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AN OVERVIEW OF MYOPIA DISEASE- DIAGNOSIS, AND MODERN SURGICAL INTERVENTIONS IN TERMS OF VISION

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ABSTRACT

Myopia, commonly known as near sightedness, has emerged as a significant global public health concern, with prevalence rates projected to affect 50% of the world's population by 2050. This review paper provides an extensive analysis of the disease, moving from its initial pathogenesis and symptomatology to advanced diagnostic techniques. A significant portion of this review is dedicated to modern refractive interventions, specifically laser vision correction (LASIK, PRK, SMILE), detailing procedural durations, recovery timelines, and post-operative protocols. Furthermore, the paper examines the necessity of spectacle prescription updates, nutritional influences on ocular health, and preventative strategies. This review aims to synthesize current literature to provide a holistic understanding of Myopia management in the 21st century.

KEYWORDS: Myopia, Refractive Error, LASIK, Photorefractive Keratectomy (PRK), SMILE, Axial Length, Diopters, Post-operative Care.

1. INTRODUCTION

The human eye functions similarly to a camera, where light must focus precisely on the retina to create a clear image. Myopia is a refractive error where parallel rays of light focus **in front of the retina** rather than directly on it [1-3]. This condition results in blurred distance vision while near vision remains relatively clear. The optical power of the eye is measured in Diopters.

The optical power of the eye is measured in Diopters (D). In a myopic eye, the relationship between focal length (f) and optical power (P) is defined as:

$$P=1/f$$

Where P is excessive relative to the axial length of the eye.

The global incidence of myopia is rising at an alarming rate, often referred to as the "myopia epidemic," particularly in East Asia. This introduction sets the stage for understanding the shift from myopia being a mere optical inconvenience to a potential cause of sight-threatening pathologies like retinal detachment and myopic maculopathy.

2. Literature Survey

Myopia, or **near-sightedness**, is a major global public health concern, characterized by light focusing **in front of the retina** due to excessive **axial elongation** of the eyeball. Current literature highlights its rapidly increasing prevalence, particularly in East Asia, where rates can exceed 80% in young adults. Projections suggest nearly **50% of the world's population** will be myopic by 2050. It carries significant risks of sight-threatening complications like retinal detachment, glaucoma, and myopic maculopathy [4-5]. Figure 1 shows the two conditions.

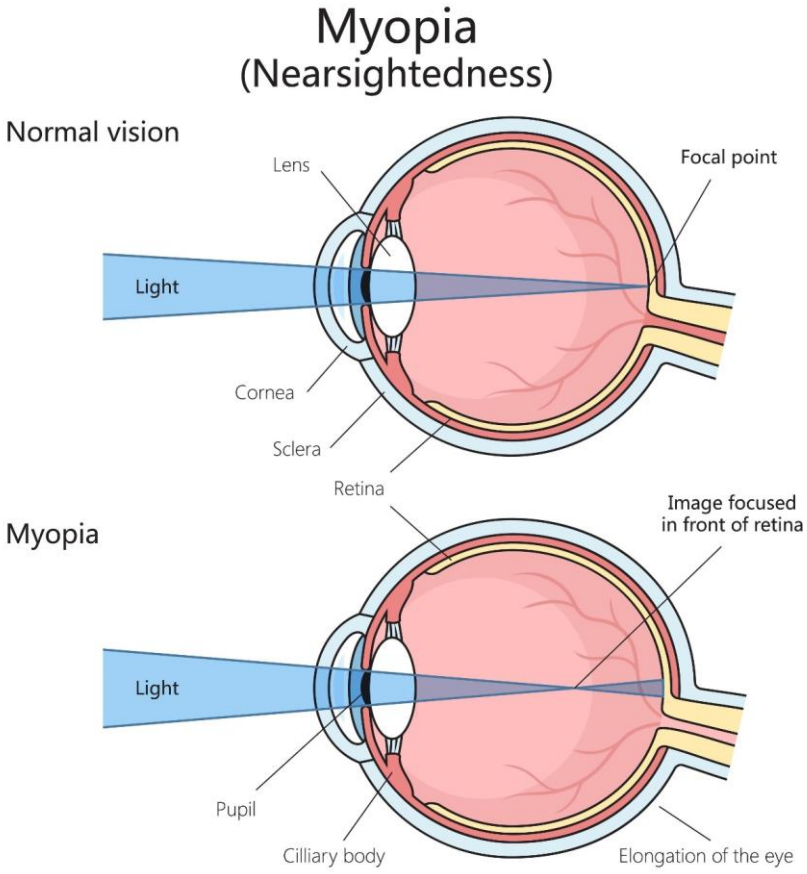

Figure 1 Normal VS Myopia Vision.

Ethology and Risk Factors

Research overwhelmingly points to a **multifactorial ethology** involving a complex interplay between genetics and environmental factors.

- **Genetic Predisposition:** A strong family history is a significant risk factor; children with **two myopic parents** have a substantially increased risk of developing the condition compared to those without [6].
- **Environmental Factors:** Lifestyle and education-related factors are major drivers of the recent epidemic. Studies consistently show a strong association between **prolonged, intense near work** (e.g., reading, screen time at close distances) and myopia onset and progression. Conversely, **increased outdoor time** during daylight hours is confirmed to have a protective effect per day often recommended to slow progression, likely mediated by light-stimulated **dopamine release** in the retina [7].

Management and Control Strategies

While traditional spectacles and contact lenses *correct* vision, they do not effectively *control* the underlying progression of axial length. Recent literature focuses on evidence-based **myopia control** strategies aimed at slowing the rate of eye growth in children and adolescents:

- **Optical Interventions:**
  - **Orthokeratology (Ortho-K):** Involves wearing rigid, gas-permeable lenses overnight to temporarily reshape the cornea. This induces **peripheral myopic defocus**, which is theorized to slow axial elongation [8-9].
  - **Specialty Contact Lenses:** Soft multifocal contact lenses and novel **defocus-incorporating spectacle lenses (D.I.M.S.)** also utilize peripheral defocus principles and have demonstrated significant efficacy in randomized controlled trials [10-14].
- **Pharmacological Intervention:**
  - **Low-Dose Atropine:** Daily topical administration of atropine eye drops at very low concentrations is one of the most effective known treatments, although its exact mechanism remains under study—it is thought to influence scleral remodelling and reduce axial.

A review of existing literature reveals a shift in the understanding of myopic progression.

- **Historical Context:** Early 20th-century studies focused largely on genetics. However, recent literature (2000–2023) emphasizes environmental factors, specifically the "near-

work hypothesis" (excessive reading/screen time) and the "outdoor light hypothesis" (lack of dopamine release due to insufficient sunlight exposure).

- **Surgical Evolution:** Literature tracks the evolution from Radial Keratotomy (RK) in the 1980s to the FDA approval of LASIK in the 1990s.
- **Recent Innovations:** Current studies focus on "Myopia Control" in paediatrics using low-dose atropine and Orthokeratology (Ortho-K), and the rise of Small Incision Lenticule Extraction (SMILE) as a minimally invasive surgical alternative.

In conclusion, the literature confirms that myopia is a rapidly escalating global crisis driven by modern lifestyles. The shift in focus from mere correction to aggressive myopia control using optical and pharmaceutical methods, combined with promoting behavioural changes like increased outdoor time, is crucial for mitigating the long-term vision-threatening risks associated with high myopia [15].

3. Myopia Initial: Pathogenesis and Onset

The "initial" phase of myopia, often called the onset, typically occurs during childhood (ages 6–14).

- **Axial Elongation:** The primary anatomical change is the elongation of the eyeball. Even a millimetre of extra length can result in significant refractive error.
- **Corneal Curvature:** In some cases, the cornea is too steeply curved relative to the length of the eye.
- **Genetic Predisposition:** Children with two myopic parents have a significantly higher risk ratio of developing the condition.

4. Initial Symptoms

Early detection is often hindered by a child's inability to articulate vision loss. Key initial symptoms include [16]:

1. **Distance Blur:** Difficulty reading the whiteboard at school or road signs.
2. **Squinting:** Partially closing the eyes to create a "pinhole effect," which temporarily sharpens focus.
3. **Asthenopia (Eye Strain):** Fatigue, sore eyes, or burning sensations after visual tasks.
4. **Headaches:** Often frontal, caused by the excessive accommodation effort.
5. **Night Myopia:** Difficulty seeing clearly in low-light conditions due to pupil dilation.

5. Detection of the Disease

Accurate diagnosis requires a comprehensive optometric or ophthalmologic examination.

- **Visual Acuity Test:** The standard Snellen chart is used to determine the baseline vision (e.g., 20/40 or 6/12).
- **Autorefraction:** A computer-controlled machine provides an objective measurement of the refractive error.
- **Retinoscopy:** An objective method where the doctor shines a light into the eye and observes the reflection (reflex) off the retina to determine the prescription.
- **Cycloplegic Refraction:** The use of eye drops (e.g., Cyclopentolate) to paralyze the ciliary muscle. This prevents the patient from "over-focusing" (accommodation) and reveals the true refractive error.
- **Axial Length Measurement:** Using optical biometry to measure the length of the eye, crucial for monitoring progression.

6. Modern Methods: Laser Surgery

For adults with stable myopia, refractive surgery is the gold standard for correcting vision.

A. LASIK (Laser-Assisted in Situ Keratomileusis)

- **Method:** A femtosecond laser creates a thin flap on the cornea. The flap is lifted, and an excimer laser reshapes the underlying stromal tissue to flatten the cornea. The flap is then repositioned.
- **Pros:** Rapid recovery, minimal pain.

B. PRK (Photorefractive Keratectomy)

- **Method:** The outer layer (epithelium) is mechanically removed or dissolved. The laser reshapes the cornea surface directly.
- **Pros:** Better for patients with thin corneas or contact sports athletes (no flap complications).

C. SMILE (Small Incision Lenticule Extraction)

- **Method:** A femtosecond laser carves a small lens-shaped disc (lenticule) *inside* the cornea, which is removed through a tiny incision.
- **Pros:** Least invasive, better preservation of corneal biomechanics.

7. Duration of Surgery

Contrary to popular belief, the surgical procedure is extremely fast.

- **Total Time in Operating Room:** Approximately 10–15 minutes for both eyes.
- **Active Laser Time:** The actual laser ablation usually takes only **10 to 40 seconds per eye**, depending on the severity of the prescription.

- **Preparation:** An anesthetic is a drug or substance used to cause temporary loss of sensation or awareness (anesthesia) for medical procedures, preventing pain by blocking nerve signals to the brain, and comes in forms like inhaled gases, IV injections, or topical creams, with general anesthesia causing unconsciousness, while local/regional types numb specific body parts. Anesthetic drops and setup take most of the time [17-18].

8. Prevention Process After Surgery (Post-Operative Care)

Success depends heavily on patient compliance immediately following surgery.

- **Immediate Restrictions (0–24 Hours):**
  - Keep eyes closed as much as possible for the first 4 hours.
  - Wear protective eye shields while sleeping to prevent accidental rubbing.
- **First Week:**
  - **No Water in Eyes:** Avoid tap water, swimming pools, and saunas to prevent infection.
  - **Medication:** Strict adherence to antibiotic and anti-inflammatory eye drops.
  - **No Eye Makeup:** To prevent particle contamination.
- **Long Term:**
  - UV Protection: Wearing sunglasses is critical to prevent corneal haze (especially in PRK).

9. Requirement of Change of Spectacle

In non-surgical management, the requirement to change spectacles depends on the rate of myopia progression.

- **Paediatric Patients:** Progression is rapid. Exams are recommended every 6 months.
- **Adult Patients:** Myopia usually stabilizes by age 21. If an adult experiences frequent prescription changes, secondary causes (e.g., cataracts or diabetes) must be investigated.
- **Post-Surgery:** Ideally, patients become spectacle independent. However, presbyopia (age-related reading blur) will still occur after age 40, requiring reading glasses.

10. Time to Recover

Recovery timelines vary by surgical method:

- **LASIK/SMILE:** "Wow" factor. Functional vision is often restored within **24 hours**. Most patients can drive and return to work the next day. Full stabilization takes 1–3 months.
- **PRK:** Slower recovery. The epithelial layer takes **3–5 days** to heal (often painful). Functional vision returns in 5–7 days, with visual fluctuations continuing for weeks.

11. Type of Food Restrictions and Diet

While there are no strict "food restrictions" that cure myopia, certain dietary habits support ocular health and recovery.

Dietary Recommendations

- **Vitamin A:** Essential for the retina (carrots, sweet potatoes).
- **Lutein and Zeaxanthin:** Protect the macula from blue light damage (spinach, kale, eggs).
- **Omega-3 Fatty Acids:** Critical for tear film stability, reducing dry eye symptoms after surgery (salmon, flaxseeds).
- **Glycaemic Control:** Some studies suggest diets high in refined sugars/carbohydrates may increase insulin levels, potentially affecting eyeball growth factors (IGF-1), leading to myopia progression.

12. DISCUSSION

The management of myopia has transitioned from a passive approach (simply prescribing stronger glasses) to an active one (myopia management and surgical correction).

The Surgical Debate: While LASIK is highly successful, it induces "Higher Order Aberrations" in some patients, leading to halos around lights at night. SMILE is emerging as a superior alternative for reducing dry eye incidence because it severs fewer corneal nerves.

The Public Health Angle: With the rise of digital devices, myopia is occurring earlier in life. This "high myopia" increases the lifetime risk of retinal detachment, glaucoma, and cataracts. Therefore, the focus of modern ophthalmology is not just on *correcting* vision via surgery but preventing high myopia in children through lifestyle changes (more outdoor time).

13. CONCLUSION

Myopia is a complex, multifactorial refractive error driven by genetic susceptibility and environmental triggers. While it begins with simple distance blur, its progression poses serious risks to long-term ocular health. Modern diagnostics allow for precise tracking of axial length, while refractive surgery (LASIK, PRK, SMILE) offers safe, rapid, and effective solutions for adults, with procedure times often under 15 minutes. However, post-operative care and long-term UV protection remain vital for surgical success. Future research must focus on stopping the progression of myopia in children to reduce the global burden of vision loss.

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