

Myopia Prescription

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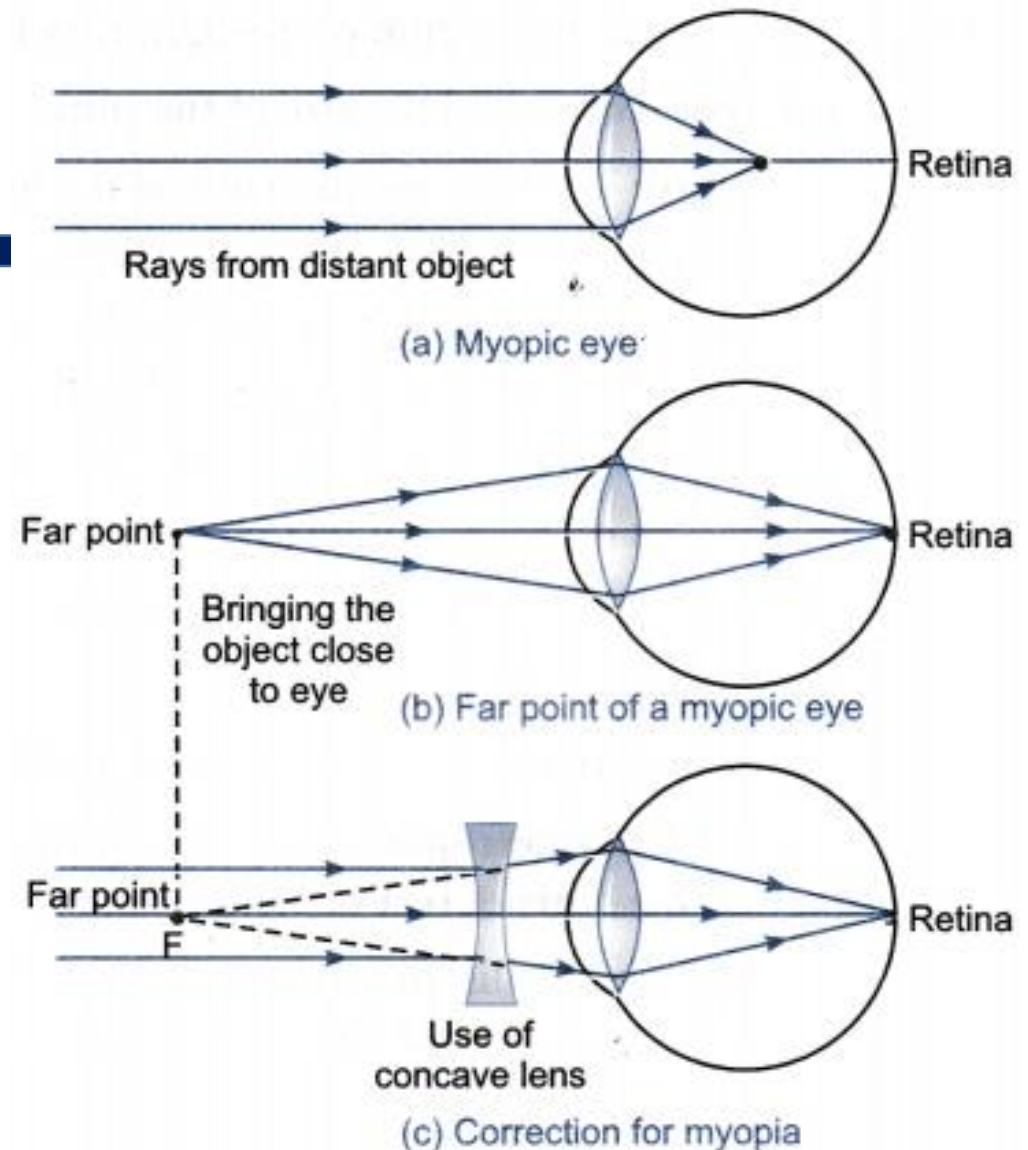
University of Medical Science

Definition

Parallel rays entering myopic eye are brought to a focus in front of the retina.

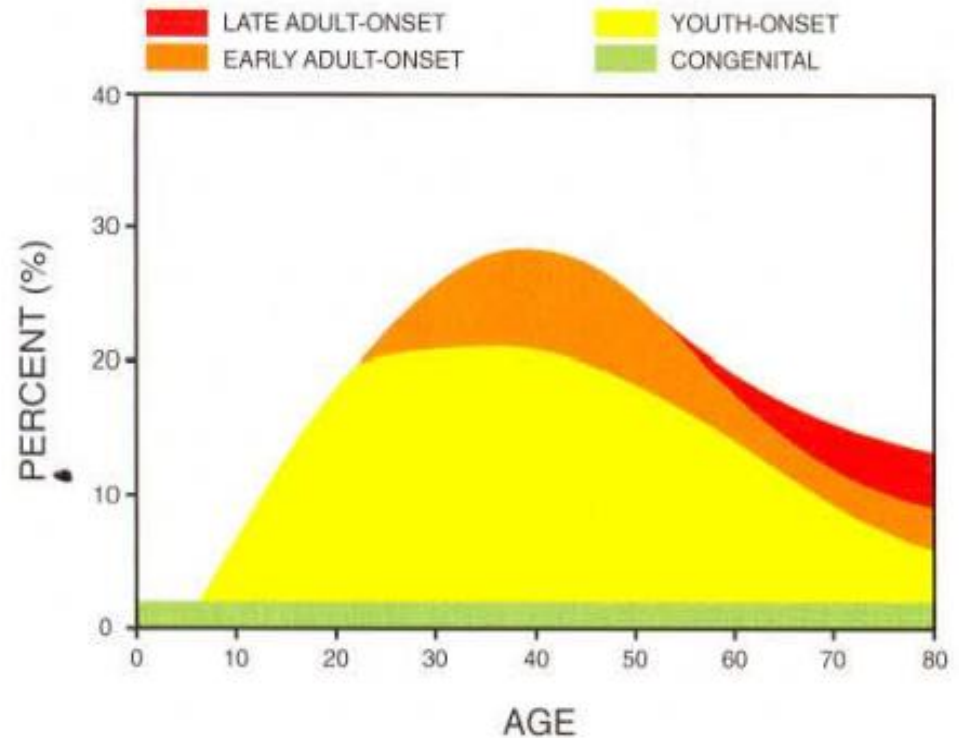
Far point is in front of the eye.

Far point: $1/f$



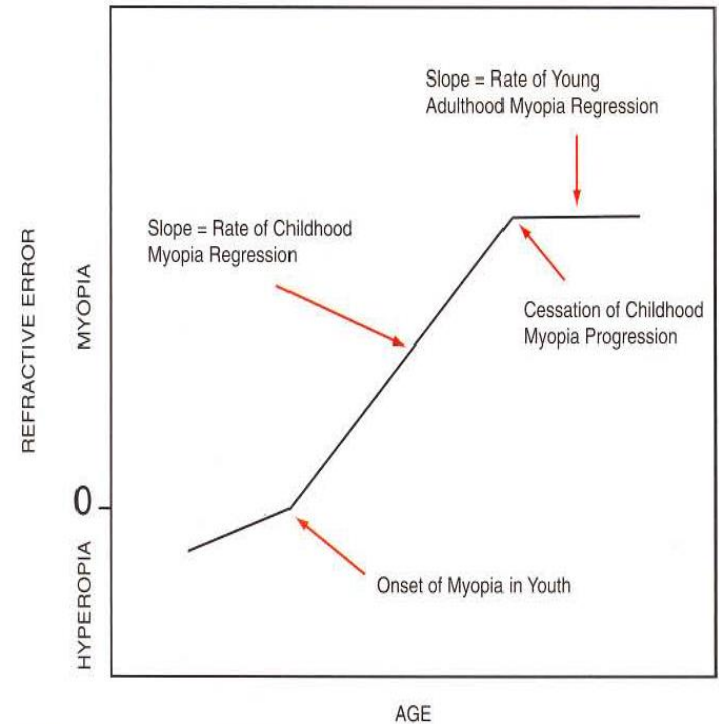
Classification: Age of onset

- Congenital
- School (juvenile) onset
- early adult onset (20-40y)
- late adult onset (>40)



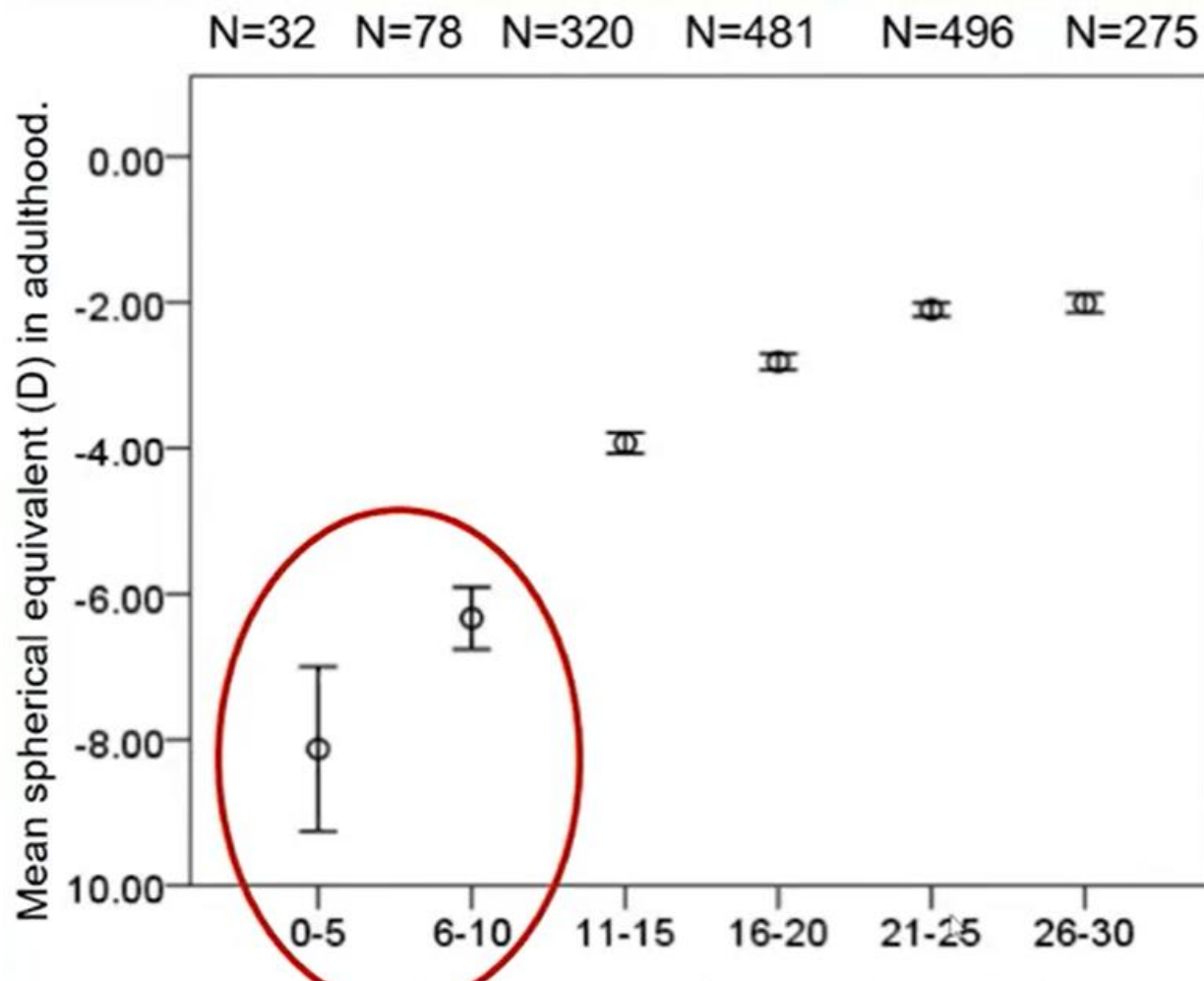
Myopia Stabilization

- In most cases, myopia increases rapidly during adolescence followed by stabilization during early adulthood.



- mean age at myopia stabilization is **15.6 years** but this can vary among children of different ethnicities.

Earlier onset ---- greater risk of high myopia



Epidemiology

- Myopia has become a significant global public health and socioeconomic problem. (US\$202 billion per annum)
- **Wide variation** of prevalence of myopia between different **regions and ethnic groups**.
- The prevalence of myopia and high myopia in young adults in **urban area of East Asian countries** has risen to **80–90%** and around **20%**, respectively.

Epidemiology

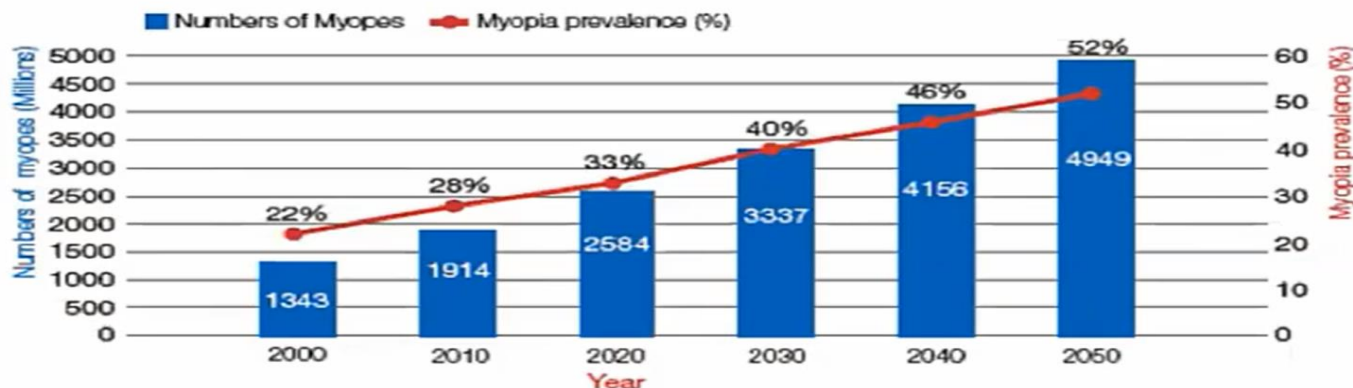
- Prevalence of myopia is more than **2 times** higher among **East Asians** than similarly aged **white persons**.
- Myopia in whites two times (%26) more common than blacks (%13).

Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050

- In 2010, an estimated 1.9 billion people (27% of the world's population) -myopic, 70 million of them (2.8%) -high myopia.
- These numbers are projected to rise to 52% and 10%, respectively, by 2050.

Fig. 1. Numbers of cases (blue) and prevalence (red) of myopia worldwide between 2000 and 2050

Results: Myopia - Now and in 2050



Prevalence of myopia according to age:

< 6 year → < 2-7%

7-15 year → 15-20%

>15 year → 25-40 %

Epidemiology

Prevalence in Iran

- **Fasa (6-7 y): 6.5%**
- **Dezfoul(6-15y) 14%**
- **Mashhad (urban): < 15y: 4%)----(>15Y: 24%)**
- **Shahrood (40-64 y): 30%**
- **Shiraz (Farvardin et al): 37-42% in highly educated group**
- **University student: (Hashemi et al): 41%**
- **Rural population(16-30): 20-30%**

Risk factors of myopia

Myopia risk factors

Genetics

- Myopia is highly heritable
 - myopia is a complex trait (200 genetic loci: chromosomes: 7, 11, 12, 17, 18, 21, 22)
 - AR & AD & X-linked inheritance have been shown in some cases of high myopia.
 - One myopic parents: **2.08 times** greater chance.
 - Two myopic parents: **5.07 times** greater chance.
- Monozygotic twin: 95%**
Dizygotic twins: 62%
Siblings: 60%

Myopia risk factors

- **Near work: Myopia and near work:**
 - Excessive near work specially during childhood causes myopia.
 - Higher amount of tonic accommodation may be a risk factor for myopia progression.
 - The Sydney Myopia Study found that near work such as close reading distance of less than **30 centimeters and continuous reading of more than 30 minutes** independently increased the odds of having myopia.

Other myopia risk factors:

- Low outdoor activity
- Urbanization
- High population density
- Small home
- Education
- Diet: low protein, low vit D
- Prematurity
- Poor or disrupted sleep
- Female gender
- Visual deprivation:

Visual deprivation in primates & birds caused myopia.

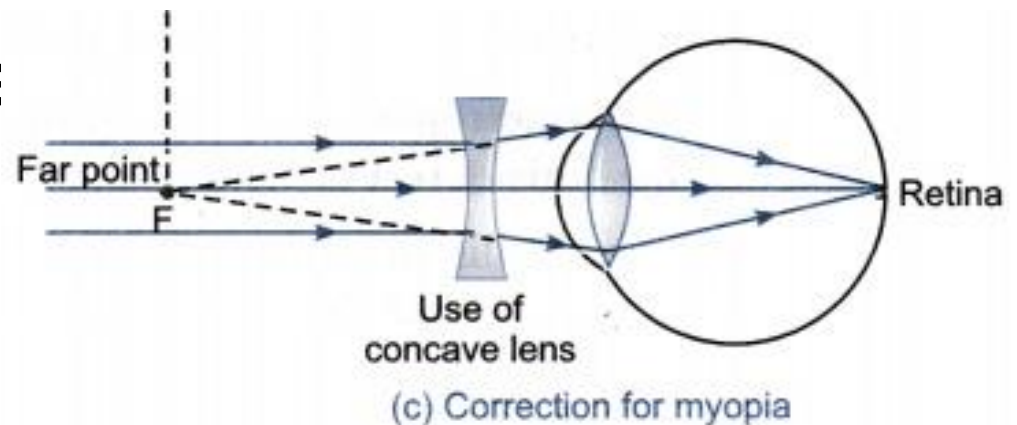
Myopia management

- **When and how to prescribe?**
- **How to prevent myopia onset and progression?**

Myopia Treatment:

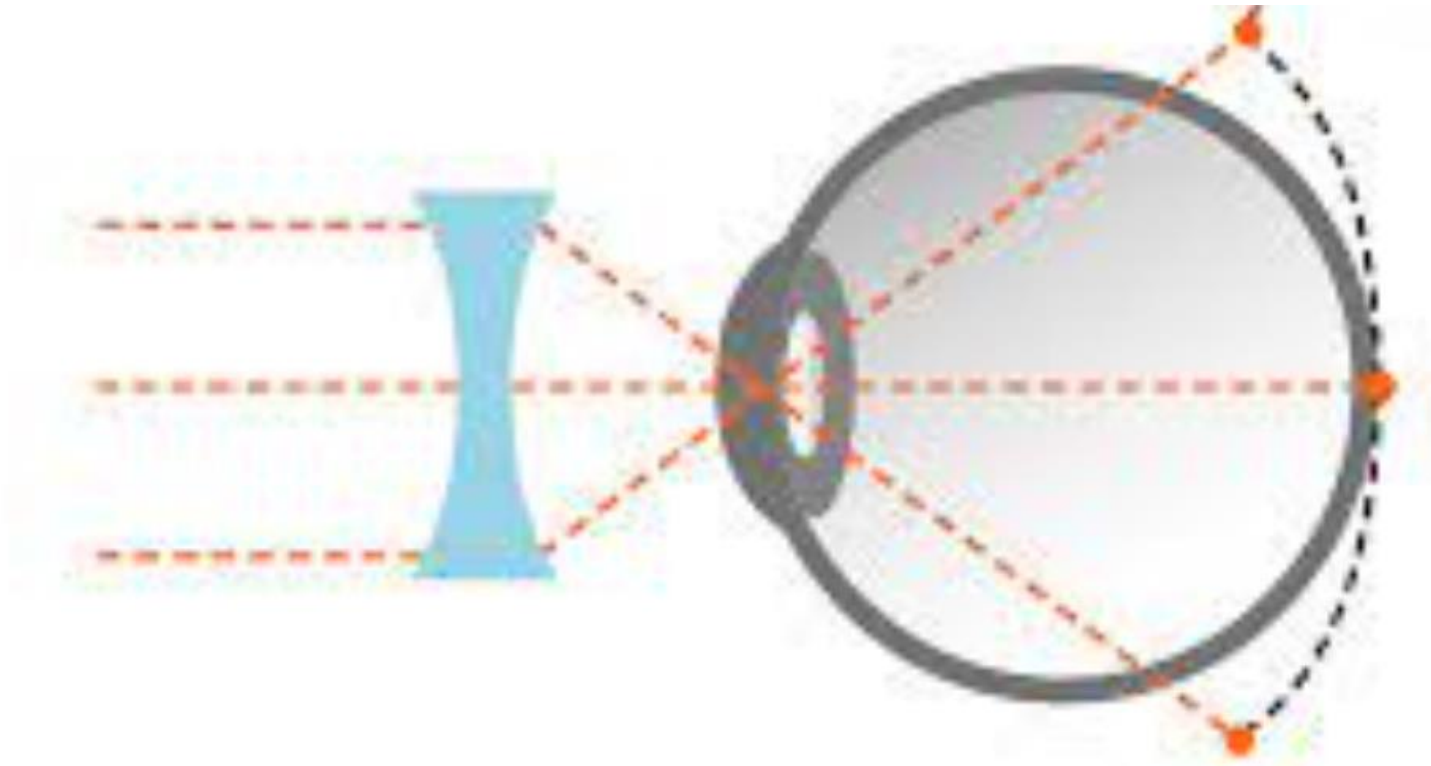
- **Glasses**
- **Minus lenses, decrease vergence focus**

parallel rays on the



Traditional minus lens

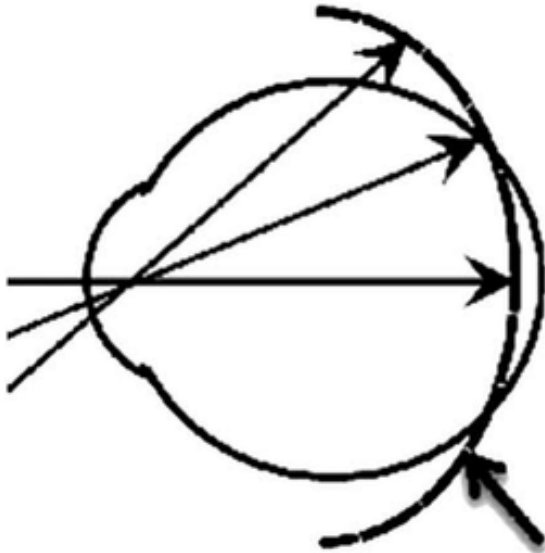
Relative peripheral hyperopic defocus



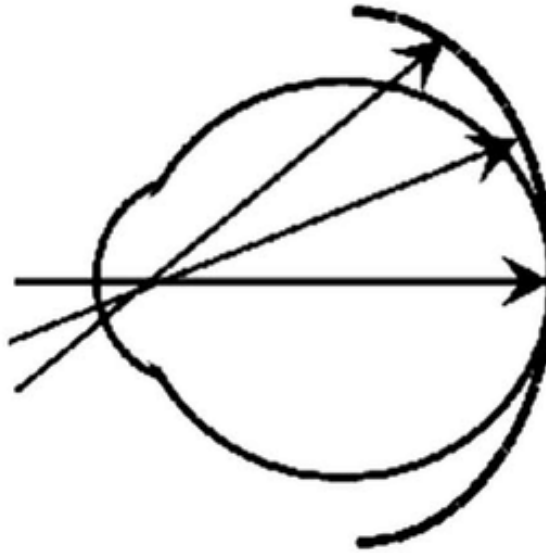
From animal studies, it is known that eyeball growth (i.e., hyperopia or myopia) could be induced by using positive and negative lenses, respectively

Central and peripheral hyperopic defocus

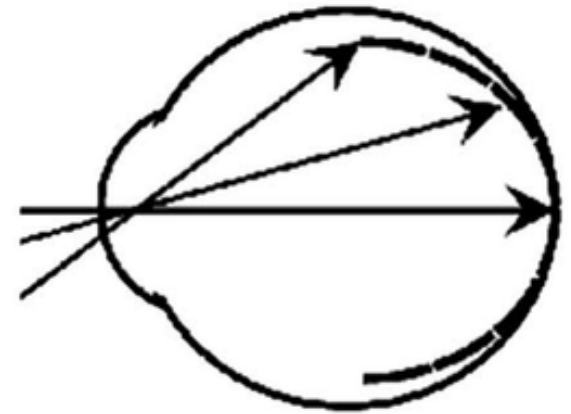
Uncorrected Myope



Traditional Correction



Optimal Correction?

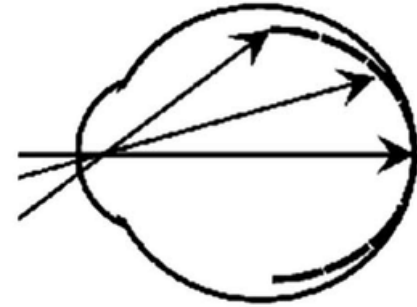


Myopia Under-correction (central myopic defocus)
Peripheral Myopic Defocus Glasses or contact lens

Under-correction of myopia

- Studies using **animals**, such as chicks and mammals, have shown that the use of optical lenses to impose myopic defocus inhibits myopic eye growth in developing eyes.
- **Contrary to the animal studies, two clinical trial studies showed that under-correction actually accelerates myopia development and progression in myopic humans. (0.5-0.75D)**

Peripheral myopic defocus design



- **Peripheral myopic defocus spectacles:** week effect on myopia progression.
- **Peripheral myopic defocus contact lenses:** moderate effect on myopia progression

Over-minus (central hyperopic defus)

- **Intermittent XT**

Do over-minus progress myopia?

- **Treatment of intermittent exotropia with overcorrecting minus lens **did not induce refractive errors changes**, even considering age, treatment period, initial spherical equivalent and overcorrection magnitude used.**

(Paula JS, Ibrahim FM, Martins MC, Bicas HE, Cruz AA. Refractive error changes in children with intermittent exotropia under overminus lens therapy. Arquivos brasileiros de oftalmologia. 2009;72:751-4.)

Mean refractive error change was 0.4D/year (range, -1.5 to +0.4).

Sethi S, Ismaeil N, Shaffer J, Davidson SL, Mills M, Sulewski M, Binenbaum G. Overminus spectacle correction in the management of intermittent exotropia. Journal of American Association for Pediatric Ophthalmology and Strabismus {JAAPOS}. 2015 Aug 1;19(4):e16.

➤ How much prescribe?

Over / under-minus??

Prescribe the list amount of myopia that reaches BCVA

Myopes reports that more minus increase clarity (minification of image by minus lenses is seen as increase clarity)

Consideration before prescription

- **Pseudo myopia**
FCR
- **Drug induced myopia**

When prescribe for children?

Rule of Tomb(-5-3-1)

➤ <2y: -5

➤ 2-6y: -3

➤ >6: -1

Table A1.1 Practice patterns generated by consensus for prescribing refractive correction

	<1 year	1–2 years	2–4 years	4–7 years
Miller and Harvey [1] ^a				
Myopia	−4.50 ^a		−3.00 ^a	−2.00 ^a
Hypermetropia	+5.50 ^a		+5.00 ^a	+4.50 ^a
Astigmatism	+3.00 ^a		+2.50 ^a	+2.00 ^a
AAO PPP [2]				
Myopia	≥−5.00	≥−4.00	≥−3.00	No specific numbers, prescribe based on symptoms
Hypermetropia	≥+6.00	≥+5.00	≥+4.50	
Hypermetropia/ET	≥+2.50	≥+2.00	≥+1.50	
Astigmatism	≥+3.00	≥+2.50	≥+2.00	

^aNumbers based on 75 % (majority) of American Association for Pediatric Ophthalmology and Strabismus (AAPOS) members would prescribe glasses.
AAO American Academy of Ophthalmology, PPP Preferred Practice Patterns

Minus glasses problems :

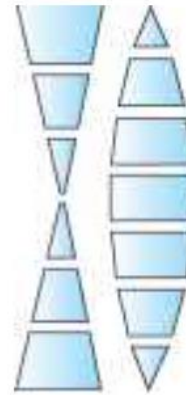
- **Image minification**



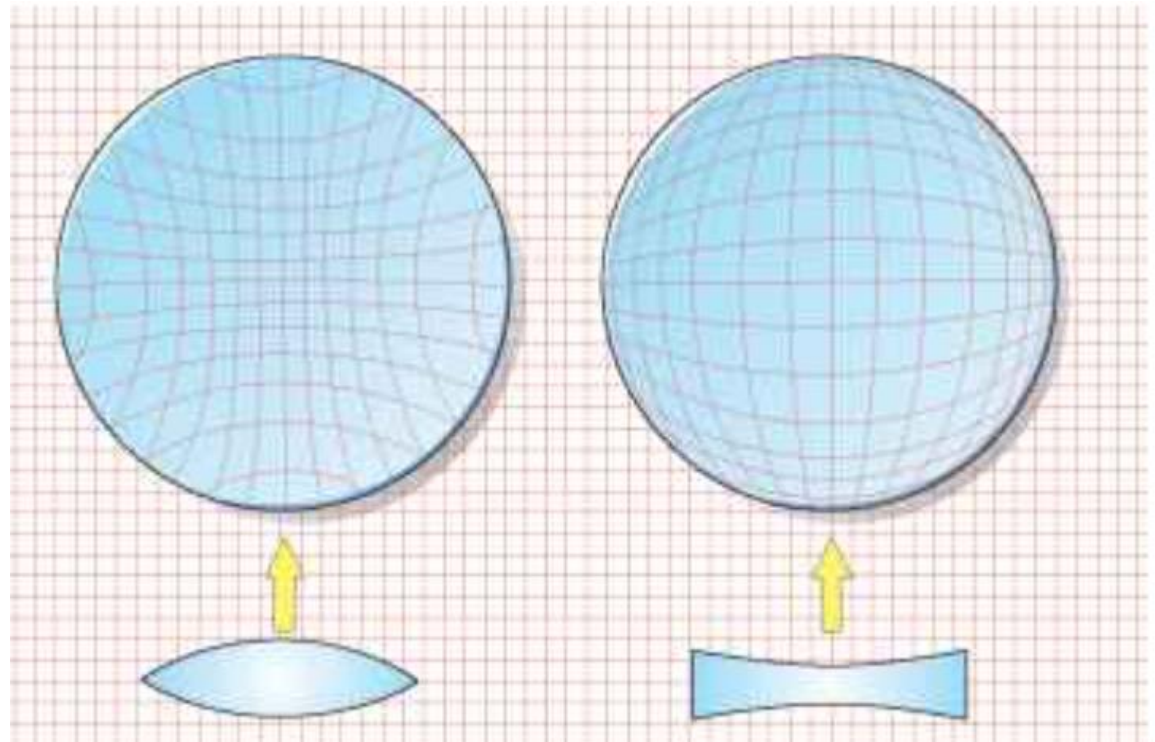
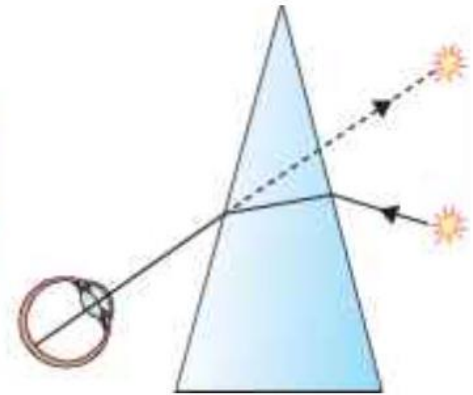
Barrel distortion

prismatic effect

Apex

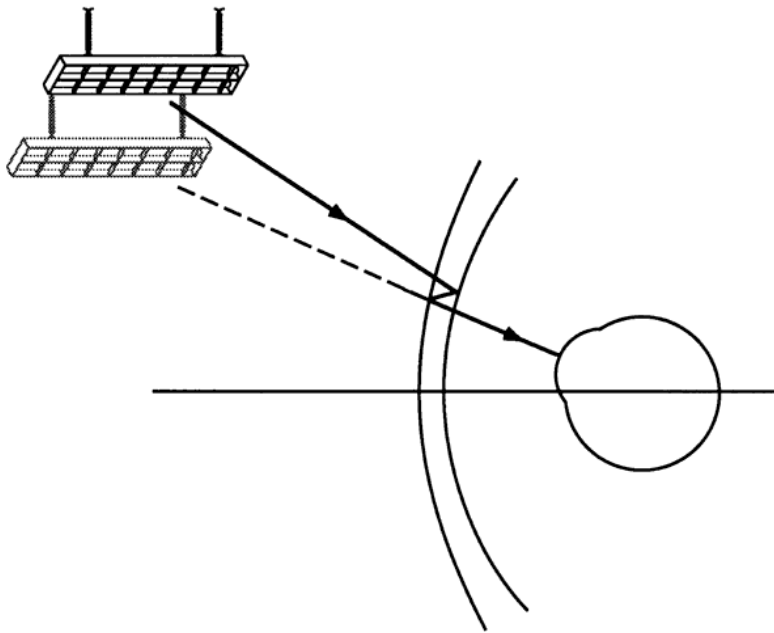


Base



Minus glasses problems :

- **Ghost image**



Myopia progression prevention modalities

Pharmacologic

Atropine, Pirenzepine
Lowering IOP: Timolol

Optical:

- Under-correction
- Peripheral defocus modifying contact lenses/spectacle
- Bifocals spectacle lenses +/- base in prism
- Progressive addition (PAL)
- Orthokeratology
- **Environmental modification:**
 - Out door activity
 - Limiting near work/ screen time



Efficacy Comparison of 16 Interventions for Myopia Control in Children

- **Clear effect**
- **Moderate effects**
- **weak effects**
- **Ineffective**



Efficacy Comparison of 16 Interventions for Myopia Control in Children

➤ Clear effect:

High-dose atropine (1% and 0.5%)

Moderate-dose atropine (0.1%)

Low-dose atropine (0.01, 0.05%)

showed clear effects in myopia control (all with statistically significant effect)

Atropine

- The initial high doses of atropine (i.e., 0.5% or 1.0%) slowed myopia progression by more than **70% over 1–2 years** .
- However, lower doses (0.1% or less) can also slow myopia by **30–60%**, and may be associated with fewer side effects (pupil dilation, glare or blur) and **rebound**



Efficacy Comparison of 16 Interventions for Myopia Control in Children

➤ **Moderate effects:**

Pirenzepine

Orthokeratology

Peripheral defocus modifying contact lenses
prismatic bifocal spectacle lenses showed

The amount of bifocal

- The **+1.50D** near addition power was chosen because it reduced the accommodation lag but did not induce a large amount of near exophoria in the standard bifocal group
- **6Δ base-in prism** (two 3pd)
- The inclusion of base-in prism in the experimental lenses was an attempt to reduce fusional vergence demand to enhance the treatment effects of the bifocals



Efficacy Comparison of 16 Interventions for Myopia Control in Children

➤ weak effects:

Progressive addition spectacle lenses

Bifocal spectacle lenses

**Peripheral defocus modifying spectacle
lenses**

More outdoor activities showed



Efficacy Comparison of 16 Interventions for Myopia Control in Children

➤ Ineffective:

Rigid gas-permeable contact lenses

Soft contact lenses

Undercorrected single vision spectacle lenses

Timolol

Upcoming studies

- **Bifocal & Atropine in Myopia (BAM) Study: Baseline Data and Methods. (2020).**

Two weeks of combination treatment reduced low-contrast distance VA and increased near exophoria slightly, but the subjects were compliant and tolerated the treatment well.

- **Myopia Control with Combination Low-Dose Atropine and Peripheral Defocus Soft Contact Lenses: A Case Series (2021)**

Thank
you

