

EVALUATION OF MULTIFOCAL ERG AND A-SCAN BIOMETRY IN MYOPIC EYES.**Bonti Bora**

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Abstract: Background: Myopia is a common type of refractive error. It is a non-life-threatening disorder with huge social and economic consequences due to its increasing prevalence. Axial length (AL) is the primary determinant of non-syndromic myopia. It is a parameter representing the combination of anterior chamber depth, lens thickness and vitreous chamber depth of the eye. Multifocal Electroretinography(mfERG) provide objective assesment of the central retinal function at different retinal areas within a short duration of time. **Objectives:** 1. to investigate early morphological changes of retinal function in myopic eye.2. Role of axial length in determining the refractive state of the eye. **Materials and Method:** A cross sectional study was done from 28-11-14 to 15-05-15 after taking ethical clearance from Institutional Ethics Committee in Electro physiology Department of Regional Institute of Ophthalmology ,Gauhati Medical College and Hospital,Guwahati,Assam,India. 28 patients were selected meticulously .The axial lengths of the myopic eyes were measured by A-scan biometry. The multifocal Electroretinography mfERG technique was done for recording local electrophysiological responses from different regions of the retina which has got high sensitivity & specificity in diagnosing early retinal defect.**Results:** There was a significant correlation between refractive error and axial length ,with longer eyes being more myopic ($p < 0.05$). The hypothesis of correlation between Axial Length and Myopia was proved. MultifocalERG of 28 myopics (56 eyes) showed normal central macular cone function means no chang in amplitude and implicit time. **Interpretation and Conclusion:** The study shows that myopic eyes has a statistically significant correlation with Axial Length .Means Diopteric power of the eye increase along with the increase of axial length .

Key Words:A-Scan Biometry,Axial Length, mfERG, Myopia.

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INTRODUCTION:

Myopia, or nearsightedness, is a worldwide common type of refractive error. It is a parameter representing the combination of anterior chamber depth, lens thickness and vitreous chamber depth of the eye. The study of Axial Length (AL) will not only identify the determinants of eye elongation, but also provide aetiological evidence for myopia¹. To investigate early changes of retinal function in myopic eyes, patients with various degrees of myopia underwent multifocal electroretinography (multifocal ERG).

Accurate interpretation of electroretinograms (ERGs) requires knowledge of effects of axial myopia on ERG responses. Our purpose was to derive expected changes of ERG responses and axial length in myopic eyes according to the International Society for Clinical Electrophysiology of Vision (ISCEV) Standard for Electroretinography.

The multifocal electroretinogram (mfERG) can provide an indication of the regional

responses of the central retina with a single examination². The first- and second-order kernel mfERG responses, which are mathematically derived from localized retinal responses through a cross-correlation technique,^{2,3} MfERG, Predominantly reflect the activity from the outer retina (i.e., photoreceptor, ON and OFF bipolar cells) and the inner retina (i.e., amacrine cells and ganglion cells), respectively³⁻⁵. Ultrasonography measures the distance between the anterior pole and the anterior surface of the retina. The axial length of the eye at birth is approximately 17 mm and reaches approximately 24 mm in adulthood. It is typically longer than 24 mm in myopes and shorter than 24 mm in hyperopes. Each mm of change in axial length of the eye corresponds to approximately 2.5 D.

Eyes with longer axial lengths, usually with high myopia, have a weaker mfERG response and this attenuation is across the measured retina (from central to paracentral regions)

but different kernel responses show a different pattern of attenuation at different retinal eccentricities. The weaker mfERG responses may be related to the morphological changes associated with increased axial length.

Retinal function can be assessed by electroretinography. The multifocal electroretinogram (mfERG) can provide an indication of the regional responses of the central retina with a single examination.⁶

OBJECTIVES:

1. To investigate early morphological changes of retinal function associated with longer axial length.

2. High myopia is associated with longer axial length. So to see the relation of axial length with myopia.

MATERIALS AND METHODOLOGY:

This was a cross sectional study where a simple random sampling was done. 28 cases (56 eyes) were collected meticulously so that internal validity and reliability would be in data collection, also in measurement. My study was a small sample study so I took two patients on each week excluding holidays in my study period. In one day I examined axial length and other day tested mf ERG. After taking ethical clearance from the Institutional Ethics Committee the study was carried out at Regional Institute of Ophthalmology, Gauhati Medical College from 28-11-14 to 15-05-15 among the Patients attending Ophthalmology Out Patient Department of Gauhati Medical College. Myopia is a noninfectious disease and not associated with any seasonal change so patient can be selected at any time after taking written consent. Both male and female patients are selected.

CRITERIA FOR SELECTION OF CASES:

INCLUSION CRITERIA:

1. Patients with myopic refractive error of -2D to -7D were taken
2. Patients within the age group of 15 years to 50 years were considered.

3. Patients without any retinal problems were taken.

EXCLUSION CRITERIA:

The patients who were excluded from the study despite being myopic were:

1. Systemic or other diseases suffering posterior segment of eye like diabetes mellitus and hypertension.
2. Patients less than 15 years and more than 50 years.

VISUAL ACUITY TESTING

Visual acuity is tested in each eye separately for distant vision by using Snellen's chart or Landolt's Chart or illiterate E-chart and for near vision using N-vision chart with and without glass and pinhole vision was also tested.

A-SCAN BIOMETRY

A Scan biometry is the measurement of ocular structures by means of directing a focused beam of ultrasound at the retina and measuring the time it takes to be reflected back to the transducer. As the sound beam is directed along the visual axis to the macula it will collide with various structure of the eyeball and be reflected back. With reflection an echo or spike is created each time the beam encounters and intraocular structure.

The "A" in A-Scan stands for amplitude or height as it relates to the echo. An accurate reading can be obtained by observing the height of the echoes as they encounter ocular structures. A Scan image is one dimensional.

Procedure of mfERG:

The multifocal electroretinography (mfERG) is an investigation that can simultaneously measure multiple electroretinographic responses at different retinal locations by cross-correlation techniques.²³It allows topographic mapping of retinal function in the central 40-50° of the retina.²³The strength of mfERG provide objective assesment of the central retinal function at different retinal areas within a short duration of time.²³

Electrical responses from the eye are recorded with a corneal electrode as in conventional, full-field ERG recording. However the nature of the stimulus of the form of the analysis differs. These differences allow a topographic map of local ERG activity to be measured. The current study was conducted in the Electrophysiological Diagnostic Centre of Diagnostic Clinic using MonPack 2 Electrophysiological Unit manufactured by Metro Vision, France.

In 2003, the International Society for Clinical Electrophysiology of Vision (ISCEV) published guidelines for recording the mfERG. To take into consideration recent developments in technology and practice, ISCEV in 2007 came up with ISCEV Guidelines for clinical multifocal electroretinography²⁴(ISCEV:<http://www.iscev.org>)

Multifocal ERG (mfERG) testing was performed in the following manner:

Proper ocular examination including visual acuity was recorded. Corrective lenses were used in cases where visual acuity was below normal. The patient eyes were dilated and kept in the dark room for 20-30 minutes prior to testing. This adaptation period was necessary for recording the impulses more efficiently. Then patient was brought to the examination room which was illuminated with dim red light. Topical anaesthesia was given and contact lens or jet electrode was applied over the cornea. The reference and ground electrodes were also placed on the temple and forehead after cleaning the skin with abrasive gel. Electro conductive gel was used on the skin surface for better conduction. The patients' chin was placed on the chin rest of the machine in such a way that the eye to be tested is 30 cm away from screen (LCD Monitor) where stimulus were present and the patient should fix their eye at the central red square target. The subject viewed a black and white pattern of hexagonal elements each of which flashes on and off with its own pseudo-random binary sequence, known as M sequence. The screen is isoilluminated throughout the recording. The display is

adjusted at 61 hexagons which provide better resolution of response topography for identifying localized functional changes. A suitable compromise between the degree of spatial resolution and the time taken for testing.²⁴The other eye was occluded throughout the procedure and recording. One eye to be tested at a time. The room was now completely cut off from the light and 5000 stimuli were applied on LCD monitor in the form of black and white hexagons, flash alternatively in pre-fixed manner. In case of invalid or reject response the procedure was repeated from the beginning. The duration of the test was between 5 to 15 minutes. The responses were recorded and three types of plots were made. One trace array chart showed the individual responses. 2-Dimensional and 3-Dimensional charts were made on the basis of the trace chart

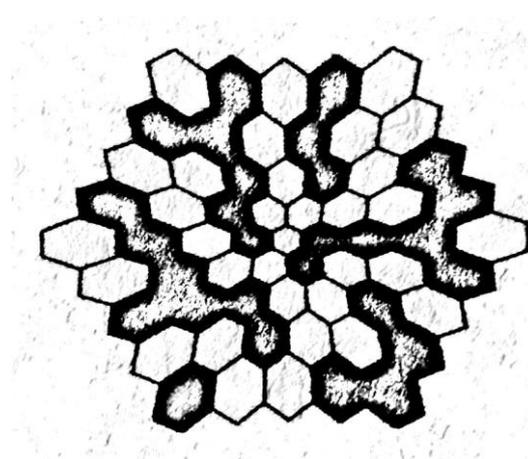


Fig 1: Hexagonal mfERG stimulus array with 61 elements scaled with eccentricity. Roughly half of the elements are illuminated at any one time

Result :

The present study consist of 28 patients of both genders. Age of the subject ranged from 15-50 years with the mean age being 35.4 ± 1.07 . Table 1 showing frequency of different axial length in both eyes, ranges from 22 to 26 mm. Table 2 showing distribution of degree of myopia ranges from 2 to 7 diopter in both eyes

RANGE OF AXIAL LENGTH (mm)	NO OF RIGHT EYE	NO OF LEFT EYE
22-23	3	2
23-24	5	10
24-25	15	11
25-26	5	5
TOTAL	28	28

Table 1 showing frequency of different axial length in both eyes,

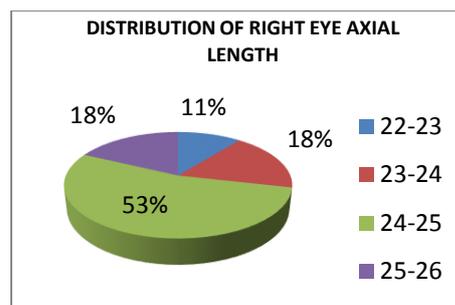


Fig 2

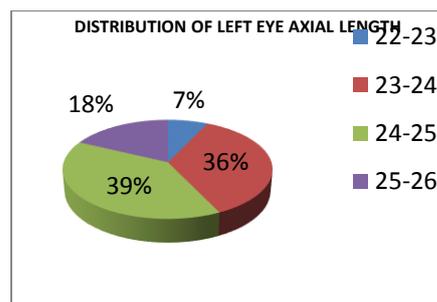


Fig 3

Figures 2 and 3 showing frequency of axial lengths in left and right eyes.

RANGE OF DEGREE OF MYOPIA (D)	NO OF RIGHT EYE	NO OF LEFT EYE
2.0-3.0	14	14
3.0-4.0	5	4
4.0-5.0	3	6
5.0-6.0	4	2
6.0-7.0	2	2
TOTAL	28	28

Table 2 showing distribution of degree of myopia.

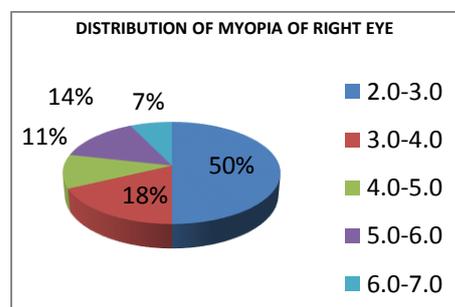


Fig 4

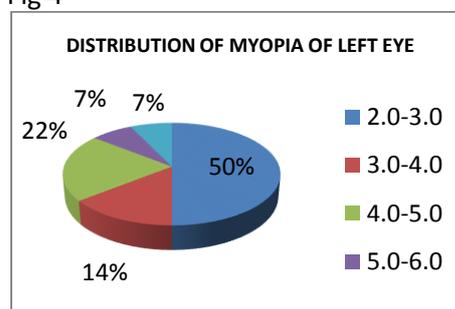


Fig 5

Figures 4 and 5 showing distribution of degree of Myopia

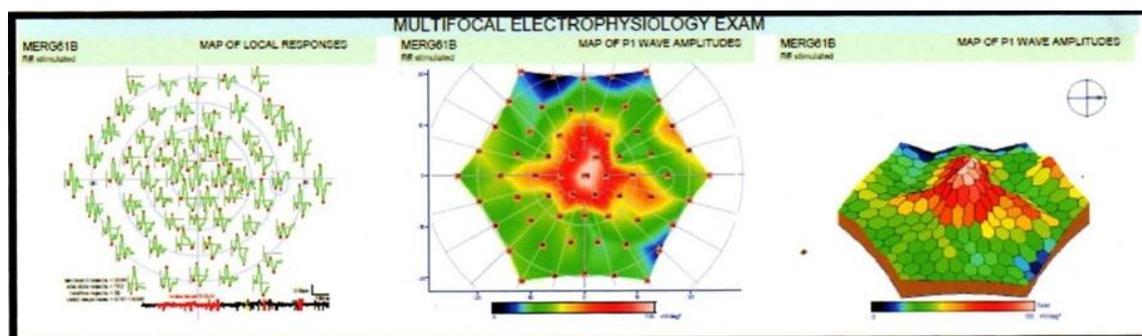


Figure 6: Normal mfERG

Normal mfERG in One trace array chart which showed the individual responses.

2-Dimensional and 3-Dimensional charts were made on the basis of the trace chart

Pearson's correlation coefficient was calculated which was denoted by 'r'.

For $n-2=26$ degree of freedom at 5% level, the highest value of r obtainable by chance is 0.360. The estimated value of r is 0.42 in Right Eye and 0.45 in Left Eye. It is more than 0.360, hence significant at 5% level. $P < 0.05$. There is a significant correlation between refractive error and axial length, with longer eyes being more myopic. Visual acuity decline with elongation of axial length.

There was no reduced or delayed amplitude and implicit time of first-order kernel mfERG response which primarily reflects the activity from the outer retina.

N1, is first negative deflection, P1 is first positive peak and N2 is second negative deflection. First-order kernel is the spatial summation response of all these wave. Implicit times are measured from the onset of the stimulus to the peak of the wave form.

Discussion

The present study confirms the anatomical relationship between ocular axial length and refractive errors; which allow us to establish anatomical differences between myopic and hyperopic eyes.

Most agree that AL is the largest determinant of refractive error.⁷ The longer the AL, the severe the myopia^{8,9}. Olsen et al.¹⁰ found that when considering the contribution of AL, lens power and corneal power together, using multiple linear regression analyses, it can explain up to 96% of the variation of

refraction in populations. Age-related AL differences were discovered in some investigations. Older people were likely to have shorter AL than younger participants¹¹. Numerous studies have indicated that the first-order kernel mfERG response is reduced and delayed, especially in the paracentral retina in myopic adults,¹²⁻¹⁵ suggesting that the outer retinal function of the myopic eye is reduced, and that this alteration in function may be regionally specific.

Compared with emmetropes, myopes have an increase in myopic refractive status, and are usually accompanied with an increase in axial length.¹⁶ Both refractive error¹⁷ and axial length¹⁸ can affect the mfERG response in myopic adults. In essence, compared with axial length, refractive error was found to account for a greater proportion of the variability in mfERG response measured with conventional stimulation in myopic adults.¹⁹ Myopia is a public health concern in many parts of the world including Asia, where the prevalence of myopia has been reported to be as high as 80%. Although myopia can be easily managed with an appropriate optical correction, it is a risk factor for a number of retinal pathologies, especially in high myopia (≥ -6.0 diopters), and may cause permanent visual impairment or even blindness. Reduction of retinal function has also been reported in myopic eyes without myopic retinopathy. Using a focal ERG, Ishikawa et al showed a significant reduction of macular cone function in a group with high myopia compared with groups with low or moderate myopia.²⁰

Although many studies have shown a strong negative correlation between the severity of myopia and ERG response amplitude in adult subjects, it is still unknown whether a similar correlation occurs in children with myopia. Furthermore, it is still unclear whether the reduction of ERG response in myopia is due to retinal degenerative changes associated with long-standing myopia or a reflection of the myopia itself. To investigate these possibilities we used the mfERG to assess the central retinal function in adults and children affected by various degrees of myopia.

The results of the current study are presented together with a consideration of the cause of reduction in ERG amplitudes associated with high myopia in adults.²⁰

There are some limitations of the study. Firstly, because the analysis were cross-sectional and the subject has to fulfill the inclusion and exclusion criteria. Secondly, the duration of the study should be more so that the sample size will be more. Thirdly, in the procedure of mfERG there may be problem in fixation of the eye. Fourthly, in this study no analysis was taken separately between male and female and among different age group.

Conclusion:

There is a no significant correlation between the refractive error and mfERG amplitude in the subjects. These findings suggest that the severity of myopia has little influence on the ERG amplitude.

This may be because we have not included subjects with higher degree of myopia. *High-degree myopia*, or severe myopia, is defined as -6 diopters or worse.²¹ Retinal function impairment is correlated with increase in the diopter of myopia, decrease of corrected visual acuity (VA), elongation of ocular axis and increased macular degeneration.²² The inner retinal function was substantially reduced in myopic adults, especially in the paracentral region. This study provides further evidence for different retinal, physiological characteristics in myopic adults.

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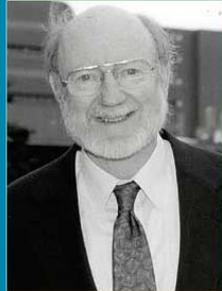
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Winners of the 2015 Nobel Prize in physiology or medicine



William C. Campbell



Satoshi Ōmura



Youyou Tu

The Nobel Prize in Physiology or Medicine 2015 was divided, one half jointly to William C. Campbell and Satoshi Ōmura *"for their discoveries concerning a novel therapy against infections caused by roundworm parasites"* and the other half to Youyou Tu *"for her discoveries concerning a novel therapy against Malaria"*.