRT II in 100 normal eyes of 50 healthy Nepalese subjects. Nepalese people would represent part of an Asian population.

The present study found that the mean (\pm standard deviation) optic disc area of a normal Nepalese population was $2.78 \pm 0.64 \text{ mm}^2$. Comparing the values of the present data to the data from Ngamkae., *et al.* [15] (Thai population), Tsai., *et al.* [9] and other studies [16-19] in table 3, this demonstrated that there were marked differences of topographic optic nerve parameters among different ethnic groups. Interestingly, Nepalese subjects had a rather large optic disc area, which was 2.78 mm^2 (95% RI: 1.45, 3.89), compared to other ethnic groups. Optic disc area of Nepalese subjects is larger than Caucasians and Hispanics. When comparing the present data to other studies in an Asian population, Nepalese subjects also had a larger optic disc area than Japanese [18], Indians [16] and Thai population [15]. The present data is even larger than the data from Tsai., *et al.* [9] for Asian population as a whole.

	Tsai., <i>et al.</i> [9]	Nakamura., <i>et al.</i> [18]	Agrawal [16]	Ngamkae., <i>et al.</i> [15]	Present data
Race of subjects	Asians	Japanese	Indians	Thais	Nepalese
Sample size	29	77	275	103	100
Mean age, yr	22.6 (4.3)	56 (NA)	42.06 (12.38)	47 (9.95)	21.38 (3.85)
Range of RE, D	NA	NA	+6.00 to -10.00	+3.00 to -6.00	+0.50 to -0.50
Disc area, mm^2	2.67 (0.10)	2.15 (0.50)	2.34 (0.47)	2.67 (0.03)	2.78 (0.64)
Cup area, mm^2	0.56 (0.10)	0.55 (0.42)	0.63 (0.41)	0.57 (0.03)	0.55 (0.36)
Rim area, mm^2	2.11 (0.07)	1.59 (0.34)	1.72 (0.32)	2.11 (0.02)	2.23 (0.47)
Rim volume, mm^3	0.64 (0.05)	0.44 (0.15)	0.45 (0.15)	0.56 (0.01)	0.67 (0.29)
Cup to disc area ratio	0.19 (0.03)	0.24 (0.14)	0.25 (0.13)	0.20 (0.01)	0.19 (0.01)
Mean RNFL thickness, mm	NA	0.25 (0.08)	0.25 (0.05)	0.26 (0.02)	0.29 (0.06)

Table 3: Comparison between the published literature and our findings for optic nerve head measurements by HRT in normal eyes.

Results are shown as mean (SD). RE: Refractive Error; RNFL: Retinal Nerve Fiber Thickness; NA: Not Available

This discrepancy could also be due to several possible reasons (i.e. difference in the mean age of the study subjects, mean refractive error of the study population and racial difference). The mean age of the subjects in Thai study was 47.00 ± 9.95 years and Indian study was 42.06 ± 12.38 . While in our study the average age of Nepalese subjects is only 21.38 ± 3.85 years. We cannot deny that the aging can have some effect on the values of the parameters. Since, the young adults were recruited in our study, we have to accept the current data of the optic nerve head of Nepalese population. The mean refractive error of the Nepalese subjects in present study is only -0.05 ± 0.174 D ranging from just $+0.50$ D to -0.50 D. However, in the study done by Ngamkae., *et al.* in Thai population the range of refractive error of the subjects included in their study was from $+3.00$ D to -6.00 D. Similarly, the range of refractive error in the Indian study was even wider ranging from $+6.00$ D to -10.00 D. It is believed that the refractive error of the individuals determines the size of the optic disc and subsequently other intra-disc parameters. Basically, the disc area increases as the myopia increases and the disc area decreases as the hyperopia increases. So, the selection criteria of the study subjects could be the major reason for the discrepancy in the results from other studies in Asian population than in present study.

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