5.1 CONTACT LENSES

Contact lenses are one of the most common ophthalmic devices. Early contact lenses were made from polymethyl methacrylate (PMMA), which provides excellent optical clarity but has low oxygen permeability. Modern contact lenses are made from hydrogel polymers such as hydroxyethyl methacrylate (HEMA) and silicone hydrogels, which allow more oxygen to pass through to the cornea and provide greater comfort.

- Contact lenses are thin optical devices placed directly on the cornea of the eye.
- They are used to correct vision defects such as myopia (short-sightedness), hyperopia (long-sightedness), astigmatism, and presbyopia.
- Contact lenses are made from special biocompatible materials that are safe for use in the eye.
- The materials must provide clear vision, comfort, and adequate oxygen supply to the cornea.

Requirements of Contact Lens Materials

- Optical transparency for clear vision.
- High oxygen permeability to supply oxygen to the cornea.
- Good wettability to maintain tear film on the lens surface.
- Biocompatibility to avoid irritation or allergic reactions.
- Adequate mechanical strength and durability.
- Flexibility for comfortable wear.
- Chemical stability in tear fluid and cleaning solutions.
- Resistance to protein and lipid deposits.

Types of Contact Lens Materials

a) Hard Contact Lens Materials

- Early contact lenses were made from Polymethyl Methacrylate (PMMA).
- PMMA provides excellent optical clarity and good mechanical strength.
- **Advantages:** High durability, Good optical properties.
- **Disadvantages:** Very low oxygen permeability**,** Causes corneal discomfort.
- Due to these limitations, PMMA lenses are rarely used today.

b) Rigid Gas Permeable (RGP) Lens Materials

- Developed to improve oxygen permeability.
- Made from materials such as silicone acrylate and fluorosilicone acrylate.
- **Advantages:** Good oxygen transmission, Excellent optical quality, more durable than soft lenses.
- **Disadvantages:** Requires longer adaptation time for the wearer.

c) Soft Contact Lens Materials (Hydrogels)

- Made from hydrophilic polymers that absorb water.
- **Common material:** Hydroxyethyl Methacrylate (HEMA).
- Other materials include Polyvinyl Alcohol (PVA).
- **Advantages:** Flexible and comfortable, high-water content, better oxygen diffusion compared to PMMA.

d) Silicone Hydrogel Lenses

- Advanced modern contact lens materials.
- Combination of silicone and hydrogel polymers.
- Advantages: Very high oxygen permeability, Suitable for extended wear.

Applications of Contact Lenses

- Vision correction.
- Cosmetic lenses to change eye appearance.
- Therapeutic lenses to protect damaged cornea.

Contact lens materials have evolved from PMMA to hydrogel and silicone hydrogel polymers. Modern materials provide better oxygen permeability, comfort, and safety, making them widely used in ophthalmology.

2. INTRAOCULAR LENSES

Intraocular lenses (IOLs) are implanted in the eye to replace the natural lens removed during cataract surgery. These lenses are commonly made from PMMA, silicone, or acrylic polymers. These materials offer long-term stability, high transparency, and good compatibility with eye tissues.

Requirements of Intraocular Lens Materials

- High optical transparency for clear vision.
- Excellent biocompatibility to prevent irritation and inflammation.
- Chemical and biological stability inside the eye.
- Light weight and proper refractive index.
- Resistance to protein deposition.
- Mechanical strength and durability.
- Long-term stability without degradation.

Materials Used for Intraocular Lenses

- **Polymethyl Methacrylate (PMMA)**
    - One of the earliest materials used for IOLs.
    - Provides excellent optical clarity and rigidity.

- Requires a larger surgical incision.

- **Silicone**
  - Flexible material that allows folding of the lens.
  - Enables implantation through smaller incisions.
  - Good biocompatibility.

- **Acrylic Polymers**
  - Widely used modern IOL material.
  - Available as hydrophobic and hydrophilic acrylic lenses.
  - Provides excellent optical performance and stability.
- **Hydrogel Materials**
  - Soft and flexible materials with high water content.
  - Provide comfort and compatibility with eye tissues.

Types of Intraocular Lenses

- **Monofocal lenses** – provide clear vision at a single distance.
- **Multifocal lenses** – allow vision at multiple distances.
- **Toric lenses** – used to correct astigmatism.
- **Accommodative lenses** – designed to mimic natural lens focusing ability.

Advantages of Intraocular Lenses

- Restore clear vision after cataract surgery.
- Permanent solution with long-term stability.
- Reduce dependence on spectacles.
- High success rate and safety.

Intraocular lenses play a crucial role in modern ophthalmology. Advances in biomaterials such as PMMA, silicone, acrylic polymers, and hydrogels have improved the

safety, comfort, and performance of IOLs. These developments have significantly enhanced the quality of vision for patients undergoing cataract surgery.