A Closer Look at Myopia

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Overview

- History of Spectacles for Myopia
- Physiology and Optics of Myopia
- Classification of Myopia
- Options for the Correction of Myopia
- Control of Myopia/Myopia Progression
- Myopia: Fact or Myth?
“Myopia”

- Myopia
  - Greek from *myein* “to shut” and *ops* “eye”
  - Commonly known as:
    - Nearsightedness
    - Shortsightedness
The History of Spectacles for Myopia

- 16th century: concave lenses
- Pope Leo X (1475-1521)
  - Renaissance papacy
  - Highly myopic
Introduction

- Global prevalence of myopic refractive errors
  - Estimated 800 million to 2.3 billion
  - Prevalence of 70-90% in some Asian countries
  - 30-40% in Europe and United States
  - 10-20% in Africa
“Survey Says …”

- How many myopes in the room?
Northern Increase in Myopia?

- Increased myopia in younger generations:
  - Native populations (Alaska & northern Canada)
- Little parent-child correlation in refractive error
  - Instead, sibling-sibling correlation exists
- Coincided with compulsory schooling after WWII
  - Increase close-up work
- Inter-racial marriage a factor?
Physiology of the Development of Myopia

- Genetic control?
  - Complex interactions of structural proteins from multiple chromosomes

- Visual environment?
  - Research using form deprivation myopia
  - Affects axial length
  - Diurnal growth rhythms of the eye
The Optics of Myopia

Myopia
(nearsightedness)

Distant vision is blurred when light rays from distant objects come to focus in front of the retina.

Correction with a minus lens allows light to once again focus on the retina.
Classification of Myopia

- **Axial Myopia:**
  - An increase in the eye’s axial length
Classification of Myopia

- **Refractive Myopia**
  - The condition of the eye’s refractive elements

- **Curvature Myopia**
  - Excessive curvature or one (or more) of the refractive surfaces

- **Index Myopia**
  - Variation in the index of refraction of one or more of the ocular media

  - *Index of refraction* – describes how light travels through a material
What is “hyperphacosorbitomyopicoisis”?  

- Myopia as the result of increased sorbitol in the lens  
- **HYPER** - Greek “over”  
- **PHACO** - Greek “lentil” [bean]  
- **SORBITO** - sugar alcohol  
- **MYOPIC** – near sighted  
- **OSIS** – affected with, condition, abnormal process  

- Occurs under conditions of elevated blood-glucose  
  - Often temporary (ie. blood-glucose level spike in diabetes)
Further Classification of Myopia

(1) Simple Myopia
(2) Degenerative Myopia
(3) Nocturnal “Night” Myopia
(4) Pseudomyopia
(5) Induced Myopia
   (a) Index Myopia
   (b) Form Deprivation Myopia
(6) Nearwork-Induced Transient Transient Myopia
(7) High Myopia
(1) Simple Myopia

- Most common type of myopia
  - Either:
    - Eye is too long for its power (cornea, lens)
    - Optically too powerful for its length
  - Genetic and environmental factors
Degenerative Myopia

- Other names:
  - “Malignant myopia”
  - “Pathological myopia”
  - “Progressive myopia”
- Changes to the fundus:
  - Posterior staphyloma
  - Laquer cracks
  - Forster-Fuch spot
- Subnormal best-corrected vision
  - Common cause of visual impairment
  - High refractive error >-6.00 D
  - Progressive worsening over time
(2) Degenerative Myopia (cont’d)
(2) Degenerative Myopia (cont’d)
(2) Degenerative Myopia (cont’d)
(2) Degenerative Myopia (cont’d)
(3) Nocturnal Myopia

- A.K.A. “Night myopia” or “Twilight myopia”
- The patient has difficulty seeing in low-illumination
  - Daytime vision is normal
- Causes:
  - Pupils dilate in low-illumination
  - More light enters the eye
  - More aberrations ("imperfect image")
- May need glasses for driving at night
- Younger people affected more than the elderly
(4) Pseudomyopia

- Blurring of distance vision due to spasm of the ciliary muscle

www.daviddarling.info/encyclopedia/C/ciliary_body.html  www.siumed.edu
(5) Induced Myopia

- A.K.A. “Acquired myopia”
  - Types of Induced myopia
    - Index myopia
    - Form deprivation myopia
  - From a secondary cause:
    - Exposure to drugs
    - Increased blood-glucose
    - Nuclear sclerotic cataract
    - Oxygen toxicity
    - Scleral buckle
(5a) Index Myopia

- Myopia as the result of variation of the index of refraction of the ocular media (ie. cataracts)
  - Nuclear sclerotic cataract -“Second sight”

www.snec.com.sg
(5b) Form Deprivation Myopia

- Occurs when eyesight is limited and deprived of clear vision
- Used in research to study the mechanisms of myopia development

http://www.cmj.org

www.vision-and-eye-health.com
(6) Nearwork-Induced Myopia

- Short-term nearsightedness immediately following a sustained near visual task
- Potential link between near work and permanent myopia?
(7) High Myopia

- Myopia of -6.00 D or more
- 30% of myopes have “high” myopia

Increased risk:
- Retinal detachments
- Primary open angle glaucoma
- Floaters

www.rameshshahmd.com

www.dro.hs.columbia.edu
Classification of Myopia – Based on Age of Onset

- Congenital myopia - infancy
- School myopia – childhood, near work
- Youth onset myopia – prior to age 20
- Early adult onset myopia – b/w age 20 and 40
- Adult onset myopia
- Late adult onset myopia – after age 40
Options for the Correction of Myopia
Options for the Correction of Myopia

- Spectacles
- Contact lenses
- Laser refractive surgery
- Phakic intraocular lenses
- Clear lens extraction and replacement surgery (CLEAR)
- Corneal ring segment implants
Options for the Correction of Myopia

- Spectacles – negative optical power (concave lens)
  - High myopes
    - Aspheric lens designs
    - Myodiscs
Options for the Correction of Myopia

- Contact lenses
  - “Soft” hydrogel or silicone hydrogel lenses
  - Gas permeable lenses
  - Orthokeratology (Ortho-K), Corneal Reshaping Therapy (CRT)
Ortho-K (CRT)

- Low to moderate myopes (-1.00 D to -5.00 D)
- Low astigmats (< –1.50 D cyl)

- More recently/under investigation:
  - Low amounts of hyperopia
  - Presbyopia

www.OrthoKDoctors.com
Options for the Correction of Myopia

- Laser refractive surgery
  - **LASIK** (Laser-Assisted in Situ Keratomileusis)
    - “Kerato” = cornea
    - “Mileusis” = to shape
  - **LASEK** (Laser-Assisted Sub-Epithelial Keratectomy)
  - **PRK** (Photorefractive Keratectomy)
    - “-ectomy” = to cut out
Options for the Correction of Myopia

- Phakic intraocular lenses
  - Lens is implanted in the eye over the patient’s existing crystalline lens
  - -5.00 D to -20.00 D
  - Age 21-45

- Clear lens extraction and replacement (CLEAR)
  - Crystalline lens extracted and intraocular implant lens replaces it
  - Age >40
Options for the Correction of Myopia

- Corneal ring segment implants (INTACS)
  - Reshape the curvature of the cornea
  - -1.00 D to -3.00 D
  - Can be removed or replaced with a different size
Control of Myopia

Methods investigated to slow the progression of myopia in children include:

(i) Under-correction of myopia
(ii) Gas permeable contact lenses
(iii) Bifocal and progressive addition lens spectacles
(iv) Eye drops:
   - Cycloplegic drops
   - Intraocular pressure-lowering drugs
   - Muscarinic receptor antagonists (atropine)
Control of Myopia

(i) Under-correction of myopia?
   - Increased progression of myopia

(ii) Rigid gas permeable lenses?
   - No evidence on effect of myopic eye growth
Control of Myopia

(iii) Bifocal and progressive addition lens specs?
- A small slowing of myopia progression

(iv) Medicated eye drops?
- Muscarinic receptor antagonists (atropine)
- Significantly less myopia progression
Myopia: Fact or Myth?
Myopia: Fact or Myth?

- Contact lenses cause more aberrations than spectacles for a high myope?
  
  **MYTH**
  
  - There are **LESS** aberrations experienced with contact lenses than spectacles b/c:
    - Lens moves with the cornea
    - Always stays centered in the middle of wearer’s gaze
    - Anti-reflective lenses help to reduce chromatic aberrations
Chromatic Aberrations

http://en.wikipedia.org/wiki/Chromatic_aberration
Myopia: Fact or Myth?

- Myopic specs were invented before hyperopic specs

MYTH
Early Use of Spectacle Lenses

- Emperor Nero, Rome 50 A.D.
  - Green emerald for watching gladiators fight
  - Sun protection?

- Magnifiers
  - 10th Century China
  - “Reading stones” used by Monks 1000 A.D.
  - 1268 England, Roger Bacon

- Eyeglasses
  - 1280 Italy

- Bifocal Lenses
  - 1760 Benjamin Franklin
History Buff?

- University of Waterloo
  - School of Optometry and Vision Science

- MUSEUM OF VISION SCIENCE

- https://uwaterloo.ca/museum-vision-science/
Myopia: Fact or Myth?

- Justin Timberlake is myopic

**FACT**

- “I’ve embraced it [his myopia]. Obviously I’ve made a commitment with these glasses. I’m good.”

  -on Jimmy Kimmel Live
Myopia: Fact or Myth?

- Ametropia and myopia are the same thing ... you say potato, I say poe-tay-to

**MYTH**

- Ametropia is a synonym of “Refractive Error”
  
  Myopia is a type of ametropia

... then what is “antimetropia”?  
  OD -2.00 DS / OS +2.00 DS
Myopia: Fact or Myth?

- Myopia is associated with a higher IQ.

FACT

- There has been found a relationship b/w
  - Myopia and IQ
  - Myopia and school achievement

Why?
- Myopic child adapted to reading which increases intelligence (and reverse)
- IQ testing is done at near, myopes have less eye strain
- A gene(s) may affect size of brain and eyes simultaneously
Myopia: Fact or Myth?

- Myopia is solely the result of how we use our eyes, **MYTH**

- Like many conditions, myopia develops due to a combination of genes and environment.
Myopia: Fact or Myth?

- High index lenses will reduce the edge thickness in myopic spectacles.

**FACT**

- Aspheric lenses will also help to decrease the edge thickness
- Remember AR when dispensing high index lenses
Myopia: Fact or Myth?

- Wearing glasses makes your myopia worse.
  
  MYTH
  
  - Research has demonstrated that wearing glasses to provide clear vision for distance does **NOT** cause more myopia
Myopia: Fact or Myth?

- “Minus” lenses for myopia minify the image viewed

FACT

Myopia: Fact or Myth?

- A high myope wearing spectacles may experience "barrel distortion" vision.

- A high hyperope wearing spectacles may experience "pincushion distortion" vision.

FACT
THANK YOU