## Astigmatism

**It is a type of refractive error wherein the refraction varies in different meridians. The rays of light entering the eye cannot converge to a point focus but form focal lines.**

## Types of Astigmatism

❖ **Based on relative position of image of distant object on the retina**

1. **Simple astigmatism: here one image is located in the retinal plane and based on the location of the other image it may be:**
   i. **Simple myopic astigmatism: The other image is located in front of the retina (Fig.1 A).**
   ii. **Simple hypermetropic astigmatism: The other image is located behind the retina (Fig.1 B).**
2. **Compound astigmatism: here both the images are either in front of the retina or behind the retina and designated as:**
   i. **Compound myopic astigmatism (Fig.1 C).**
   ii. **Compound hypermetropic astigmatism (Fig. 1 D).**
3. **Mixed astigmatism: here one image is formed in front of the retina and the other image is located behind the retina (Fig. 1 E).**

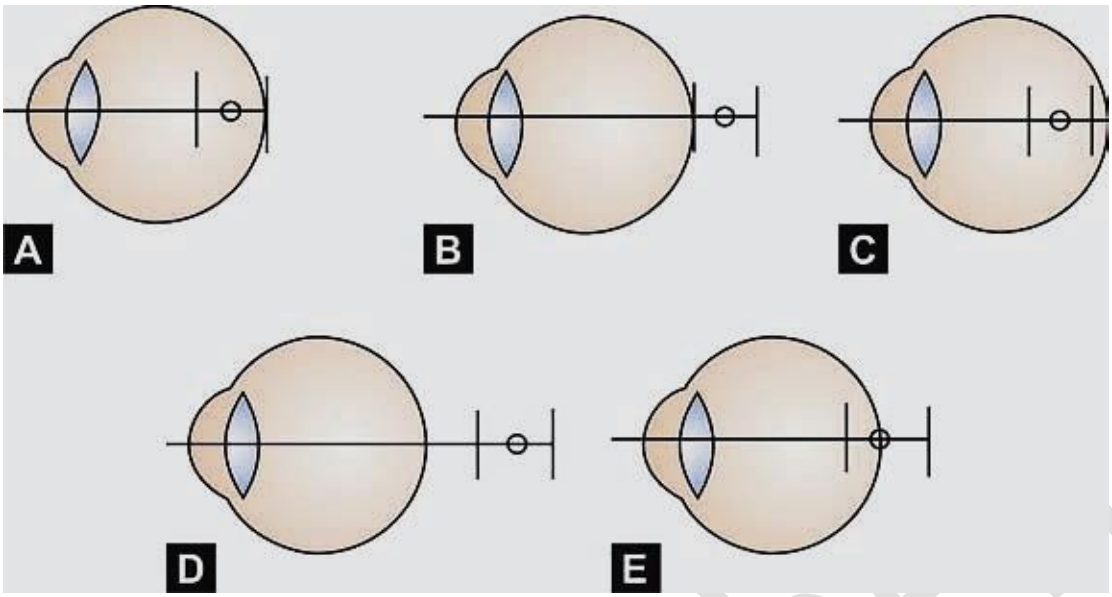
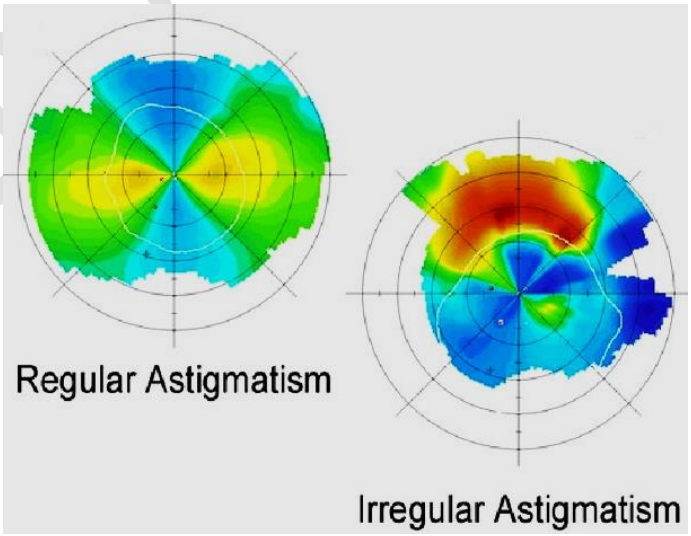



**Fig. 1: Types of astigmatism, O = Circle of least diffusion**

❖ **Based on angle between the two principal meridians**

a) **Regular astigmatism: here two principal meridians curvature are positioned at right angles, i.e. 90° to each other.**

b) **Irregular (or Bi–Oblique) astigmatism: here two principal meridians curvature are not perpendicular positioned to each other. It is very uncommon and found in keratoconus, scarred cornea and after penetrating keratoplasty.**



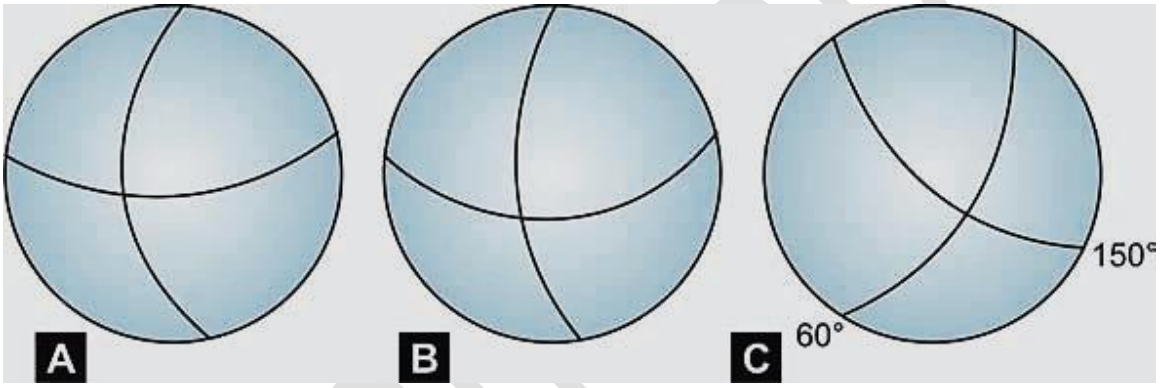
## ❖ Based on Aetiology

### a) Orientation of curvature of cornea

i. **Astigmatism with–the–rule (WTR)**: usually vertical corneal meridian is more curved than horizontal one due to pressure of the eyelids on the eyeball (Fig. 2 A).

ii. **Astigmatism against-the-rule (ATR)**: here the corneal curvature in horizontal meridian is greater than the vertical one (Fig. 2 B).

iii. **Oblique astigmatism**: here the radius of curvature of curvature are aligned at 90° to each other but the two principal meridians are neither near horizontal nor near vertical (Fig. 2 C).




**Figs 2: Types of astigmatism based on orientation of maximum curvature of cornea. (A) = With-the-rule, (B) = Against-the-rule and (C) = Oblique**

### b) Lenticular astigmatism – It is due to:

i. **Curvature**: It is due to variations in the curvature of one or both surfaces. Lenticular astigmatism is typically against the rule and it tends to neutralize the corneal astigmatism.

ii. Index: It is due to inequalities of refractive index in different sections of the lens. It is seen in early cataract and is the reason of polyopia in early cataract.

iii. Displacement of the refractive element of

- ✓ crystalline lens, i.e. subluxation خلع جزئي
- ✓ decentration or tilting of pseudophakia (IOL).

## Symptoms of Astigmatism

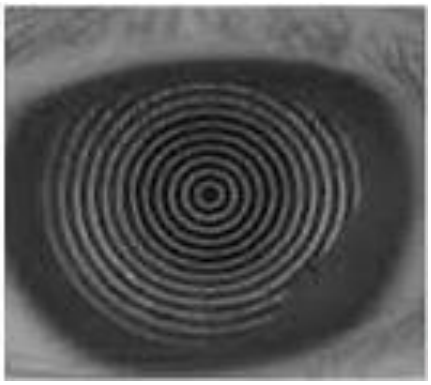
i. Diminished distant visual acuity–this is least in mixed astigmatism
ii. Eye strain or asthenopia
iii. Headache and eyeache
iv. Blurring of letters while reading.

## Diagnosis of Astigmatism

- Objective

1. Retinoscopy
2. Keratometry
3. Placido keratoscope disc: this test reflects irregularities on the corneal surface. The examiner looks through a hole in the centre of the disc, with alternatingly painted black and white circles, at the corneal image reflected from a light behind the patient.





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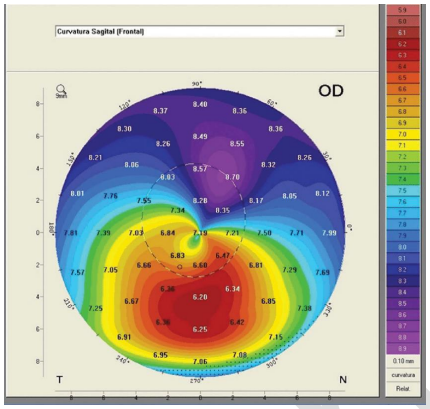
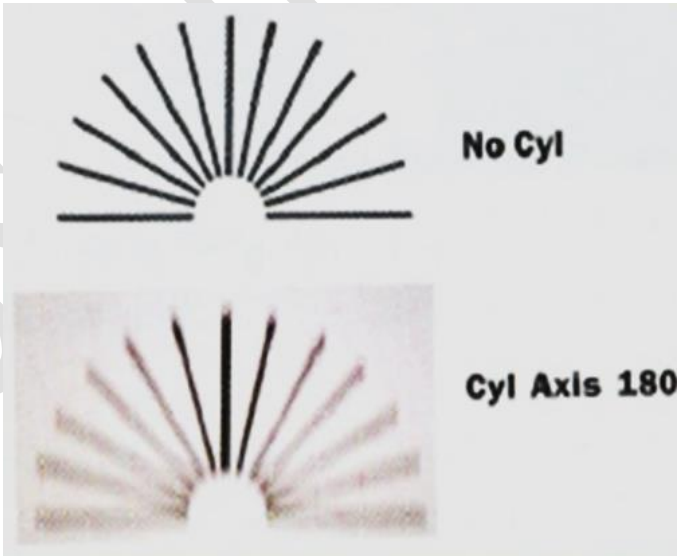
4. **Computerized corneal topography**




## Subjective

1. **Astigmatic fan: It is used to measure the strength of the cylindrical lens and it's axis. The end point of cylindrical lens correction is achieved when the outline of the whole fan becomes equally clear and sharp. The axis of the cylinder is at right angles to the line which was initially most clearly defined.**




2. **Stenopaeic slit test**
3. **Jackson's cross cylinder test (JCC test)**