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Diagnostic Capability of Perimetryin Primary Open Angle Glaucoma before and After Trabeculectomy:

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ABSTRACT: Purpose: To study the diagnostic capability of Perimetry in the evaluation ofvisual field in a population of clinical patients with primary open angle glaucoma undergone trabeculectomy pre-operatively, 1 and 3 month post-operatively in the Sub-Himalayan region.
Methods: Normative data was collected from 27 patients having primary open angle glaucoma. The patient population consists of adults with open anterior chamber angle and with demonstrative Visual Field loss. Average Visual Field measurements were taken. Octopus 900Perimetry was used to measure visual field at a week before surgery and 1 and 3 month post operatively. Pre and post operative value were analyzed using Repeated Measure ANOVA with Bonferroni correction.
Results: Visual Field Changes were observed on aPerimetry Octopus 900machine in which, though, minor fluctuations can be attributed to lowering of IOP, post-Trabeculectomy in POAG.The Mean value for MS were observed at 3rd month and the values came to be equal to 9.859 ± 5.5606 (p=0.043).The Mean MD came to be equal to 18.26 ± 5.164 (p=0.003) at 1 month period. The value of MD at third month came to be equal to 17.926 ± 5.4928 (p=0.012).The value of sLV were not significant throughout.
Conclusions: Visual Field showed significant improvement in MS and MDpost-operative, which was analyzed using Octopus 900Perimetry machine. However the minor changes observed in present study could be improved by early stage analysis of Glaucomatous eye by using Perimetry.
KEYWORDS: Perimetry; Trabeculectomy; Visual Field; POAG; MS; MD; sLV;

I. INTRODUCTION:

The human eye is a precise system, which comprises components that must be optimally maintained so that a clear image is seen. Transparency, surface regularity, smoothness, and a stable ocular anatomy are important for sight. The constant shape of eye is due to the structure of the sclera and a stable intraocular pressure, higher than the atmospheric pressure[5,6].Glaucoma is a group of acute and chronic, progressive, multi-factorial optic neuropathies in which intraocular pressure (IOP) and other contributing factors are responsible for a characteristic, acquired loss of retinal ganglion cell axons leading to atrophy of the optic nerve with demonstrable visual field defects[17].

The basic concept that impairment in aqueous humor outflow results in elevation of the IOP is a central tenet of glaucoma pathology and treatment. The glaucoma's are classified by the appearance of the irido-corneal angle. There are open angle, closed-angle, and developmental categories, which are further divided into primary and secondary types. Primary open-angle glaucoma can occur with or without elevated intraocular pressure; the latter is sometimes called normal-tension glaucoma. Primary open-angle glaucoma includes adult-onset disease (occurring after 40 years of age) and juvenile-onset disease (occurring between the ages of 3 and 40 years of age), primary open-angle glaucoma, in which the irido-corneal angle is open (unobstructed) and normal in appearance but aqueous outflow is diminished [1].

PERIMETRY:

Perimetry is the systemic measurement of visual field function. (Gr. Peri: around Gr. Metrein: to measure). Perimetry is used extensively in diagnosis and follows up of several eye diseases such as in glaucoma, diseases of retina and neurological diseases.

The uniocular visual field may be defined as projection outwards of all retinal points at which visual sensations can be initiated. Perimetry refers to the measurement of the visual field on a curved surface and has largely replaced campimetry in modern clinical practice. The first perimeters were arc perimeters that, like tangent screen, used small round objects as test targets. Light projection arc perimeters, such as the Aimark, were introduced in the 1930s, and the development of the Goldmann hemispheric projection perimeter in 1945 ushered

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in the modern era of quantitative perimetry. Perimetry connotes the determination of the peripheral outline of the field and scotometry the delineation of the blind areas or scotomata within its boundaries. The blind spot projected by the optic disc is a physiological scotoma. The new Octopus 900 technology provides Goldmann 900 bowl and supports the computer assisted Standard Goldmann Kinetic Program. The study of visual field and the methods by which they are measured is to consider Traquairs classical analogue of ―an Island of vision surrounded by a sea of blindness. The shoreline of the island correspond to peripheral limits of VF which normally measure with maximum target stimulation approximately 60° above and nasal, 70-75° below and 100-110° temporal to fixation [4].

The reduction in visual field and the vertical loss of vision in glaucoma associated with damage to the nerve fibre at the optic disc and has been widely regarded as irreversible. Certainly loss of visual fields is the most important indication for surgery in glaucoma and this field loss can perhaps be best demonstrated by the use of automated perimetry. It is important to know whether glaucomatous field defect can be improved after trabeculectomy for open angle glaucoma. In this study we have used automated perimetry to evaluate these changes [10].

TRABECULECTOMY:

With its long-established history, remains widely practiced for glaucoma. Studies are robust in supporting its efficacy in lowering IOP[2]. Trabeculectomy is a surgical operation which lowers the intraocular pressure (IOP) inside the eye in patients with glaucoma. This is achieved by making a small hole in the eye wall (sclera), covered by a thin trap-door in the sclera. The fluid inside the eye known as aqueous humour, drains through the trap-door to a small reservoir or bleb just under the eye surface, hidden by the eyelid. The trap-door is sutured (stitched) in a way that prevents aqueous humour from draining too quickly. By draining aqueous humour the Trabeculectomy operation reduces the pressure on the optic nerve and prevents or slows further damage and further loss of vision in glaucoma. Control of the eye pressure with a Trabeculectomy will not restore vision already lost from glaucoma[3].

II. MATERIALS AND METHODS:

The rationale for the current study was, to prospectively study of Visual FieldPerimetry Octopus 900 before and after Trabeculectomy in Primary Open –Angle Glaucoma, in patients attending Department of Ophthalmology, I.G.M.C Shimla. The stimulus for this work was only ophthalmological for the exploration of Visual Field by using the maximum means at our disposal.

Informed consent was obtained from all recruited individuals. Each subject underwent extensive examination including Best Corrective Visual Acuity (BCVA) by using Snellen‘s chart. Slit lamp bio-microscopy was done to assess the ocular adnexa and the anterior segment **(**AC Depth using Van Herricks Grading) of eye using a slit lamp bio-microscope (Haag Striet-900). Intra ocular pressure is measured by using a Goldman‘s applanation tonometer. An open anterior angle chamber using Gonioscopy by Shaffer‘s system using Goldmann Single Mirror Gonioscopic Lens. Optic Disc Examination- for glaucomatous changes was performed in dilated pupil with slit lamp (Haag Striet-900) using 90D lens (Magnification= 0.76). Fundus examination was done by using the direct and indirect ophthalmoscope after pupillary dilatation using 5% phenylephrine and 1% tropicamide drops instilled once or twice as required.

The criteria for inclusion were diagnosis of primary open angle Glaucoma, age taken was older than 40 years and not more than 80 years. No previous Glaucoma surgery, no cataract surgery during follow-up, no retinal or neurological disease and patients having significant cataract affecting perimetry were not taken. While the patient was under maximally tolerant medication, the indication for surgery was Optic Nerve Head Parameter and RNFL which was high risk of glaucomatous progression as well as worsening of the visual field. All patients eligible for surgery underwent baseline and postoperative Perimetry measurement. Perimetry pre-operatively were to be acquired within 1 week of the planned surgery.

Surgical Technique:

No pupillary dilatation and a bridle suture/corneal Traction Suture were inserted (commonly superior cornea). Site of Trabeculectomy was supero-nasal or supero-temporal. A fornix based flap of conjunctiva and Tenon capsule was fashioned superiorly. Epi-scleral tissue was cleared and major vessels cauterized.

An incision was made through about 50% of sclera thickness to create a trap-door lamellar sclera flap. This flap was triangular according to preference. The superficial triangular flap was dissected forwards until clear cornea is reached.

A paracentesis was made in temporal peripheral clear cornea and air injected. The anterior chamber

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was entered along most of the width of the trapdoor base. Sclerotomy incision was 1mm clear of either side of sclera flap. After the initial linear incision into anterior chamber sclerotomy is fashioned with sclera punch.

A fistula 0.5mm to 1mm in height and 1.5 to 2mm in width created. Peripheral iridectomy was created. Superficial scleral flap was sutured to its underlying bed tightly with Apex sutures, using nylon 10-0 suture. Balanced salt solution was injected through the paracentesis to deepen the anterior chamber and test the patency of the fistula. Conjunctiva/Tenon capsule flap was sutured. Irrigation through the paracentesis was repeated to produce a bleb. Steroid and antibiotic was injected under the inferior conjunctiva. Postoperative Perimetry was done at 1 and 3 month respectively. All data was collected on data forms.

Statistical analysis:

Data collected during the study was tabulated and analyzed by using Repeated Measure ANOVA with Bonferroni correction. The probability value ('p'-value) was calculated and a value of <0.05 was implied to be statiscally significant.

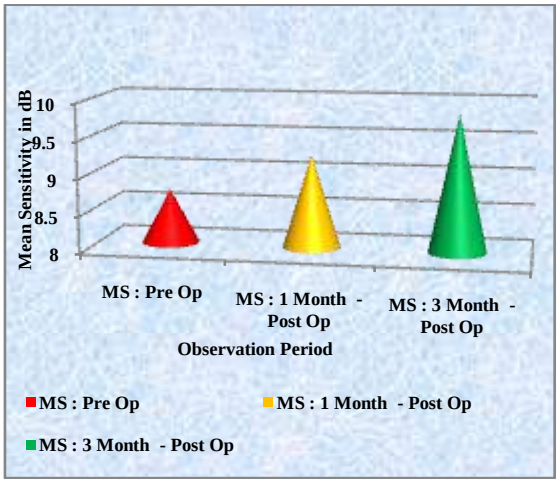
I. RESULT:

Automated Visual Field Analysis was done for Mean Sensitivity, Mean Deviation and Square Root Loss of Variance

MEAN SENSITIVITY:

The pre-operative values were taken and the Mean values were 8.73 ± 4.5493**.** The Mean values for MS were then observed at 1 Month and the Mean value were 9.267 ± 4.9947 (p=0.097). The Mean value for MS were then observed at 3rd month and the values came to be equal to 9.859 ± 5.5606 (p=0.043). The Mean Values were then depicted in the form of a graph for all observational period.

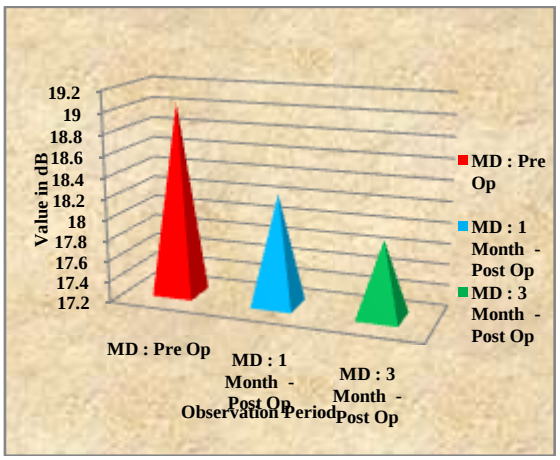
	Mean	Standard Deviation	p-Value
MS : Pre Op	8.73	±4.5493	
MS : 1 Month - Post Op	9.267	±4.9947	(p=0.097)
MS : 3 Month - Post Op	9.859	±5.5606	(p=0.043)



MEAN DEVIATION:

The MD was observed at the pre-operative period equal to 19.044 ± 4.6111. The Mean value came to be equal to 18.26 ± 5.164 (p=0.003) at 1 month period. The Mean value came to be equal to 17.926 ± 5.4928 (p=0.012) at third month.

	Mean	Standard Deviation	p-Value
MD : Pre Op	19.044	± 4.6111	
MD : 1 Month - Post Op	18.26	± 5.164	(p=0.003)
MD : 3 Month - Post Op	17.926	± 5.4928	(p=0.012)



SQUARE ROOT LOSS OF VARIANCE:

The pre-operative value was observed and the Mean value was 7.822 ± 2.1344. The sLV at 1 month was 7.544± 2.1378 (p =0.525). The last

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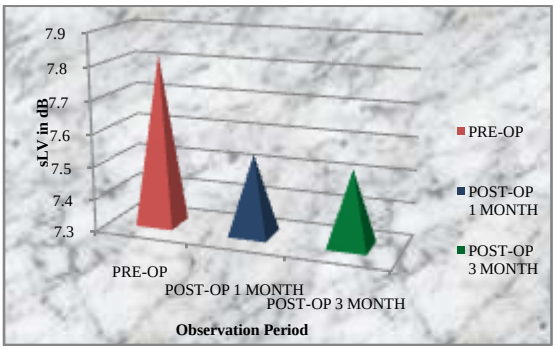
reading at 3rd month was observed to be 7.53 ± 2.138 (p=0.851).

	MEAN	STANDARD DEVIATION	p-VALUE
PRE-OP	7.822	± 2.1344	
POST-OP 1 MONTH	7.544	± 2.1378	0.525
POST-OP 3 MONTH	7.53	± 2.138	0.851



Glaucomatous optic neuropathy causes progressive death of retinal ganglion cells and their axons. These structural changes precede VF defects as measured by standard automated perimetry[9]. Visual field assessment is an important clinical tool in the assessment of patients with acute and chronic ocular diseases. For these several tasks there may be different strategies. With automated perimetre's, users may select the appropriate stimulus duration and interval according to what seems best in the patients[4]. The mean deviation on Octopus perimetry is recorded as a positive value. Values for global indices (mean deviation (MD), pattern standard deviation (PSD)/loss variance (sLV)) was taken for direct comparison as was value of mean sensitivity (MS). MS was automatically calculated on Octopus results[14]. Figus et al (2011) found a small change in MD after surgical IOP reduction. Dieng et al (2009) observed that the factors studied, only age and graded follow-up time from surgery had a statistically significant influence on VF after trabeculectomy, the results (59% improvement or stability), in spite of the small sample size, argue in favor of this surgical treatment for some patients with POAG[7].

In our study the Mean Sensitivity pre-operative value was 8.73 ± 4.5493,at 1 Month the mean was found to be 9.267 ± 4.9947 (p=0.097). The Mean value for MS at 3rd month was 9.859 ±5.5606 (p=0.043). The MS values showed significant increase at 3rd month. Similarly MD observed at pre-operative period was 19.044 ± 4.6111 Mean value at 1 month was 18.26 ± 5.164 (p=0.003). The Mean value at 3rd month was found to be 17.926 ± 5.4928 (p=0.012). The results showed a significant improvement in the follow-up period. Bertrand et al (2014) in his study evaluated the rates of MD loss before and after trabeculectomy and showed that there was a considerable reduction in the rate of MD loss after surgery. The average difference between the rates of MD loss before and after surgery was 0.20 dB⁄ year (p = 0.15), a reduction of 56% on average. Although this difference was not statistically significant, an overall reduction of 56% of MD loss after surgery can be considered clinically significant [11].

In our study the pre-operative value of sLV was observed and the Mean value was 7.822 ± 2.1344. The sLV at 1 month was 7.544 ± 2.1378 (p =0.525). The last reading at 3rd month was observed to be 7.53 ± 2.138 (p=0.851). All values showed numerical improvement but none were statistically significant. Similar studies done by various authors showed changes in the VF global indices, Figus et al (2011) found the average pre-operative MD and PSD were -14.05±3.37 and 8.58±1.79 dB, respectively. At 3 and 6 months, respectively, MD decreased to -13.35±3.26 and -13.58±3.54 dB (P¼0.06 and P¼0.06), and PSD increased to 9.20±1.86 and 8.97±1.52 dB (P¼0.08 and P¼0.06). He further adds changes in functional parameters did not show statistically significant correlation[8]. Kotecha et al (2001) in their study observed, approximately one third of eyes continued to display glaucomatous progression after trabeculectomy, and that progression was detected predominantly by changes in VF sensitivity. Changes in VF sensitivity are present in only a small proportion of eyes. Similar results were also observed by Dieng et al (2009), Sahli et al (2012), Yildrim et al (1990), Lazaro et al (2007), Kalpana et al (2014), Fiona et al (2014).

II. DISCUSSION:

Glaucomatous optic neuropathy causes progressive death of retinal ganglion cells and their axons. These structural changes precede VF defects as measured by standard automated perimetry[9]. Visual field assessment is an important clinical tool in the assessment of patients with acute and chronic ocular diseases. For these several tasks there may be different strategies. With automated perimetre's, users may select the appropriate stimulus duration and interval according to what seems best in the patients [4]. The mean deviation on Octopus perimetry is recorded as a positive value. Values

for global indices (mean deviation (MD), pattern standard deviation (PSD)/loss variance (sLV)) was taken for direct comparison as was value of mean sensitivity (MS). MS was automatically calculated on Octopus results[14]. Figus et al (2011) found a small change in MD after surgical IOP reduction. Dieng et al (2009) observed that the factors studied, only age and graded follow-up time from surgery had a statistically significant influence on VF after trabeculectomy, the results (59% improvement or stability), in spite of the small sample size, argue in favor of this surgical treatment for some patients with POAG[7].

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Various studies have shown that after Trabeculectomy VF global indices progression has either stabilized or slightly improved showing the benefits of lowering the IOP in POAG. In the present study the Mean IOP at 3rd month post operatively was found to be 11.81± 3.552, which could be a possible reason for the stabilization or improvement in parameters taken in the study. Our findings corroborate other reports regarding the significance of a lower IOP during follow-up. One possible explanation for changes in visual field indices are the restoration of normal axoplasmic flow, after reduction in IOP.

III. CONCLUSION:

Perimetry is used for the measurement of visual field. The reduction in visual field and the vertical loss of vision in glaucoma associated with damage to the nerve fibre at the optic disc and has been widely regarded as irreversible. Certainly loss of visual fields isone ofthe early indications for surgery in glaucoma, and this field loss can perhaps be best demonstrated by the use of automated Perimetry. The minor changes observed in present study could be improved by early stage analysis of Glaucomatous eye using Perimetry.

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