MATERIAL AND METHOD

In this study 2285 ophthalmic cases were examined for apparent myopia cases from November 2005 to October 2007. Fundus photographs of myopic eyes were taken at a) Dr. Jethva’s ophthalmic hospital, Anand, b) Dr. Sonalben’s eye hospital, Anand and c) Dr. Madhvi’s Govind Retinal hospital, Vadodara.

Collection of cases: 215 myopic eyes fundus photographs were taken after obtaining their written consent. 125 myopic persons; 58 females and 67 males fundus photographs were taken from OPD of above mentioned hospitals. Myopic persons age range from 13 years to 70 years and power of myopia ranges from -0.5 to -30. 90 persons both eyes and 35 persons single eye fundus photographs were taken. 50 cases of normal eyes fundus photographs were taken for control group.

Single eye photographs were taken due to following reasons:

- Operated eye: Previously operated eye for retinal detachment has not been considered in study because its fundus photographs have chances of false reading due to its operated scar.
- Corneal opacity: If corneal opacity present in one eye other eye’s fundus photographs only taken.
- Cataract: If present in single eye, other eye has taken for study purpose.
- Rigid pupil: If one eye has a rigid pupil then dilatation of it is not proper so only other eye with properly dilated pupil is taken in consideration for the study.

Inclusion criteria: All myopia starting from -0.5 D and above.
Age of myopic person: above the age of twelve year.

Exclusion criteria:

- Age below 12 years: below twelve year children are not taken in the study due to their probable less cooperative nature.
- Person previously operated for retinal detachment: Chances of False reading of their fundus photographs. Operated scar may have a chance of false reading as a haemorrhage.
• Myopia with retinopathy: Retinopathy like diabetic, hypertensive, etc. was not considered in study group.

• Aphakia: Aphakic eye was not taken in the study to avoid confusion in disc size as disc size depends on the presence or absence of the lens.

• Depth of optic cup
• Optic disc atrophy
• Optic disc pallor
• Cataract
• Glaucoma

Dilatation of pupil: Mydriatic eye drops ‘Tropacamide plus’ were introduced in the myopic eyes for the dilatation of pupil. Fundus photographs were taken after full dilatation (10-15 minutes) of pupil.

Fundus photography: Fundus photography involves the use of a retinal camera to photograph the regions of the vitreous, retina, choroid and optic nerve. Fundus photography is indicated to document abnormalities related to disease processes affecting the eye or to follow the progress of the disease. Fundus photographs were taken by fundus camera after full dilatation of pupil.

Fundus camera: The camera is like an eye. It is basically a light – tight box (globe= camera body) that focuses light (lens+cornea =camera lens) onto a receiving plane (retina=film). A cover (eyelid=shutter) determines when light enters the box. In this study eye photographs were taken by fundus cameras.

A fundus camera or retinal camera is the optical instrument, a specialized low power microscope with an attached camera designed to photograph the interior surface of the eye, including the retina, optic disc, macula, and posterior pole (i.e. the fundus). A fundus camera provides an upright, magnified view of the fundus.

In this study two different types of fundus cameras are used; Topcon and Zeiss. Photographs were stored in computer and colored print out were taken.

Material and Method
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Topcon Mydriatic Fundus Camera

Zeiss Mydriatic Fundus Camera
All fundus cameras share three interrelated subsystem: mechanical, optical, and electrical. The joystick steers the camera, while the optical system creates the image from light energy provided by the electrical system.

Support for the fundus camera is provided by the mechanical subsystem. The heavy optical head is mounted on a height-adjustable table, the most versatile of which is wheelchair accessible. The chinrest and forehead rest minimize patient head movement. During the procedure, precise positioning is controlled by the joystick and optical head height control.

The retinal image is transferred to the film by using the optical subsystem. The classic fundus camera design features an aspheric objective lens precisely aligned with a 35-mm single-lens reflex camera body. Simply stated, the optical system of the fundus camera projects a ring of illumination through the dilated pupil; the light then reflects off the retina, exits the pupil through the center of the illumination ring, and continues through the fundus camera optics to form an image at the film plane. The viewfinder and the film back or digital recording device are integral parts of this subsystem.

The electrical subsystem powers two illumination sources. Viewing the retina requires a continuous light source that can be adjusted according to the patient’s level of comfort and the photographer’s ability to distinguish fine retinal detail. The viewing light is usually a tungsten bulb that is specific to a particular camera model. Changing the viewing lamp intensity does not affect the final fundus photograph.

A xenon-filled flash tube provides a brief burst of intense light that exposes the fundus photograph. The gas in the flash tube is ionized by the high voltage that is stored in the capacitors of the camera’s power unit. Changing the intensity of the flash setting has no effect on the viewing illumination.

Fundus cameras are often described by the angle of view - the optical angle of acceptance of the lens. An angle of 30 degrees, considered the normal angle of view, creates a film image 2.5 times larger than life. Wide - angle fundus cameras image between 45 and 140 degrees and provide proportionately less retinal magnification. A narrow - angle fundus camera has an angle of view of 20 degrees or less. Normal - angle cameras have smaller illuminating annuli, making them more suitable for patients with pupils of a smaller diameter. The inner diameter of the illuminating ring in wide - angle cameras is larger, making it more difficult to photograph patients with small pupils.

Material and Method
In Topcon camera angle of views are 20 degree, 35 degree and 50 degree. In Zeiss camera angle of views are 20 degree, 30 degree and 50 degree. In this study photographs were taken at 30 degree and 35 degree.

Mydriatic and nonmydriatic fundus cameras require patient dilatation. Mydriatic fundus cameras require pharmacologic dilatation, while nonmydriatic fundus camera uses infrared viewing system to exploit the patient’s natural dilatation in a dark room. In this study, cameras used were of mydriatic type.

Material and Method
Methods of Taking Photographs:

- Explained the procedure: Procedure and purpose of taking fundus photographs were explained to the myopic persons.
- Consent: Taken written consent of the myopic person.
- Eye drop: Used one to two drops of mydriatic eye drops (Tropicamide plus) in the eyes to be photographed.
- Dilatation of pupil: Asked person to sit for ten to fifteen minutes till the full dilatation of pupil. Checked full dilatation of pupil before taking photographs. If pupil was not fully dilated then asked person to wait more minutes till its full dilatation. If still required add one more drop of mydriatic eye drop and wait for its dilatation. If it was not dilated then that eye was not taken in study considering as a rigid pupil.
- Positioned the patient: After full dilatation of pupil asked person to sit in front of the camera. Adjusted the patient’s chair height and then photographer’s height.
- Adjustment: Asked person to place his or her chin on the chin rest and forehead against the bar. The height of his or her eyes should approximately correspond to the height of the objective lens. Glasses should be off.
- Positioned own sitting: After patient’s comfortable position, adjusted own sitting position. Examiner’s eye should be at the same height as the viewfinder.
- Established fixation: Asked them to try to see straight ahead. Slided the fundus camera in front of the eye to be photographed. Asked patient to look at the little light in the middle of the big light and not to blink for a while till the photographs has been clicked and keep looking at external fixation light.
- Focused the eye: Grossly aligned the fundus camera from side to side until the viewing light was centered on the cornea.
- Adjusted the joystick: Kept joystick upright and adjusted optical head height as needed.
- Adjusted Illumination: Positioned the illumination system by moving the forehead rest adjustment toward or away from the objective lens until the doughnut of light was centered on the pupil and focused on the cornea.
- Selected the view: Recentered the camera in the pupil by using the joystick. Moving the joystick toward and away from the patient and checked the most even, most fully saturated view.
- Selected the area of interest: Adjusted the external fixation device until the area of interest was centered in the field of view.
- Selected the angle of view: Fixed the degree of an angle of the camera at which photographs to be taken. Photographs were taken on 30 and 35 degree of view angle.
- Checked the focus: Began turning the focusing knob till retinal image became sharp.

Material and Method
Exposed the film: Clicked the photographs pressing joystick down.

Labeled: Clicked three to four photographs and chosen the good one. Digital images of the best chosen photographs were saved for the study purpose. Labeled the photographs.

Finished and finalized:Inserted the patient's photograph in the table (chart).

The retina is nourished by two sets of blood vessels: the retinal blood vessels and the choroidal blood vessels. The central retinal artery, a branch of the ophthalmic artery, enters the globe through the optic nerve. It branches into the outbound retinal arteries (thinner, lighter blood vessels) and returning retinal veins (thicker, darker blood vessels). The choroids describe a network of spongy blood vessels that are separated from the retina by a layer of pigmented cells called the retinal pigment epithelium (RPE).

**Reading of photographs:** In this study, normal eyes fundus photographs (control group photos) were compared with quoted findings of different ophthalmic books. Myopic eyes fundus photographs were studied by comparing their changes with normal findings.

The retina is transparent. When we look at a normal fundus photograph, we see the red retinal arteries and retinal veins superimposed on an orange background that is the choroids as filtered by the coloration of the RPE.
In this study, observation of optic disc was done by comparing its size with full photographs and its distance from Macula. Disc size depends on the degree of myopia, corneal curvature and presence or absence of lens. Types of crescents were observed. Study of macula was done by observing foveal reflex, macular degeneration, macular haemorrhage, macular pigmentation and macular scar. Staphyloma, choroidal markings and gross chorio-retinal changes were observed.

**Optic Disc:** It is somewhat oval, pink structure, located about 15 degree nasal to the central visual axis (fovea). Disc size depends on the degree of myopia, corneal curvature and presence or absence of lens. In flat cornea there is less magnification so it looks smaller in size. While if corneal curvature is more then because of more magnification it looks large in size.

In Observations of optic disc two things were noted: Disc diameter and Type of crescent. Disc diameter was observed by comparing its size with full photographs and its distance from Macula. Macula is situated two disc diameter (DD) to temporal side of edge of the disc or 3 mm from the disk, little below the level of the horizontal meridian. So observation include Normal/Large/Very large as N/L/VL respectively.

Distance between optic disc and macula is less in large optic disc and further decreased in very large disc.

**Crescent:** It occurs if the choroids became unanchored from its attachment site at the margin of optic nerve head. It is strongly correlated with axial length and/or refractive error (Curtin & Karlin 1971, shih et al., 1989, 1996, Fulk et al., 1992). Degree of crescent indirectly suggests amount of thinning of sclera in myopia. In this study crescent was observed by noting its type as Temporal, Nasal, Inferior and Annular.
Crescent: Nasal, Inferior  Annular

Fovea and Macula: Histologically the fovea describes a small (0.5 mm) central depression that contains the richest saturation of cones. Through a fundus camera, you can more easily discern a centrally located area of darker xanthophylls pigmentation termed the macula. The fovea usually lies about 2.5 DD temporal and slightly inferior to the midline of the optic disc. In this study it is observed by noting foveal reflex as Normal/Dull.

Foveal Reflex: Normal  Dull

Macula is situated two disc diameter (DD) to temporal side of edge of the disc or 3 mm from the disk, little below the level of the horizontal meridian. In this study different macular observations are as below:
Macular degeneration: Observed by noting loss of pinkish glow, this is normally present in healthy retina. Bruch’s membrane is a complex layer between the RPE-retinal pigment epithelium and the choroid and is composed of elements from the base of the RPE and the choriocapillaris. In ARMD (age related macular degeneration) fluid may collect under the RPE, appearing as soft drusen.

Macular Degeneration

Macular scar: It is observed as whitish scar in the fundus photograph.

Macular Scar
Macular haemorrhage: It looks reddish or brownish discoloration in the fundus photograph.

Macular pigmentation: It looks yellowish brown discoloration at the site of macula.
Staphyloma: Elongation of the globe, known as posterior staphyloma, occurs in stages and results from scleral thinning i.e., a bulging of a weakened sclera at the posterior of the eyeball resulting from loss of the choroid lining. In this study its presence or absence was noted and if it was present then its early or advanced forms were noted.

Staphyloma: Early Advance

Choroidal markings: It is also known as tessellations. It means a stippled or striated appearance. It is consistent with the choroid becoming increasingly thin as the eye enlarges. It is well correlated with axial length (Otsuka, 1967; shih et al., 1989). It was noted as mild, moderate or in marked form in this study.

Tessellations: Mild Moderate Marked
Chorioretinal findings: In this study many chorio-retinal changes were noted; myopic degeneration in different quadrent i.e in temporal, nasal or grossly all over.

Gross Myopic degeneration

Lacquer cracks or angioid streaks: Irregular, Jagged lines, red to brown in color. They are radial cracks in Bruch’s membrane. Because they are red and radiate from the disk; they may be mistaken for blood vessels (thus, “angioid”). Breaks in Bruch’s membrane with accompanying choroidal atrophy create lesions known as lacquer cracks. These dehiscences are associated with increased risk for choroidal neovascularization.

Angioid Streak
**Choroidal neovascularisation:** Discontinuities in bruch’s membrane allowing choroidal vessels to grow into the sub-RPE and subretinal space (subretinal neovascular membrane). In myopic eyes, bruch’s membrane is stretched tenously thin and is prone to breakage.

**Macular hole:** It is due to combine pathology of vitreous and retina. It is because of vitreous traction and thinner retina. It develops if abnormal vitreous attachment and traction create a divot in the foveola. A cuff of retinal detachment is frequently seen.
Advantages of Imaging (Fundus Photography):

- Study through imaging procedure helpful to preserve the record (findings) permanently so which is helpful in follow up of the disease.
- Study through imaging technique (fundus photography) helpful to send the records to different places easily and at any time i.e. whenever and wherever needed. (Digitally captured images can be sent electronically to clinicians or to reading centers for grading).
- The photographs are provided with nearly immediate feedback.
- Low illumination of the fundus can often be immediately observed and illumination readjusted to attempt to improve the image.
- Images can be cataloged and tracked more efficiently.

So, in this study it is easy to take opinion from any place immediately if it is needed in any queries or if it is needed for confirmation of any diseases or of any changes.

In fundus photography wave length of light source is similar to visual spectrum also there are no UV rays and no Infrared rays used, so there is no harm to the eyes in taking fundus photographs.

Proforma of Observations:

- Gender of the person:
- Age:
- Degree of Myopia
  - Right eye
  - Left eye
- Optic Disk
  - Diameter
    - Normal (N)
    - Large (L)
    - Very Large (VL)
  - Type of Crescent
    - Temporal
    - Inferior
    - Annular
    - Nasal
- Macula
  - Foveal Reflex
    - Normal (N)
    - Dull
  - Degeneration
  - Scar

Material and Method
- Haemorrhage
- Pigmentation

- Staphyloma
  - Early
  - Advance

- Choroidal Markings (Tessellations)
  - Mild
  - Moderate
  - Marked

- Gross Chorio retinal findings
  - Degeneration in different quadrants
  - Macular hole
  - Angioid streaks
  - Others