“Biomechanics is the science of the internal and external forces acting on the human body and the effects produced by these forces”
The mechanical property of the tissue depends not only upon the inherent properties of its constituents but also upon how the constituents are arranged relative to each other.
CORNEAL BIOMECHANICS

shape trasparency
CORNEAL BIOMECHANICS

central thickness

IOP

age
CORNEAL BIOMECHANICS

stroma

lamellae

fibril orientation collagen network ↔ tissue mechanics
NORMAL CORNEA

posterior 2/3

- limbus to limbus
- limited anteroposterior interweave
- preferential directions
- circular or pseudocircular course at the limbus
NORMAL CORNEA

*anterior 1/3*

- preferred meridional arrangement
- extensive anteroposterior interweave
- insert into the Bowman’s layer at the limbus
NORMAL CORNEA

**anterior 1/3**  \(\rightarrow\) corneal shape

**posterior 2/3**  \(\rightarrow\) corneal strength

*(at the limbus)*

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NORMAL CORNEA

Interfibrillar adhesion

Interaction between the corneal fibrils and matrix proteins

- (type III, type I and V collagens and proteoglycans, dermatopontin, keratan sulfate, decorin…)

Stabilization of corneal lamellae

- keratocytes
1. **Altered organization of collagen**

2. **Abnormal matrix**
   - **Disrupted Bowman’s layer**
     - Fibronectin
     - Laminin
     - Entactin
     - Type IV collagen
     - Type II collagen (epith. basement membrane)
   - **Subepithelial fibrosis**
     - Type III collagen
     - Tenascin C
     - Fibrillin 1

3. **Keratocyte apoptosis**

*Not in the entire cornea*
*Not keratoconus specific*
4. Abnormal interaction between keratocytes and matrix

5. Abnormal keratocyte surface components


Yue BY, Baum JL, Smith BD. Identification of collagens synthesised by cultures of normal human corneal and keratoconus stromal cells. Biochim Biophys Acta 1983;755:318-25
Development of keratoconus

1. Tissue degradation or reduced maintenance
2. Slippage between collagen fibrils

**KERATOCONUS CORNEA**

*Development of keratoconus*

**main region of cone formation:**

*central and inferior regions*

**minimum interlamellar cohesive strength**

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Development of keratoconus

Biomechanical hypothesis

Corneal thinning and ectasia

= interlamellar and interfibrillar slippage of collagen, due to a loss of cohesion between collagen fibrils and noncollagenous matrix


**Development of keratoconus**

**Biomechanical hypothesis**

**Unraveling of**

- Anterior lamellae
- Posterior lamellae

- disinsertion from Bowman
- release from the limbus

- Lateral rearrangement
- Increased length
