SUMMARY

Biomechanics is concerned with the medical application of mechanical concepts. Eye biomechanic helps us to understand its normal function and predict changes in response to forces such as changes in IOP, and surgical intervention.

The ***cornea*** reacts to stress as a ***visco-elastic*** material. The cornea has numerous layers; each layer exhibiting different material behavior, all adding up to a complex material. The immediate elastic response seems to reflect the properties of the collagen fibers, and the steady state elastic response reflects the properties of the corneal matrix.

Since awareness of ***corneal biomechanics***; studies have renewed to measure such a property. A particularly interesting technique has emerged during the last few years; ***Ocular Response Analyzer** (**ORA**)*, that enables a dynamic measure for IOP including two applanation events, respectively. Theoretically, these two pressures should be the same, but this is not the case, which represents the resistance of the corneal tissue to applanation due to its visco-elastic properties. The difference between the inward and outward pressures is termed ***Corneal Hysteresis*** **(CH)** and is measured in millimeters of mercury. Hence, CH is a viscoelastic property that reflects the difference in behavior under loading and unloading. It is a function of corneal ***viscous damping*** properties, i.e. energy absorption capabilities.

Clinically, CH is applied in 3 impact areas**,** namely**;** 1. Glaucoma / OHT, for accurate trans-corneal IOP measurement. 2. Refractive surgery, for improved predictability. 3. Keratectasia, for accurate diagnosis & preventing iatrogenic ectasia.

It has potential uses in screening ***refractive surgery*** candidates and predicting / controlling outcomes. CH could provide a more accurate characterization of the biomechanical state than the measure of central corneal thickness (CCT). Corneal steepness (central-K), ACD, and spherical equivalent refraction did not affect CH.

There is significant reduction in post-LASIK hysteresis which may reflect changes in the viscous and elastic qualities of the post-LASIK cornea. This reduction in corneal hysteresis is not primarily a function of reduction in corneal tissue, but rather a result of a weakening of the structure due to the flap. So, it is recommended that the postoperative residual corneal thickness should remain thicker than three-quarters of the preoperative pachymetry. This will ensure that corneal biomechanical reactions are not excessively stressed. The femtosecond laser used in making uniformly thin corneal flaps demonstrated an increase in the safety of LASIK. It produced more predictable changes in corneal biomechanics with less induction of higher order aberrations.

Also, CH enables the calculation of a new pressure measurement called ***IOPCC*** (corneal compensated). This measurement is less influenced by corneal properties such as CCT and does not appear to drop artificially post-LASIK; hence its importance to measure IOP following refractive surgery procedures.

Corneal Hysteresis is affected also after *clear corneal cataract surgery*. At day one, after surgery, CH is diminished, whereas CCT is increased significantly. Postoperative corneal edema leads to a change of corneal visco-elastic properties, resulting in a lower damping capacity of the cornea.

A study for the biomechanical and refractive effects of different corneal transplant procedures showed that the model simulating the penetrating keratoplasty predicted more change in the post-operative corneal curvature than models simulating anterior lamellar keratoplasty or posterior lamellar keratoplasty. Posterior lamellar keratoplasty is preferable for obtaining a better corneal curvature profile.

Soft contact lens wear results in corneal swelling. However, there were no significant differences of CH at any time after lens wear. Regarding Orthokeratology; there was a trend toward a faster effect and faster recovery of the orthokeratologic effect for corneas with less resistance in terms of biomechanical properties. Higher values of CH meant slower effect and recovery of the orthokeratologic effect.

Corneal biomechanics can be used to identify and classify various **corneal pathologies**; depending on the biomechanical properties of corneal tissue. Glaucomatous subjects, compared to normal subjects, have a significantly lower average corneal hysteresis. Lower-than-average corneal hysteresis is also observed in patients who have been labeled normal-tension glaucoma subjects.

It is documented that corneal ectasia; has a *biomechanical abnormality* before any clinical, topographic or wavefront signs of ectasia. Targeting this abnormality may facilitate screening of at-risk patients for understanding pathogenesis, early detection.

Keratoconic eyes are known to be more elastic and less rigid than normal eyes. CH was significantly higher in normal than in keratoconic eyes. It may be a useful measurement in addition to CCT.

A new hope for the correction of keratectasia has been introduced, in the technique of riboflavin/ultraviolet-A (UVA) corneal cross-linking. This technique has introduced as a method of stiffening the biomechanically weakened collagen of keratoconus and postoperative ectasia after LASIK. The changes in CH, CR was assessed after intra-corneal ring segments implantation in keratoconic eyes. Although not statistically significant, they observed a slight increase in CH & CRF.