IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 2 Ver. 15 February. (2018), PP 80-84
www.iosrjournals.org

Comparative evaluation of macular thickness and peripapillary RNFL thickness to analyse and monitor glaucoma patient

Dr.(Mrs.) Padmini Warkhede [1] ,Dr.PervezAhemed Siddiqui [2]
[1].*Asst.Professor ,M.B.B.S.,M.S.(Ophthalmology),N.S.C.B. Medical College ,Jabalpur(M.P.)*
[2.]*Professor ,M.B.B.S.,M.S.(Ophthalmology),N.S.C.B. Medical college ,Jabalpur (M.P.)*
Corresponding author: Dr.PervezAhemed Siddiqui

***Abstract*:**
Purpose *– To evaluate macular thickness and peripapillary RNFL thickness to analyse and monitorglaucoma patient*
Material and method *–The present study was conducted in 200 patients who attended OPD of upgraded department of ophthalmology,NSCB Medical college during academic session October 2015-November2017.All All selected patients underwent a complete examination including visual field examination by humphrey'sautomated perimeter and macular scan with retinal nerve fiber layer (RNFL) scan by Spectral Domain-OCT (SD-OCT)after taking proper history and other necessary clinical examination. Correlation of OCT data with visual field defect was evaluated.*
Result *–Macular thickness and RNFL thickness values were significantly reduced in glaucomatous eyes(Avg.GCIPL58±13.19*µm,*min.GCIPL42.93± 16.92*µm *and Avg.RNFL thickness58.1415±.76*µm) *than in healthy eyes(Avg.GCIPL 81.31*±4.64µm,*min.GCIPL 77.99± 4.95*µm *and Avg.RNFL thickness91.91*. ±6.*85*µm *)and it was correlated well with visual field global indices like MD(-9.07± 6.23) and PSD(6.34±3.36) and average CD ratio (0.75± 0.09)*
Conclusion *– Quantitative measurement of macular thickness and peripapillary RNFL thickness using OCT correlates with visual field global indices in glaucoma patient .In this way we can say that macular and RFNL thickness analysis are excellent modality of analysing and monitoring glaucoma patient*.

Date of Submission: 12-02-2018 Date of acceptance: 03-03-2018

I. Introduction

Glaucoma is leading cause of irreversible blindness in the world . A recent report estimated that there are 60.5 million people worldwide with glaucoma which will increase to 80 million by 2020.POAG is the most common type of glaucoma. It is basically chronic progressive optic neuropathy accompanied by cupping and atrophy of Optic disc,visual field loss etc. Glaucomatous Optic Neuropathy causes progressive death of Retinal Ganglion Cells(RGC) and their axons which Can be seen by increased optic nerve cupping or peripapillary RNFL losses on SD-OCT.

Macula is densely populated by RGC containing 30% of the total no. of these cell occupying only 2% retinal area while 50% located within 4.5 mm of fovea with peak density occurring 750 to 1100 micron from centre of fovea. It has been hypothesized that in early glaucoma loss of RGCoccur in macula and disease invariably affect macular thickness early in it's course and fundamental defining abnormality is located at RGC.Thus macular RGC and IPL(inner plexiform layer)thickness measurement are ideal parameters for detecting glaucoma its earliest progressive Profile.

Conventionally in glaucoma patient structural progression may be focal or diffuse and it may occur well before any visual deficits are apparent. Structural tests depends on clinicians eliciting changes on the optic disc and of retinal nerve fiber layer(RNFL) on clinical examination.Though nerve anatomy and topography demonstrate significant inter individual variability,we frequently find it cumbersome to distinguish physiological variants such as cupping fromthose caused by glaucoma (neuroretinal rim loss).

OCT does an objective and quantitative measurement of RNFL and IPL thickness.It is a noninvasive imaging modality uses low coherence light to obtain high resolution cross section of human structures and has drastically changed our perception of retina visualisation . The technology has evolved leaps and bounds since its inception by Huang et al in 1991.The most significant growth occurred when the moving mirror was used

during collection of time domain OCT.OCT data was refined in favour of Fourier analysis of collected data. As a result the current spectral domain OCT technology collects up to 55000 A-scans per second with an axial resolution of 5 micron a 100 improvement over the earlier generation TD-OCT2.Obtaining large data cubes reduces test –retest variability allows Three dimensional reconstruction and alignment,improves registration and facilitates test-retest comparisons Tremendous diagnostic ability for glaucoma and its progression with an axial resolution of 8µm.

The purpose of this study to compare macular thickness and peripapillary RNFL thickness in normal and POAG patient to analyse and monitor glaucoma.

II. Material and method

This study was conducted during the session October2015- November 2017 in upgraded department of ophthalmologyNSCB medical college, Jabalpur. In this study overall 100 eyes of POAG and 100 eyes of normal age matched control were included . Informed consent was obtained from all subjects.The tenets of declaration of Helsinki were followed. All patients were subjected to detailed history taking regarding following points-

1.Detailed ocular exam – It includes diminution of vision,pain,redness,watering,photophobia,colouredhaloes,headache,vomiting etc.

2.History of surgery – like cataract surgery ,filteringsurgery,post.segment surgery

3.History of associated systemic illness like diabetes mellitus, hypertension, bleeding disorder or any other disease

4.History of trauma

5.Family history

6.Personal history

All patients underwent detailed clinical evaluation including BCVA by means of snellens chart, Anterior segment evaluation by slit lamp biomicroscopy, fundus examination, IOP measurement with NCT, gonioscopic examination with 4 mirror gonioscope and visual field testing including 30-2 SITA full threshold program with Humphrey's automated perimeter.All patients were scanned with the Zeiss Cirrus HD Spectral Domain OCT.

Exclusion criteria for all patients included-BCVA less than 20/40,refractive error exceeding± 5 diopter of sphere or 2 dioptre of cylinder, evidence of vitreous or retinal pathology apart from glaucoma unreliable AP or other pathological condition that could affect the visual field (pituitary lesion,demyelinating diseases) and secondary causes of IOP rise(iridocyclitis, corticosteroid use) and prior incisional surgery or laser treatment.

Visual Field testing – Perimetry was performed with Humphrey field analyser using the Swedish Interactive Threshold Algorithm(SITA) standard strategy 30-2 full threshold test procedure and size 3 stimulus . The analysis of data was carried out by program STATPAC2 included in the software of the perimeter . Perimetry was performed at the same time with OCT. Reliability criteria to accept visual field examination included Fixation loss less than 20% and maximum false positive and false negative rates of 25%.Measurement of visual field depression presented on Humphrey printout include the mean deviation(MD) and patterned standard deviation(PSD).MD is measure of overall field loss and it reflect generalised visual field loss while PSD is measure of focal loss or variability within the field taking into account any generalised depression in the hill of vision and it reflect small localized defects that appear in early stages of glaucoma. The MD and PSD were used for statistical analysis in order to evaluate correlation between macular GCIPL thickness, RNFL thickness and visual field global indices. Visual field global indices and GCIPL and RNFL thickness measurement were compared statistically in all groups.

OCT measurements – The Zeiss Spectral Domain Optical Coherence Tomography(SD-OCT) is a noncontact and noninvasive technology that allows cross sectional imaging of human retina at histologic level of resolution . It is based on principle of low coherence interferometry . It is designed to provide real time ,objective,cross sectional measurement of various layers of retina based on reflectivity of its different layers .It was excluded that an image with a minimum strength 6/10 and below. One of the 3 scans with maximum signal strength was included.for this study we analysed the global average macular GCIPL(Ganglion cell-inner plexiform layer) and average peripapillary RNFL(Retinal nerve fiber layer) thickness in 2 groups of subjects . The results were analysed using the SPSS for windows software and relationship were considered significant if $P<0.05$.Data were reported as mean± standard deviation .

III. Results

Table 1: Age profile

Sr.No.	Age group	Control	POAG	Total

		No.	%	No.	%	
1	40-50 years	37	37	15	15	52
2	51-60 years	35	35	41	41	76
3	61-70 years	22	22	37	37	59
4	>70 years	4	4	7	7	11

This table shows most of the patients were of 51-60 years age group

Table no.2: Gender profile

Sr.No.	Gender	Control		POAG		Total
		No.	%	No.	%	
1	Male	53	53	54	54	107
2	Female	47	47	46	46	93
3	Total	100	100	100	100	200

This table shows that maximum no.of patients were male in both group

Table no. 3: IOP Recording and Average CD Ratio

Sr. No.	Parameter	Control	POAG	Significance
1	IOP (mm of hg)	14.82±1.72	24.49±1.91	T=31.48 P<0.001
2	Average CD Ratio	0.38±0.06	0.75±0.09	T=26.9 p<0.001

This table shows IOP and average CD Ratio in control group and POAG patients

Table no.4: Visual Field Indices

Sr.No.	Parameter	Control	POAG	Significance
1	MD (in decibel)	01.71 ± 0.87	-9.07 ± 6.23	T = 9.79 p=0.0001
2	PSD (in decibel)	1.84 ± 0.30	6.34 ± 3.36	T= 11.19 p<0.0001

This Table shows MD and PSD in control and POAG group

Table no.5: Co-relation of RNFL thickness with visual field indices

S. No.	Status	MD	PSD
1	Average RNFL Control (91.91±6.85)	0.03 p= 0.75	0.04 P=0.74
2	Average RNFL POAG (58.14±15.76)	0.57 P<0.0001	-0.45 P<0.0001

This table shows Average RNFL POAG is directly related to MD and inversely related to PSD

Table no.6: Various OCT Parameter studied during this study

S. No.	OCT Parameter	Control	POAG	Significance
1	AVERAGE RNFL(in µm)	91.91 ± 6.85	58.14 ± 15.76	(36.74%) T = 16.44 p<0.001
2	AVERAGE GCIPL(in µm)	81.31 ± 4.64	59.20 ± 13.19	(27.19%) T = 13.23 p<0.001
3	Minimum GCIPL (in µm)	77.99 ± 4.95	42.93 ± 16.92	(44.95%) T= 16.64P<0.001

This table shows Average RNFL,GCIPL and minimum GCIPL in control group and POAG patients

Table no.7: Correlation of Average GCIPL

S.No	Status	MD in decibel	PSD in decibel	MinimumGCIPL
1	Average GCIPL in control 81.31 ± 4.64 µm	01.71 ± 0.87	1.84 ± 0.30	77.99 ± 4.95 µm

2	Average GCIPLinPOAG 59.20 ± 13.19 µm	-9.07 ± 6.23	6.34 ± 3.36	42.93 ± 16.92mu

This table shows correlation between average GCIPL thickness in control group and POAG patients and MD,PSD and minimum GCIPL

Table no. 8: Correlation - Macular Thickness and Peripapillary RFNL

Group	MD	PSD	Average RNFL	Average CD ratio	Minimum GCIPL
Average GCIPL in control (81.31 ± 4.64 µm)	01.71 ± 0.87 db -0.14	1.84 ±0.30db 0.14	91.91±6.85 0.29	0.38±0.06 -0.05	77.99 ± 4.95 µm
	P=0.21	P=0.23	P=0.014	P=0.66	P<0.0001
Average GCIPL in POAG (59.20 ± 13.19 µm) (27.19%)	-9.07 ± 6.23 0.09	6.34 ± 3.36 -0.1	58.14 ± 15.76 0.35	0.75±0.09 -0.18	42.93 ± 16.92 µm 0.76
	P=0.41	P=0.37	P=0.002 *(*36.74%)	P=0.12	P<0.0001 *(*44.95%)

This table shows correlation of Average GCIPL thickness in control group and POAG patients with MD,PSD,Average RNFL thickness,Average CD Ratio and Minimum GCIPL thickness

Table no.9: Correlation- Macular Thickness and Peripapillary RFNL

Group	MD	PSD	Average RNFL	Average CD ratio	Average GCIPL
Minimum GCIPL in control 77.99 ± 4.95 µm	-0.07	0.20	91.91±6.85 0.32	0.38±0.06 -0.09	81.31 ± 4.64 µm 0.87
	P=0.56	P=0.08	P=0.005	P=0.42	P<0.0001
Minimum GCIPL in POAG 42.93 ± 16.92 µm	0.31	-0.28	58.14 ±15.76 0.40	0.75±0.09 -0.06	59.20 ± 13.19 µm 0.76
	P=0.008	P=0.01	P=0.005 (36.74%*)*	P=0.56	P<0.0001 (27.19%)

This table shows correlation between minimum GCIPL thickness in control group and POAG patients and MD,PSD, Average RNFL thickness,average CD ratio and average GCIPL thickness

IV. Discussion

The main goal of glaucoma management is to diagnose disease when it is asymptomatic . Visual field testing is essential in diagnosis and monitoring of glaucoma but standard perimetrycan not detect VF defects until 20-40% of ganglion cells have been lost . Nowadays RNFL defects have been objectively demonstrated earlier than Visual Field defects with new investigative technologies. Measuring macular RGC,GCIPL and RNFL thickness by OCT enables an objective and quantitative assessment of glaucomatous structural loss. Mwanza et al. showed that Cirrus OCT had an excellent intravisit and intervisit reproducibility of RNFL thickness and ONH parameters . Hong et al. also reported reproducibility of Cirrus HD-OCT to analyse peripapillary RNFL thickness was excellent in healthy eyes.

Naithani et al. compared the performance of optic nerve head and RNFL thickness parameters obtained by parameters obtained by TD-OCT and HRT 2 for detection of early to moderate glaucoma from control eyes .In differentiating early and moderate glaucoma from normal controls the average RNFL thickness was the best parameter among the RNFL parameters.Badala et al.compared the ability of four methods used imaging of optic disc and RNFL . Combination of Stratus OCT average RNFL thickness and HRT 3 cup –disc area ratio was shown to provide a high diagnostic precision . Huang et al.compared the capability of the optic disc,peripapillary RNFL thickness,macular inner retinal layer thickness and their combinations in differentiating a glaucoma suspect from perimetric glaucoma by using SD-OCT and found that average RNFL thickness is the optimal parameter to detect perimetricglaucoma.Li et al suggested that the best parameters of SD-OCT technique for discriminating normal frem early glaucoma were average thickness for RNFL thickness parameter. Taliantzis et al. found a moderate correlation between RNFL thickness measured by Stratus OCT and VF indices.

SITA –Standard is commonly used strategy for glaucoma patient which we used in this study.It is faster than old strategies.We wanted to evaluate a correlation between visual field global indices and macular RNFL thickness

We found correlation between MD and PSD with macular GCIPL and RNFL thickness parameters in POAG group (MD -9.07±6.23,PSD1.84±0.30,Min.GCIPL 42.93±16.92,Avg.GCIPL 59.20 ±13.19,Avg.RNFL thickness 58.14±15.76) as Well as control healthy group(MD 01.71±0.87,PSD 1.84±0.30,Avg.GCIPL

81.31±4.64,Min.GCIPL77.99±4.95,Avg.RNFL thickness91.91±6.85) . These correlation are clinically important . And monitoring the patient during the course of treatment aptly modifying the treatment while gauging the parameters of macula (average GCIPL and minimum GCIPL thickness) and RNFL thickness.

V. Conclusion

SD - OCT of the macula and optic nerve are excellent adjuvant modality for evaluating glaucoma patient and can increase the detection of glaucoma disease in its earlier stage and monitoring the patient during the course of treatment aptly modifying the treatment while gauging the parameters of macula (average GCIPL and minimum GCIPL Thickness) and RNFL thickness. Early diagnosis of glaucoma and early initiation of treatment is very important so that further vision loss can be stopped or slowed down.The evaluation by SDOCT is not superior to ophthalmologist as data acquired from SD-OCT can only guide us.It should be evaluated with the clinical findings of glaucoma patients.

References

[1]. Huang D,SwansonEA,LinCP,Schumanjs,StinsonWG,et al.(1991)Optical coherence tomography. Science 254:1178-1181
[2]. Stamper RL,LibermanMF,Drake MV(1999) Becker &Shaffer's Diagnosis and therapy of theGlaucomas(7 thEdn)Mosby,StLouisMissouri.
[3]. .BluementhalEZ,WilliamsJM,WeinrebRN,GirkinCA,BerryCC,et al (2000) Reproducibility of nerve fiber layer thickness measurements by use of optical coherence tomography. Ophthalmology 107:2278-2282
[4]. Kerrigan –BaumrindLA,QuigleyHA,PeaseME,KerriganDF,MitchellRS.Number of ganglion cells in glaucoma eyes compared with threshold visual field tests in the same persons. Invest Opthal Vis Sci.2000;41:741-748
[5]. Jones AL,SheenNJ,NorthRV,Morgan JE(2001)The Humphrey optical coherence tomographscanner:quantitative analysis and reproducibility study of the normal human retinal nerve fibre layer .Br J Ophthalmol 85:673-677
[6]. Schuman js ,Pedut –KloizmanT,Hertzmark E HeeMR,Wilkins JR et al.(2003)Reliability of nerve fiber layer thickness measurements using optical coherence tomography in normal and glaucomatous eyes.Ophthalmology 110:190-195
[7]. Paunescu LA Schuman JS,PriceLL,StarkPC,Beaton S et al.(2004) Reproducibility of nerve fiber thickness ,macular thickness and optic nerve head measurements using Stratus OCT Invest Ophthalmol Vis Sci 45:1716-1724
[8]. BudenzDL,ChangRT,HuangX,KnightonRW,Tielsch JM(2005) Reproducibility of retinal nerve fiber thickness mmeasurements using the stratus OCT in normal and glaucomatous eyes Invest Opthalmol Vis Sci 46:2440-2443
[9]. BudenzDL,FredetteMJ,FeuerWJ,Anderson DR(2008) Reproducibility of peripapillaryretinal nerve fiber thickness measurement with Stratus OCT in glaucomatous eyes.Ophthalmology 115:661-666
[10]. Mwanza JC,ChangRT,BudenzDL,DurbinMK,Gendy MG et al.(2010)Reproducibility of peripapillary retinal nerve fiber layer thickness and optic nerve head parameters measured with cirrus HD-OCT in glaucomatous eyes.InvestOphthalmol Vis Sci 51:5724-5730
[11]. Mathers K RosdahlJA.AsraniS.Correlation of macular thickness with visual fields in glaucoma patients and suspects J.Ophthalmol.2015;29:201-204
[12]. Hwang YH,AhnSI,KoSJ.Diagnostic ability of macular ganglion cell asymmetry for glaucoma .ClinExperiment Ophyhalmol.2015;43:720-726

Dr.(Mrs.) Padmini Warkhede "Comparative evaluation of macular thickness and peripapillary RNFL thickness to analyse and monitor glaucoma patient.". "IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), Volume 17, Issue 2 (2018), PP 80-84.