INTRODUCTION

In the present time there is increasing knowledge in management and definition of glaucoma. But in the past there was much disagreement between experts in management of glaucoma. Clearly, fundamental clinical research was needed to provide a solid foundation for good glaucoma care. The large randomized glaucoma trials often referred to as the 'alphabet soup' [The Advanced Glaucoma Intervention Study ***(AGIS, 1994).*** The Collaborative Initial Glaucoma Treatment Study **(Musch et al., 1999).** The Collaborative Normal Tension Glaucoma Study ***(CNTGS, 1998).***The Early Manifest Glaucoma Trial (EMGT) ***(Leske et al., 1999).*** The Ocular Hypertension Treatment Study (OHTS) ***(Gordon & Kass 1999)*** and The European Glaucoma Prevention Study (EGPS) ***(Miglior et al., 2002),*** were designed to provide evidence for glaucoma care, important knowledge has also come from other clinical studies.

Reducing intraocular pressure IOP is very important in glaucoma management. The randomized trials have also shown that treatment effects are surprisingly large. as in EMGT ***(Leske et al., 2003),*** OHTS ***(Gordon et al., 2002),*** and EGPS ***(Miglior et al., 2007).*** In the more recent Canadian glaucoma Study, which included treated patients with lower IOP levels than the other studies, risk reduction was as high as 19% per mmHg ***(Chauhan et al., 2008a).***

These findings are very important, because they show that over long time an extra pressure reduction of just a few mmHg might make a great difference.

Another important observation is that most patients with glaucoma do progress if monitored with moderately sensitive tools. This is so even if IOP is always measured within normal range. **(Leske et al. 2007)** Therefore, progression criteria in glaucoma have changed. It was considered that any progression was a reason to step up treatment. Now, it has proven that any change of treatment depends on the magnitude of the progression, and whether the progression rate is considerable enough to affect the quality of life (QoL) of the patient.

The trials have also shown that early progression can be identified with great statistical power using standard automated perimetry, if only field testing is performed often enough, and event analyses are used to identify progression.

It is preferable to measure damage with perimetry for two reasons: One is that perimetric results are results of visual function testing that show how much visual reserve available, and how much on the visual field scale the QoL is affected. Certainly, structural parameters frequently show progression in patients with glaucoma, but the agreement with perimetry is small ***(Chauhan et al., 2001; Leung et al., 2011).***This may change in the future with

the fast development of imaging technologies and techniques for statistical interpretation of imaging methods.

In newly detected glaucoma frequent perimetry is required the first years after diagnosis, to be able to detect rapidly progressing eyes before additional damage has occurred. Thus, three visual fields per year are needed, during those first two years ***(Chauhan et al., 2008b).*** This way of glaucoma care is part of modern management recommendations, for example, by the **European Glaucoma Society (2008)**, and by the Swedish Ophthalmological Society ***(Heijl et al., 2010).***

Nevertheless variability has been the biggest drawback of visual field assessment, as it may greatly affect interpretation of the test. Fluctuation varies among patients and among sectors in the same visual field, and usually increases with the severity of the disease. Any abnormalities in a visual field test should be confirmed in subsequent tests ***(Luciana & Felipe, 2011).***

Irreversible visual field defects are the final common feature of glaucomatous damage to the retinal ganglion cells (RGC), and for many years, functional evaluation of these cells relied solely on white-on-white standard automated perimetry (SAP). Whereas light detection can be transported by almost all RGCs, more specific features, such as contrast sensitivity, movement perception and color vision, are encoded by specific subsets of these cells. When one single pathway is isolated, a deficit may be manifest even when a small proportion of cells are affected because there are still other cell types functioning in a given retinal area. Frequencies

doubling technology (FDT) and short-wavelength automated perimetry (SWAP) have shown to be helpful, especially when SAP is within normal limits and there is a suspicion of glaucomatous damage, they are predictive of both the onset and location of future SAP defects ***(Johnson et al., 1993a; Johnson et al., 1993b; Sample et al., 1993; Johnson & Samuels, 1997; Cello et al., 2000; Burnstein et al., 2000 and Medeiros et al., 2004).***

Function-specific perimetric tests may offer several advantages for early diagnosis of functional loss but should not be done at the expenses of SAP. Prospective longitudinal studies are still necessary in order to provide guidelines for clinicians on how to best incorporate the results from these new instruments into clinical practice ***(Luciana & Felipe 2011).***

Static computerized perimetry has become more standardized over time, so that the term standard automated perimetry (SAP) is becoming more frequently used, SAP refers to static computerized threshold perimetry of the central visual field performed with ordinary white stimuli on white background ***(Park and Youn, 1994).***

The resultant information tell us much such as total deviation, pattern deviation, and global indices, interpretation of them and decision making in management are dependent on the judgment of the clinician, there are some well-known confounding factors to be considered in interpreting the visual field examination, while it is easy to control variables related to the machine itself, the

factors related to the subjects such as pupil size, refractive correction and media opacity may make it more difficult in maintaining the optimal and consistent test conditions ***(Park and Youn, 1994).***

It has become frequently noticed that some of the patients prefer to undergo visual field testing, after having a previous fundus examination with pupillary dilatation, preferring not to wait to another appointment, which raises concerns on the effect of pupillary dilatation on visual field parameters in glaucoma patients. Many studies have either investigated the effect of pupillary dilatation on visual field in normal subjects, or its effect in Glaucoma patients taking miotics, but still there were few studies investigating the effect of pupillary dilatation in Glaucoma subjects not taking miotics ***(Kudrna et al., 1995).***

The factor intended to be investigated in this study is the pupil diameter and its effect on different parameters of the SAP test results.

AIM OF THE WORK

The aim of the study is to investigate the influence of pupillary dilatation on visual field testing results in glaucoma patients, by using automated static perimetry.

VISUAL FIELD

The field of vision is defined as the area that is perceived simultaneously by a fixating eye ***Traquair (1931).*** Traquair in his classic thesis, described an island of vision in the sea of blindness. The island represents the perceived field of vision, and the sea of blindness is the surrounding areas that are not seen. In the light-adapted state, the island of vision has a steep central peak that corresponds to the fovea, the area of greatest retinal sensitivity (Fig. 1).

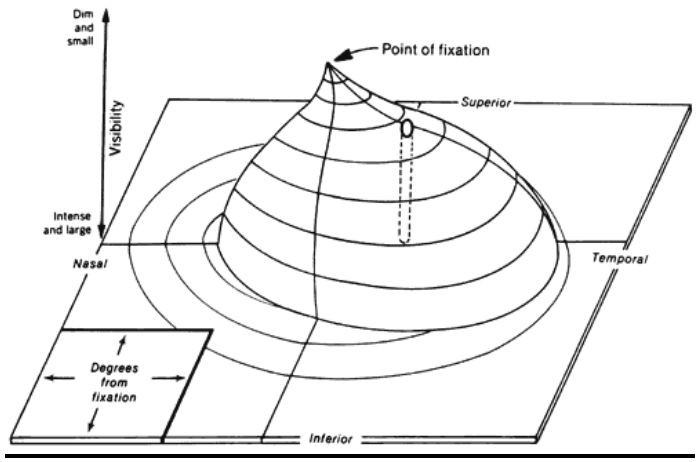

Fig. (1): The normal island of vision. The hill is highest at fixation, where visual sensitivity is greatest. The height of the hill of vision declines toward the periphery as visual sensitivity diminishes ***(Anderson, 1987).***

Every point in the retina corresponds to a certain direction in the visual field. The boundaries of the field of vision, measured in degrees from the point of fixation (the object at which the eye is directed) are approximately as follows: 60 degrees superiorly (above), 75 degrees inferiorly (below), 100 degrees temporarily (to

the right for the right eye, to the left for the left eye), and 60 degrees nasally (to the left for the right eye, to the right for the left eye.***(Anderson, 1992)*** (Fig. 2).

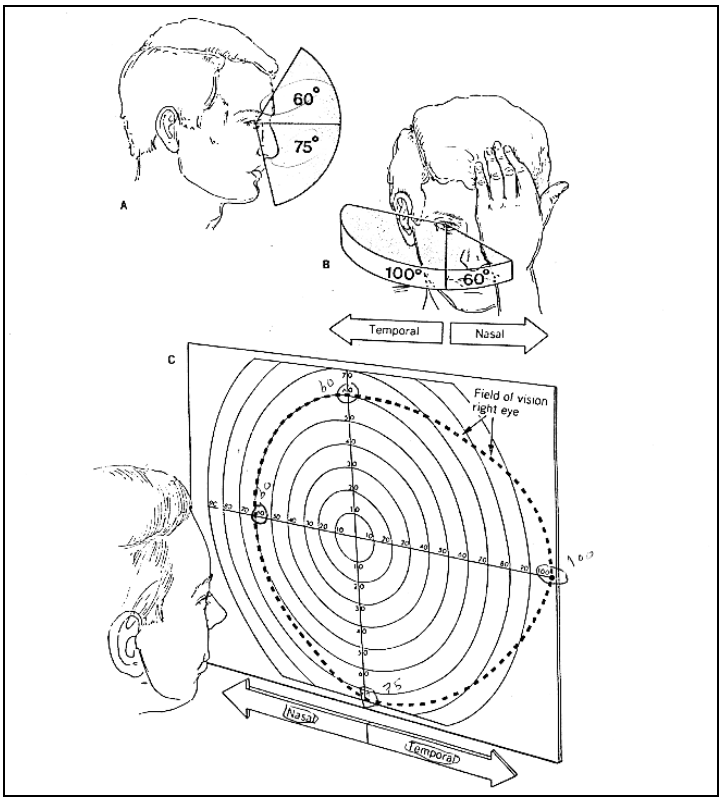

Fig. (2): Limits of t.he average normal visual field ***(Anderson, 1992)***.**A,** Upward and downward. **B,** Temporal and nasal. **C,** Plot of the limits for the right eye.

Note that the field is normally plotted on the field diagram "as the patient sees it", the border of visual field to the right being plotted to the right on the field diagram ***(Anderson, 1992)***.

Visual field testing:

History

The concept of visual field testing was documented during antiquity by Ptolemy (Claudius Ptolemaeus, 87 - 150 BC) as having been described in the 2nd century BC.

Campimetry refers to examination of the visual field projected on to a flat surface, e.g. on a wall, a transparent screen, or a video or flat-panel monitor. This method is best suited to examination of the central visual field, up to approximately 20 degrees of eccentricity, but is less useful in more peripheral locations due to geometric distortions, it was introduced by Porta in 1593 CE, and the first description of the physiologic blind spot was by Mariotte in 1666. The first determination of an acquired visual field defect was reported by Young in 1800. The systematic use of visual field testing as an essential component of the ophthalmic examination dates from the time of Albrecht von Graefe (1828 - 1870), and the technology and methods of modern perimetry developed most rapidly during the second half of the 20th century ***(http://www.perimetry.org/articles/Conventional-Perimetry-Part-I.pdf)*** (Fig. 3).

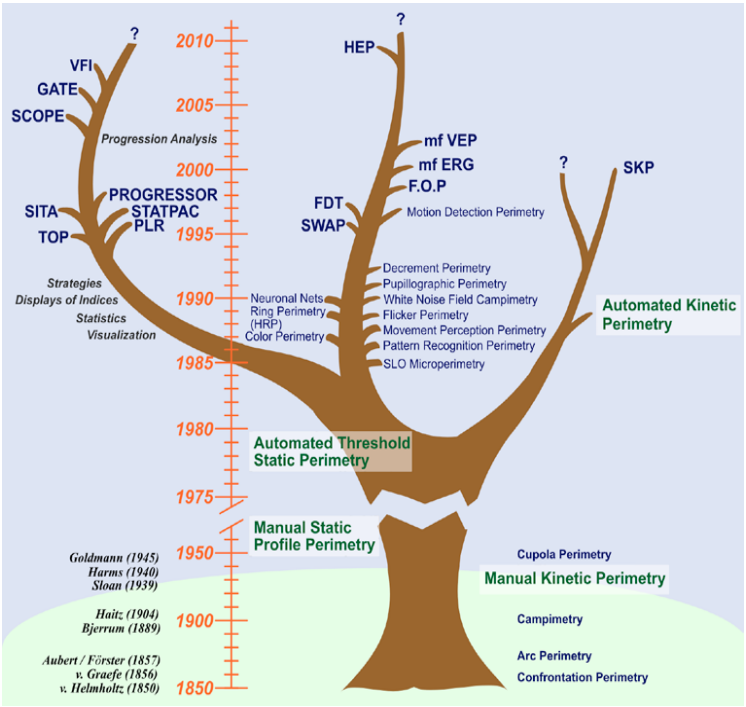

Fig. (3): The "perimetric family tree" diagrams the evolution of clinical methods for visual field testing during the 20th Century.

FDT = Frequency Doubling Technology, FOP= Fundus oriented perimetry, GATE = German Adaptive Thresholding Estimation, HEP = Heidelberg Edge Perimeter, mfVEP = multi-focal Visually Evoked Potentials; mf-ERG = multi-focal Electroretinogram, PLR = pointwise linear regression, SCOPE = Scotoma oriented Perimetry, SITA = Swedish Interactive Thresholding Algorithm, SKP = semi-automated Kinetic Perimetry; SWAP = Short Wavelength Automated Perimetry; TOP = Tendency- Oriented Perimetry; VFI = Visual field index

(Schiefer et al., 2005)

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 the tangent screen, used small round objects as test targets. Light projection arc perimeters, such as the Aimark, were introduced in the 1930s. The development of the Goldmann hemispheric

projection perimeter in 1945 ushered in the modern era of quantitative perimetry (Fig 4).

Fig. (4): Goldmann Bowl
(www. perimetry. org/ Perimetry History/ 5- standardization. Htm)

Computer technology was combined with visual field testing in the mid-1970s, resulting in the introduction of the first automated perimeters, the television campimeter of Lynn and Tate, the Octopus device of Fankhauser, and the Computer of Heijl and Krakau ***(Portney and Krohn, 1978).***

There are now several automated visual field testing devices on the market, but the two most widely used systems are the Octopus perimeter marketed by the Swiss firm Interzeag and the Humphrey Visual Field Analyzer marketed by the American firm Humphrey Instruments. Automated perimetry has largely replaced manual perimetry in clinical practice because of its superiority in detecting glaucomatous visual field loss ***(Katz et al., 1995).***

The introduction of computer graphics has set the stage for a revolution in perimetric methods ***(Harwerth et al., 2005).***

Next came high-pass resolution perimetry developed by Lars Frisén. Also called the ring test, Frisén made use of vanishing optotypes as stimuli. Other types have followed:

- Short wavelength sensitive perimetry
- Flicker Perimetry
- Pupil Perimetry
- Aulhorn's Snow field campimetry
- Motion perimetry
- Frequency doubling technology perimetry
- The Henson Perimeters
- Rarebit perimetry
- Multifocal VEP

http://www.perimetry.org/PerimetryHistory/7-comput-perim.htm

Kinetic perimetry uses test objects that are fixed in size and brightness. They are moved from non-seeing areas into seeing portions of the visual field, the test subject being asked to signal when the object first becomes visible. This method is particularly realistic and relevant to clinical practice, since visible objects in everyday life come to notice either through their own movements or by gaze movements of the eye, causing their images to move across the retinal surface. The results of

this method are plotted in the form of so-called isopters, which are lines of equal differential light sensitivity (DLS). ***http://www.perimetry.org/articles/Conventional-Perimetry-Part-I.pdf***

Static perimetry employs stationary test objects that vary in size and brightness, but never move.

If the test objects are to be presented across an area of the field, a computer algorithm controls their display in a manner that is largely independent of the examiner's input - a method called ***static automated perimetry.*** ***http://www.perimetry.org/articles/Conventional-Perimetry-Part-I.pdf***

AUTOMATED STATIC PERIMETRY

Static testing can be performed in an objective and standardized fashion. The computer allows stimuli to be presented in a pseudorandom, unpredictable fashion. Patients do not know where the next stimulus will appear, so fixation is improved, thereby increasing reliability of the test. Random presentations also increase the speed with which perimetry can be performed by bypassing the problem of local retinal adaptation, which requires a 2-second interval between stimuli if adjacent locations are tested ***(Punjabi and Lin, 2006).***

Computerized static perimetry provides an estimate of the reliability and variability of the test. Data storage is possible, and computer-assisted statistical analysis is available ***(Drance and Anderson, 1985).***

The most widely used automated perimeters are the Humphrey visual field analyzer (HFA) (Fig. 5) and the Octopus perimeter. Both perimeters perform a wide variety of programs so that examinations can be tailored to the needs of individual patients. Computerized perimetry can be used as an alternative to tangent screen testing for tubular visual fields ***((Pineles and Volpe, 2004).*** Another advantage is that patients apparently do not easily recognize the visual field expansion, making it an ideal test to "fool" patients with functional visual loss.

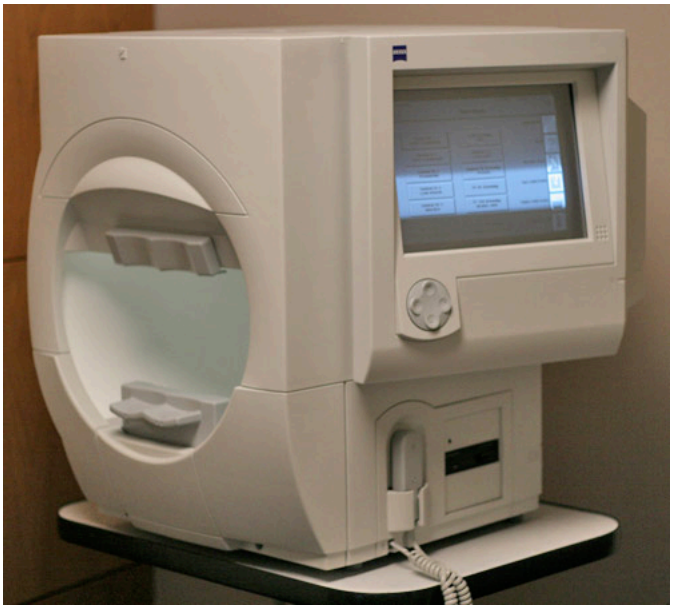

Fig. (5): Humphrey field analyzer
(http://www.kerreyecare.co.uk/visualfields.html)

The concept of automated perimetry

The perimetry measures the differential light threshold which is the ability of the visual system to detect a difference in contrast between two areas of different luminance (the background luminance of the perimeter bowl and the test target***) (Chandrinos 2008).***

There is a difference between concepts of threshold and sensitivity ***(Ellenberger, 1980)***.

Threshold is a property of the target. A threshold target is just bright enough to be seen. It is presented in a particular location. The brightness of the target (target luminance) is varied and the