"REFRACTIVE ERRORS" 👁️

Emmetropia 👍

Definition

Emmetropia is a state of refraction in which parallel rays of light coming from infinity are focused exactly on the sensitive layer of the retina, with accommodation at rest.

➡️ In simple words:
The eye is *optically perfect* for distance vision without any effort.

Basis of Emmetropia

- Proper correlation between:
  - Axial length of the eyeball
  - Refractive power of cornea + lens

📌 Even a small mismatch between these two leads to refractive error.

Accommodation (in Emmetropic Eye)

Accommodation is the adaptive mechanism by which the eye increases its refractive power to focus near objects.

Mechanism

- Objects closer than 6 meters emit divergent rays
- These rays tend to focus behind the retina
- Eye compensates by increasing lens curvature

Flowchart - Accommodation

Near object (< 6 m) → Divergent light rays → Image tends to form behind retina → Ciliary muscle contracts → Lens becomes more convex → ↑ Refractive power → Image focused on retina 🎯

Refraction in an Emmetropic Eye

- Distant vision:
  Parallel rays from optical infinity → Focus on retina → No accommodation required
- Near vision:
  Divergent rays → Accommodation required → Image focused on retina

📌 Clinical correlation

- In advanced age, accommodation becomes insufficient
- Near objects appear blurred
- Convex (plus) lenses are required for near vision

Ametropia (Refractive Error) 👎

Definition

Ametropia is a refractive state where there is a mismatch between axial length and refractive power, causing parallel rays not to focus on the retina.

Types of Ametropia

- Hypermetropia (Farsightedness)
- Myopia (Nearsightedness)
- Astigmatism
- Presbyopia

Hypermetropia (Hyperopia) 👁️⚠️

Definition

Hypermetropia is a refractive state in which parallel rays of light from infinity are focused *behind* the retina, with accommodation at rest.

Refraction in Hypermetropia

Parallel rays from infinity → Insufficient refractive power / short eyeball → Image formed behind retina → Retina receives blurred image 📉

📌 Patient uses accommodation even for distance vision.

Etiology of Hypermetropia 📌

1. Axial Hypermetropia (Commonest)

- Axial shortening of eyeball
- 1 mm shortening = ~3 Diopters

📌 Most frequent cause seen in exams.

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2. Curvature Hypermetropia

- Flatter curvature of:
  - Cornea (most common)
  - Lens
- Seen in cornea plana

- 1 mm change ≈ 6 Diopters
- Curvature often becomes irregular → astigmatism

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3. Index Hypermetropia

- Decrease in refractive index of lens
- Commonly seen in old age

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4. Positional Hypermetropia

- Posteriorly placed crystalline lens
- Reduced effective refractive power

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5. Absence of Crystalline Lens (Aphakia)

- Congenital
- Acquired (post-surgery / trauma)

Symptoms of Hypermetropia 🧠

1. Asymptomatic

- Especially in children and young adults
- Due to strong accommodative power

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2. Asthenopic Symptoms

- Eye strain / tiredness
- Frontal or fronto-temporal headache
- Watering of eyes
- Mild photophobia

Aggravating Factors

- Prolonged near work
- Long working hours
- Dim illumination
- Physical debility
- Emotional stress

📌 Important viva question.

Signs of Hypermetropia 👁️

External & Anterior Segment

- Small eyeball
- Small cornea
- Shallow anterior chamber

Fundus Findings

- Small optic disc
- Accentuated vascular reflexes

Complications of Hypermetropia ⚠️

- Accommodative convergent squint
- Amblyopia
- Predisposition to primary narrow-angle glaucoma

📌 Shallow anterior chamber → angle closure risk.

Management of Hypermetropia 🎯

1. Optical Management

- Convex (plus) lenses
- Glasses or contact lenses

📌 Corrects refractive power deficiency.

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2. Surgical Management

- Photorefractive Keratectomy (PRK)
- Laser Epithelial Keratomileusis (LASEK)
- Laser in situ Keratomileusis (LASIK)
- SMILE

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Hypermetropia predisposes to primary angle-closure glaucoma due to a shallow anterior chamber.

Myopia (Nearsightedness) 👁️➖

Definition

Myopia is a refractive state of the eye in which parallel rays of light from infinity are focused *in front of the retina* when accommodation is at rest.

➡️ Result:

- Distant objects appear blurred
- Near vision is relatively better

Refraction in Myopia

Parallel rays from infinity → Excess refractive power / elongated eyeball → Image formed in front of retina →

Rays diverge before reaching retina → Blurred distant vision 🎯

Etiology of Myopia 📌

1. Axial Myopia (Commonest)

- Increase in antero-posterior length of eyeball
- Retina lies behind the focal point

📌 Most frequent cause asked in exams.

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2. Curvature Myopia

- Increased curvature of:
  - Cornea
  - Lens
  - Or both
- 1 mm increase ≈ 6 Diopters

Seen in:

- Corneal ectasias
- Conical cornea
- Anterior lenticonus
- Posterior lenticonus

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3. Positional Myopia

- Anterior placement of crystalline lens
- Effective refractive power increases

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4. Index Myopia

- Increased refractive index of lens nucleus
- Commonly associated with nuclear sclerosis

📌 Elderly patient suddenly reading without glasses = index myopia.

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5. Myopia due to Excessive Accommodation

- Persistent accommodative spasm
- Seen in young individuals with prolonged near work

Clinical Types & Signs of Myopia 👁️

A. Simple Myopia

Signs

- Prominent eyeballs
- Deep anterior chamber
- Pupils: large & sluggish
- Gradual increase in refractive error
  → ~0.5 D per year

📌 Usually stabilizes by early adulthood.

B. Pathological (Degenerative) Myopia

Signs

- Markedly prominent eyeballs

- Large cornea
- Deep anterior chamber
- Pupils: large & sluggish
- Myopic fundal changes (important!)

📌 Progressive and vision-threatening.

Complications of Myopia ⚠️

- Retinal detachment
- Complicated cataract
- Vitreous hemorrhage
- Choroidal hemorrhage

📌 Retinal detachment is the most feared complication.

Management of Myopia 🎯

1. Optical Management

- Concave (minus) lenses

- Glasses or contact lenses

📌 Concave lenses diverge rays → shift focus onto retina.

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2. General Measures

- Adequate illumination
- Avoid excessive near work
- Regular follow-up in progressive myopia

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3. Surgical Management

- Photorefractive Keratectomy (PRK)
- Laser Epithelial Keratomileusis (LASEK)
- Laser in situ Keratomileusis (LASIK)
- Clear lens extraction
- Phakic posterior chamber IOL
- SMILE

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> Retinal detachment is the most common and serious complication of pathological myopia.

Astigmatism 👁️📐

Definition

Astigmatism is a refractive error in which parallel rays of light are focused into *two focal lines* rather than a single focal point.

➡️ Vision is distorted at all distances.

Etiology of Astigmatism

Lens-Related Causes

- Change in refractive index → Index astigmatism
- Decentration of lens or intraocular lens (IOL)

- Change in curvature of lens → Lenticonus

Corneal Causes (Most Common)

- Eyelid pressure
  → With-the-rule astigmatism
  → Against-the-rule astigmatism
- Pterygium
- Corneal scar
- Keratoconus

📌 Cornea is the commonest site involved.

PRESBYOPIA 👁️📖

Definition

Presbyopia is a physiological loss of accommodation occurring with advancing age.

Pathophysiology

- Gradual loss of lens elasticity
- Reduced accommodative power

Clinical Features

- Begins around 45 years of age
- Accommodation falls below 3 Diopters
- Near point shifts to 40–50 cm
- Difficulty reading fine print
- Headache
- Visual fatigue

Flowchart – Presbyopia Development

Increasing age → Loss of lens elasticity → ↓ Accommodation → Near point recedes → Difficulty in near vision 📉

Treatment of Presbyopia 🎯

- Convex lenses for near vision
- Reading glasses
- Bifocal glasses
- Trifocal glasses
- Progressive power glasses

📌 Distance correction may be added if ametropia coexists.

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> Presbyopia is not a refractive error, but a physiological age-related change.

-> The End <-