



جامعة المستقبل
كلية التقنيات الصحية والطبية
قسم تقنيات البصريات



Second Stage 2024-2025

REFRACTIVE ERRORS

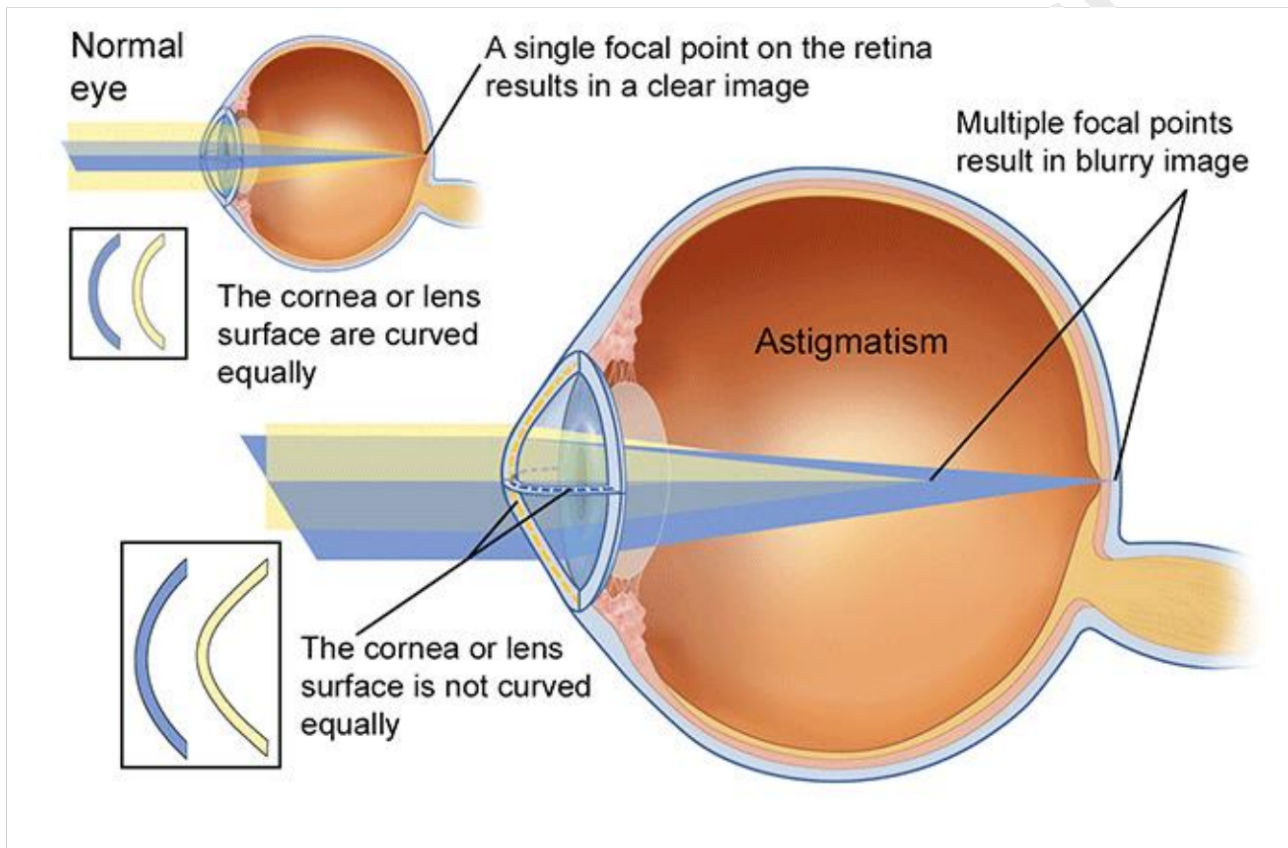
Lecture Title
Astigmatism

Lecture Number: 10 / course 1

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Astigmatism

Astigmatism is a refractive error caused by an irregular shape of the cornea or lens of the eye. Unlike a normal eye, which has a spherical shape (like a basketball), the eye of someone with astigmatism is shaped more like a football or an egg. This irregular shape prevents light from focusing properly on the retina, resulting in blurred or distorted vision.



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).

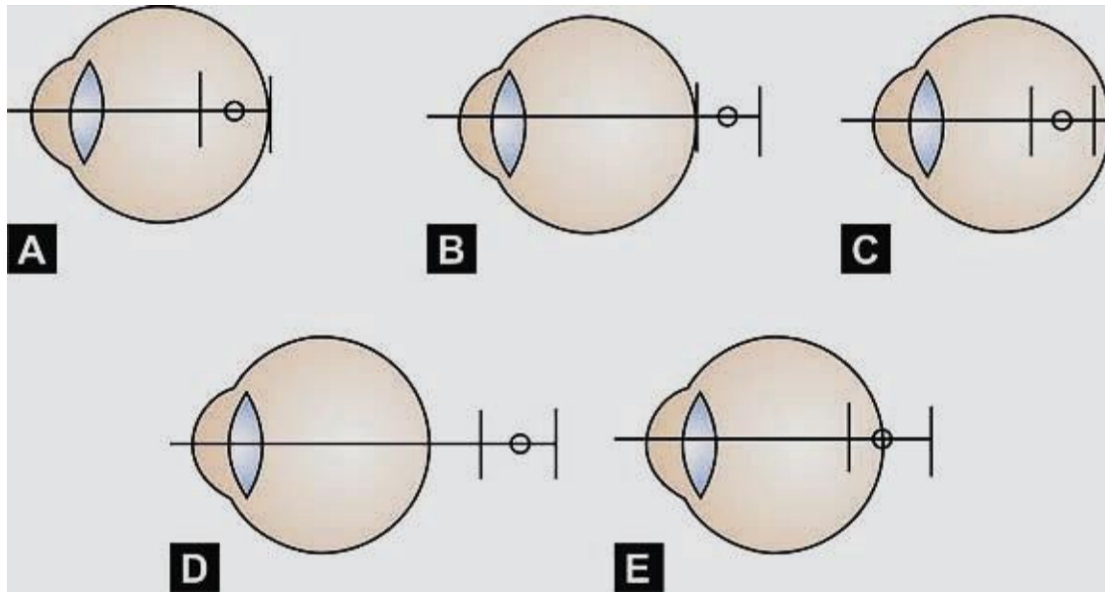
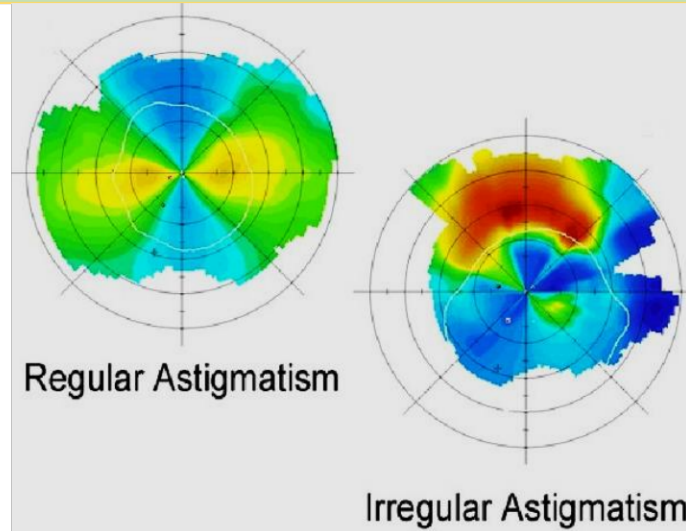


Fig. 1: Types of astigmatism, O = Circle of least diffusion

❖ Based on angle between the two principal meridians

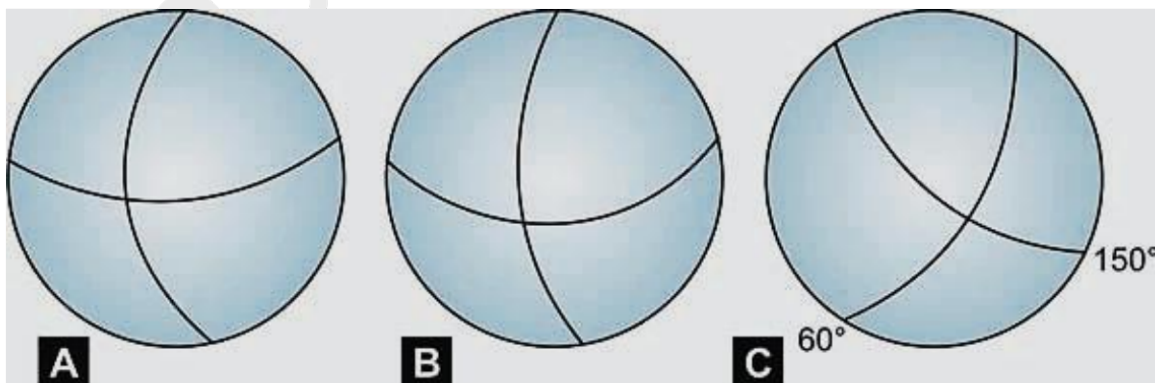
- a) **Regular astigmatism:** here two principal meridians curvature are positioned at right angles, i.e. 90° to each other.
- b) **Irregular (or Bi-Oblique) astigmatism:** here two principal meridians curvature are not perpendicular positioned to each other. It is very uncommon and found in keratoconus, 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. Blurred or distorted vision at all distances
- ii. Eyestrain or discomfort
- iii. Frequent headaches
- iv. Difficulty seeing clearly at night

Causes of Astigmatism

- i. **Genetics:** It is often inherited, meaning that people whose parents have astigmatism are more likely to develop it.
- ii. **Developmental Factors:** Some people are born with an irregularly shaped cornea or lens.
- iii. **Eye Injury or Surgery:** Trauma to the eye or surgical procedures like cataract surgery can sometimes lead to astigmatism.
- iv. **Keratoconus:** A condition where the cornea becomes thinner and develops a cone-like shape, causing severe astigmatism.

Diagnosis of Astigmatism

Objective

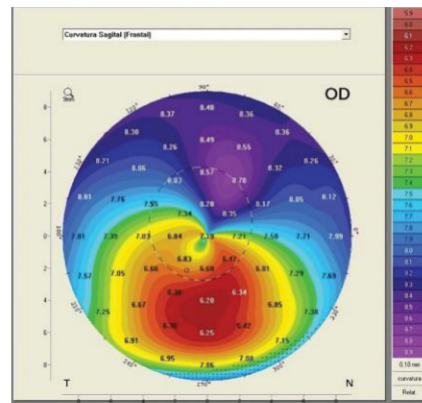
1. Retinoscopy

2. Keratometry: A measurement of the corneal curvature, often used to detect irregularities in corneal shape.

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.

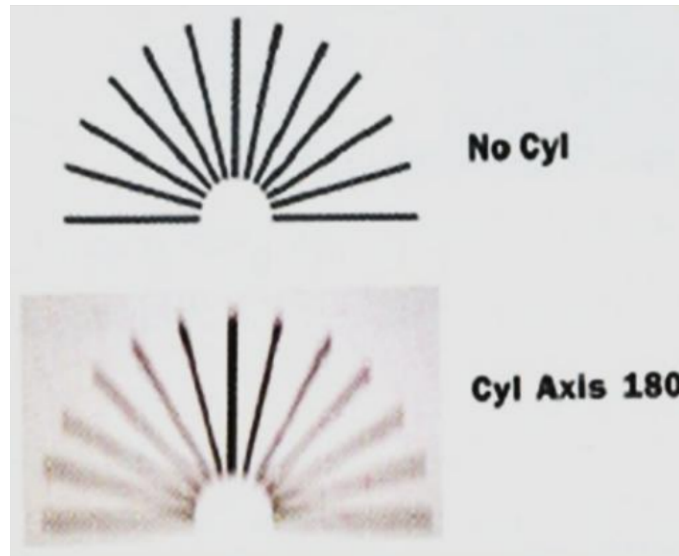


4. Computerized corneal topography



Subjective

1. **Astigmatic fan:** It is used to measure the strength of the cylindrical lens and its 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)**

Treatment Options for Astigmatism

1. **Eyeglasses** are the most common and simplest way to correct astigmatism. Special cylindrical lenses are used to compensate for the irregular shape of the eye.
2. **Contact Lenses** Special toric contact lenses can be used to correct astigmatism. These lenses are designed to sit on the cornea and help focus light properly onto the retina. For severe astigmatism, some people may benefit from rigid gas-permeable (RGP) lenses, which provide better clarity and sharpness of vision.

3. Refractive Surgery

- ✓ **LASIK:** This is a type of laser eye surgery that reshapes the cornea to improve focus. It can be very effective for treating astigmatism.
- ✓ **PRK:** Similar to LASIK, but instead of creating a flap in the cornea, the outer layer is removed and then reshaped using a laser.
- ✓ **Toric Intraocular Lenses (IOLs):** For patients undergoing cataract surgery, toric lenses can be implanted to correct astigmatism.