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STUDY ON AGEING CHANGES OF THE OPTIC NERVE HEAD IN A GROUP OF NORMAL SUBJECTS

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ABSTRACT

Introduction: Thickness of RNFL around the different quadrants of the optic disc margin progressively increases. Macular fibers occupying the lateral quadrant are the most resistant to glaucomatous damage and explain the retention of the central vision till end. This study was undertaken to determine the age related changes in the optic nerve head (ONH) and retinal nerve fiber layer (RNFL) in a group of normal subjects.

Material and Methods: This prospective cross sectional hospital based study consisted of 150 healthy eyes of 75 subjects whom underwent ONH measurement using the Optovue optical coherence tomography (OCT) and examined the result of optic nerve head parameters and RNFL.

Results- Mean cup disc ratio was found to be higher with increasing age. And the average RNFL thickness was found to decrease with increasing age.

Conclusion: There are changes in optic disc parameters and RNFL with increasing age and the changes were measurable and significant.

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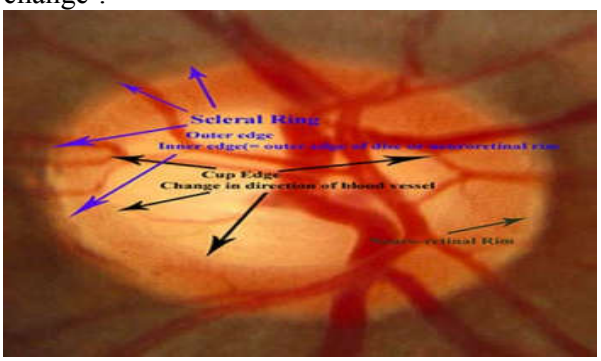
INTRODUCTION

The optic disc or optic nerve head (Fig 1) is the location where ganglion cell axons exit the eye to form the optic nerve. There are no light sensitive rods or cones to respond to a light stimulus at this point[1]. This causes a break in the visual field called the blind spot or the physiological blind spot. The optic disc represents the beginning of the optic nerve (second cranial nerve) and is the point where the axons of retinal ganglion cells come together. The optic disc is also the entry point for the major blood vessels that supply the retina. The optic nerve head in a normal human eye carries from 1 to 1.2 million neurons from the eye towards the brain. This pale centre is devoid of neuroretinal tissue and is called the cup. The vertical size of this cup is devoid of neuroretinal tissue and is called the cup (Fig 2). The vertical size of this cup can be estimated in relation to the disc as a whole and represented as a "cup to disc ratio". A cup to disc ratio of 0.3(i.e. cup occupies 1/3 of the entire disc) is generally considered normal, and an increased cup to disc ratio may indicate a decrease in the quantity of healthy neuro-retinal tissue and hence, glaucomatous change[3].



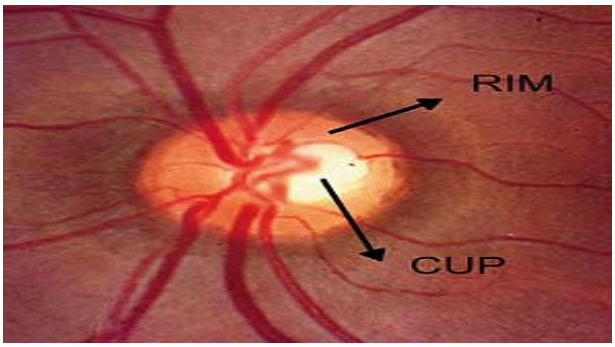


Figure 1 and 2

A pale disc is an optic disc which varies in colour from a pale pink or orange colour to white and indicates of a disease condition. RNFL of retina essentially consist of unmyelinated axons of the ganglion cells which converge at the optic nerve head, pass through lamina cribrosa and become ensheathed by myelin posterior to lamina. Retinal vessels lie in the nerve fiber layer but as a rule do not project on the surface of retina. A rich bed of superficial capillary network is present in this layer. The nerve fibers vary in their thickness from 0.5 to 2mm and are non-myelinated[4]., the cytoplasm of the axons contains microtubules, fine fibrils, mitochondria and occasional vesicles. Fibers from the half of the retina come directly to the optic disc as superior and inferior radiating fibers. Fibers from the macular region pass straight in the temporal part of the disc as papillomacular bundle and fibers from the temporal retina arch above and below the macular and papillomacular bundle as superior and inferior arcuate fibres with a horizontal raphe in between. Whereas fibers from the peripheral part of the retina lie deep in the retina but occupy the most peripheral part of the optic disc while the fibres originating closer to the optic nerve head lie superiorly in the retina and occupy a more central portion of the disc[5]. Thickness of RNFL around the different quadrants of the optic disc margin progressively increases in the following order- Most lateral quadrant (thinnest) > Upper temporal and lower temporal quadrant > Most medial quadrant > Upper nasal and lower nasal quadrant (thickest). Papilloedema appears first of all in the thickest quadrant and last of all in the thinnest quadrant. Macular fibers occupying the lateral quadrant are most resistant to glaucomatous damage and explain the retention of the central vision till end. This study is to determine the age related changes in the optic nerve head (ONH) and retinal nerve fiber layer (RNFL) in a group of normal subjects between age group of 10-65 yrs.

MATERIAL & METHODS

This prospective cross sectional hospital based study consisted of 150 healthy eyes of 75 subjects, between the age group of 10–65 years. The sample size couldn't be extended further because the evaluation tools like Optical coherence tomography and color fundus photography were expensive. Patients underwent ONH measurement using the Optovue Optical coherence tomography (OCT) and examined the result of optic nerve head parameters and RNFL conducted in Glaucoma department of Al Salama Eye Hospital, Perinthalmanna which is an associate institution of MES Medical college. Study was performed between December 2013 to August 2014. This study was in accordance with ethical standards of responsible committee on Human experimentation and with the Helsinki Declaration of 1975 which was revised in 2000 and it was reviewed and cleared by Institutional ethics committee. The cases were included after an informed written consent was taken from patients. A complete ocular evaluation including Snellen visual acuity testing, Slit lamp biomicroscopy, IOP using Applanation Tonometer, ONH measurements using O C T (Fig 3) were performed at baseline. Only ONH scans meeting appropriate scan quality were included for data analysis. ONH topographic parameters of qualified scans were analyzed for differences in regards to optic disc size and age. Patients between age group of 10-65 yrs and without significant refractive error, other ocular disease, and systemic problems were included in this study. Patients were excluded if their Best corrected visual acuity (BCVA) was less than 6/12 ,who had known contraindications to pupillary dilation , past history of glaucoma in either eye, visual field defect in either eye , any intra ocular procedures done less than one year, with diabetes mellitus and hypertension or any evidence of active ocular disease.

Statistical Methods[5-8]:

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. The following assumptions on data is made,

Assumptions:

Dependent variables should be normally distributed, 2.Samples drawn from the population should be random, Cases of the samples should be independent. Analysis of variance (ANOVA) has been used to find the significance of study parameters between three or more groups of patients, Pearson correlation between study variables is performed to find the degree of relationship.

Classification of Correlation Co-efficient (r)

Up to 0.1	Trivial Correlation
0.1-0.3	Small Correlation
0.3-0.5	Moderate Correlation
0.5-0.7	Large Correlation
0.7-0.9	V.Large Correlation
0.9- 1.0	Nearly Perfect correlation
1	Perfect correlation

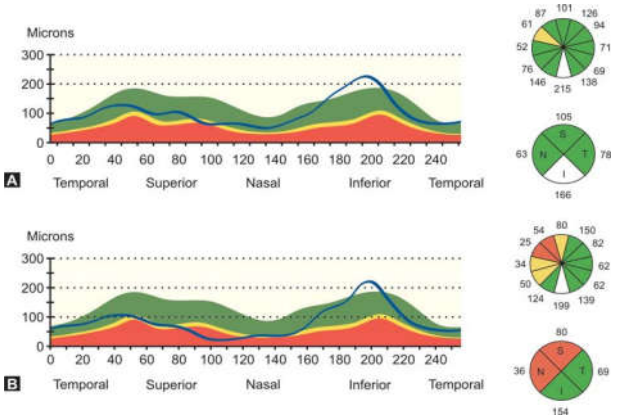
Significant figures

+ Suggestive significance (P value: 0.05<P<0.10)

* Moderately significant (P value:0.01<P ≤ 0.05)

** Strongly significant (P value : P≤0.01)

Statistical software: The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1 ,Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc**.**



RESULTS

This study included 60% males and 40% females. The mean age is: Mean ± SD: 35.00±14.84 (table 1) The average optic disc area was found to be Mean ± SD: 1.95±0.23 (Table 2). The mean cup area in this population was Mean ± SD: 0.69±0.22 (Table 3) with a mean rim area of Mean ± SD: 1.26±0.29

(Table 4). The mean cup disc ratio was Mean ± SD: 0.35±0.12 (Table 5) and the average RNFL thickness was found to be Mean ± SD: 112.74±10.27 (Table 6). Table 7: shows Pearson Correlation. Table 8 and Graph 1 to 5 shows Comparison of study variables according to age in years. Pearson Correlation of study variables with age in years is showne in table 9.

Study shows that age did not have any influence on optic disc size. The values show that cup area increased per decade whereas neuro retinal rim area declined per decade. The mean cup disc ratio was found to be higher with increasing age. Results were statiscally analyzed and found to be significant.

Table 1: Age distribution of patients studied

Age in years	No. of patients	%
10-20	15	20.0
21-30	17	22.7
31-40	13	17.3
41-50	17	22.7
51-60	12	16.0
>60	1	1.3
Total	75	100.0

Mean ± SD: 35.00±14.84

Table 2: Optic disc area distribution of eyes studied

Optic disc area mm^2	No. of Eyes	%
1.4-1.8	65	43.3
1.9-2.3	64	42.7
>2.3	21	14.0
Total	150	100.0

Mean ± SD: 1.95±0.23

Table 3: Cup Area distribution of eyes studied

Cup Area mm^2	No. of Eyes	%
<0.5	27	18.0
0.5-1	110	73.3
>1	13	8.7
Total	150	100.0

Mean ± SD: 0.69±0.22

Table 4: RIM Area mm^2distribution of eyes studied

RIM Area mm^2	No. of Eyes	%
0.5-1	26	17.3
1-1.5	93	62.0
1.6-2	31	20.7
Total	150	100.0

Mean ± SD: 1.26±0.29

Table 5: Cup disc area ratio distribution of eyes studied

Cup disc area ratio	No. of Eyes	%
<0.2	15	10.0
0.2-0.4	88	58.7
0.4-0.6	44	29.3
>0.6	3	2.0
Total	150	100.0

Mean ± SD: 0.35±0.12

Table 6: RNFL average thickness on diameter (µm) distribution of eyes studied

RNFL Average thickness on diameter (µm)	No. of Eyes	%
<100	10	6.7
100-120	103	68.7
>120	37	24.7
Total	150	100.0

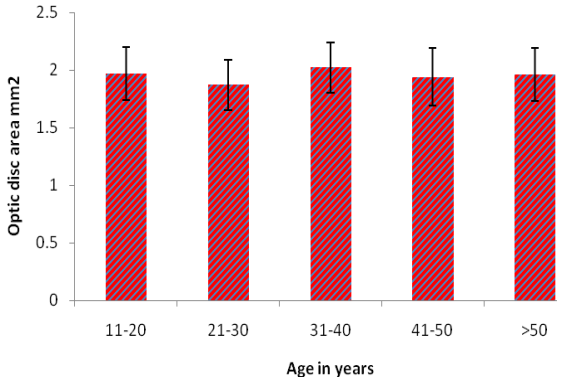
Mean ± SD: 112.74±10.27

Table 7: Pearson Correlation

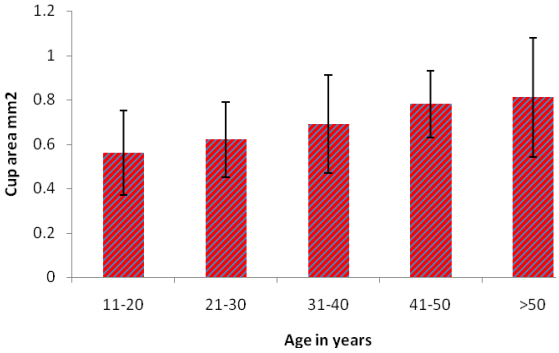
Pearson Correlation	R value	P value
Optic disc area mm2**vs** Cup area mm2	0.205	0.012*
Optic disc area mm2**vs** RIM area mm2	0.658	<0.001**
Optic disc area mm2**vs** Cup disc area mm2	-0.175	0.032*
Optic disc area mm2**vs**RNFL average thickness on diameter (µm)	-0.039	0.633
Cup area mm2**vs** RIM area mm2	-0.603	<0.001**
Cup area mm2**vs** Cup disc area mm2	0.920	<0.001**
Cup area mm2**vs**RNFL average thickness on diameter (µm)	-0.047	0.566
RIM area mm2**vs** Cup disc area mm2	-0.851	<0.001**
RIM area mm2**vs**RNFL average thickness on diameter (µm)	0.004	0.959
Cup disc area mm2**vs**RNFL average thickness on diameter (µm)	-0.051	0.536

Table 8: Comparison of study variables according to age

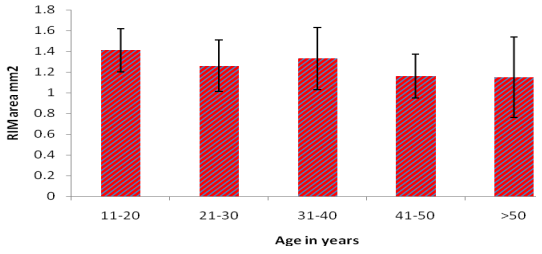
Variables	Age in years					Total	P value
	10-20	21 -30	31 -40	41 -50	>50		
Optic disc area mm2	1.97 ±0.23	1.87 ±0.22	2.02 ±0.22	1.94 ±0.25	1.96 ±0.23	1.95 ±0.23	0.158
Cup area mm2	0.56 ±0.19	0.62 ±0.17	0.69 ±0.22	0.78 ±0.15	0.81 ±0.27	0.69 ±0.22	<0.001**
RIM area mm2	1.41 ±0.21	1.26 ±0.25	1.33 ±0.30	1.16 ±0.21	1.15 ±0.39	1.26 ±0.29	0.001**
Cup disc area mm2	0.28 ±0.09	0.33 ±0.10	0.34 ±0.11	0.40 ±0.06	0.42 ±0.16	0.35 ±0.12	<0.001**
RNFL average thickness on diameter (µm)	114.67 ±10.84	113.11 ±9.52	112.94 ±10.04	112.90 ±10.72	109.61 ±10.24	112.74 ±10.27	0.475



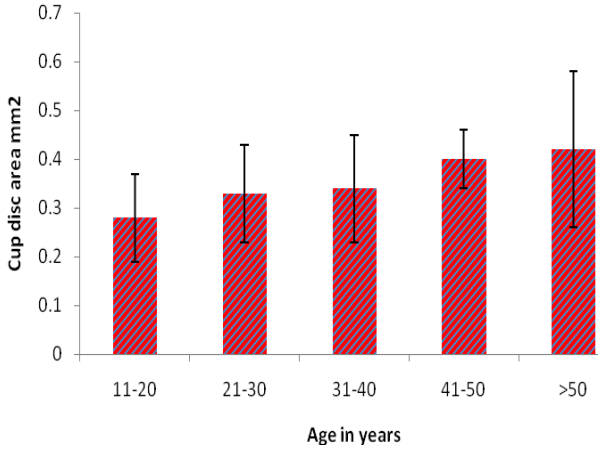
Graph 1



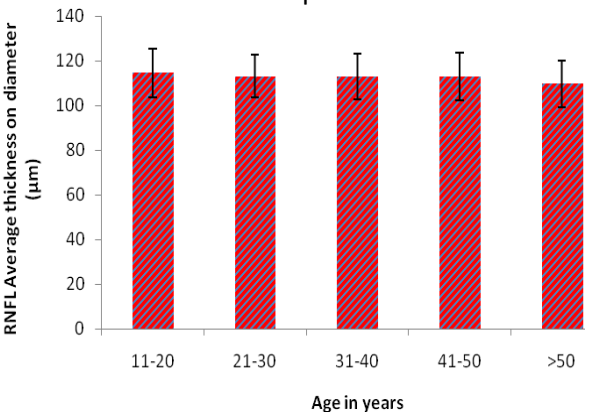
Graph 2



Graph 3



Graph 4



Graph 5

Table 9: Pearson Correlation of study variables with age in years

Pearson Correlation	R value	P value
Age in years **vs** Optic disc area mm2	0.032	0.698
Age in years **vs** Cup area mm2	0.369	<0.001**
Age in years **vs** RIM area mm2	-0.258	0.001**
Age in years **vs** Cup disc area mm2	0.373	<0.001**
Age in years **vs**RNFL average thickness on diameter (µm)	-0.126	0.125
Age in years vs Cup disc area mm2	0.373	<0.001**
Age in years vsRNFL average thickness on diameter (µm)	-0.126	0.125

DISCUSSION

In the studies conducted by D Poinoswamy et al[9], concluded that a progressive reduction of the nerve fibre layer thickness with increasing age. Studies conducted by G.savani et al[10], showed a significant correlation with optic disc area. And RNFL thickness measurements increased significantly with an increase in optic disc size. Another study conducted by B Almouti et al[11], showed that both Retinal thickness and RNFL thickness were significantly correlated with age and values decreased with age. The average RNFL thickness was found to be slightly decreases with increasing age. This study shows that age did not have any influence on optic disc size. Optic disc size, but not age, should be considered in the interpretation of optic disc variables. The mean cup area values show that cup area increased per decade whereas neuro retinal rim area declined per decade. The mean cup disc ratio was found to be higher with increasing age, this is accordance with many other studies. According to this study, it was found that there are changes in optic disc and RNFL with increasing age. And the changes were measurable and significant.

CONCLUSION

The study showed that optic disc area remained nearly constant, unchanged with age. The cup disc ratio and optic cup area increased with age whereas the neuroretinal rim area and RNFL thickness decreases with age. The study has its own limitations like a restricted and uneven sample size in different decades. Hence , it cannot be extrapolated to the general population. However it provides contributory evidence for day to day clinical practice in our subset of population. Further studies with a larger sample size are required in the future to study the ageing changes in optic disc and retinal nerve fiber layer.

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