of the eye permits the calculation of a new biomarker. Furthermore, despite IOP is the only modifiable risk factor, recent publications highlighted the valuable role of another OBP, the ocular volume change (OVC), as valuable information in relation to the disease pathogenesis. Such OBP will define a new biomarker as result of the ocular volumetric response to a pressure input in a corresponding time frame. IOP and OVC have been considered until now separately as there is no device able to detect simultaneously variation in pressure and corresponding variation in volume monitoring continuously.

A primary object of the present invention is therefore to provide for a device and a method capable of measuring two different OBPs, such as but clearly not limited to direct IOP, temperature and optionally eye's dimensional variation simultaneously, because the measurement conditions can vary from one measurement to the other one, so inventors have explored for a new device for simultaneously or consecutively measuring and monitoring two OBPs.

In the present application the term simultaneously means that the measured OBPs are measured during the same time interval regardless of the exact arrival time of each signal to the recording device. Even if there is a slight time phase between the two signals (few seconds or less) simultaneously means that the OBPs are measured during a single measurement period of time. On the other hand, the term consecutively means measuring a first OBP alone and then, without replacing the measuring and monitoring device, measuring a second OBP once the first measurement is completed.

In the present invention, ocular biomechanical properties (OBP) relate to parameters/properties such as intraocular pressure (IOP), intraocular volume (IOV), corneal rigidity, corneal thickness, sclera rigidity, geometrical dimensions and/or temperature of the eye and more generally any ocular property.

CLAIMS

1. Ocular biomechanical property (OBP) measuring and monitoring device comprising a contact lens presenting an inner surface and an outer surface and a sensing unit, said sensing unit being united with said contact lens such that it is applied against an eye of a user for sensing at least a first OBP and a second OBP of said eye when said contact lens is worn by said user, said sensing unit being adapted to measure simultaneously or consecutively the first and second OBPs and transmit these OBPs to a CPU such that said CPU receiving said measurement is able to determine at least one new biomarker based on a combination between at least these two OBPs.

2. OBP measuring and monitoring device according to claim 1 characterized in that the sensing unit comprises a single sensor capable of measuring at least two different OBPs.

3. OBP measuring and monitoring device according to claim 1, characterized in that the sensing unit comprises at least two single sensors each capable of measuring a single OBP.

4. OBP measuring and monitoring device according to claim 3, characterized in that the at least two single sensors are each capable of measuring a single OBP different from each other.

5. OBP measuring and monitoring device according to any one of preceding claims, characterized in that the first OBP is the intraocular pressure and the second OBP is the eye's temperature or the eye's dimensional variation.

6. OBP measuring and monitoring device according to claim 5 when dependent on claim 3 or claim 4, wherein the sensing unit comprises an eye's dimensional variation sensor as one or several active strain gauge presenting a circular or arc shape and is situated in an outer portion around the inner portion of said contact lens.

7. OBP measuring and monitoring device according to claim 6, wherein said strain gauge is a continuous longitudinal element made of a resistive material, such as a metal or an alloy.

8. OBP measuring and monitoring device according to claims 6-7, wherein the eye's dimensional variation sensor comprises four gauges in a Wheatstone bridge configuration, such as two active gauges and two passive ones being placed alternatively on the bridge.

9. OBP measuring and monitoring device according to any one of claims 1, 3, 4, 5 when dependent on claim 3 or claim 4, and 6 to 8, characterized in that the sensing unit comprises a direct pressure sensor.

10. OBP measuring and monitoring device according to claim 9, characterized in that the contact lens is a soft contact lens comprising an inner portion and an outer portion, said inner portion being more rigid than said outer portion.

11. OBP measuring and monitoring device according to claim 10, characterized in that the direct pressure sensor is located in said inner portion.

12. OBP measuring and monitoring device according to claim 10 or 11, wherein the inner portion is adapted to maintain said inner surface with a curvature radius adapted to flatten at least a portion of the eye surface in contact with the direct pressure sensor so as to reach a pressure equilibrium around the direct pressure sensor when said contact lens is worn by said user.

13. OBP measuring and monitoring device according to claims 10-12, characterized in that the inner portion has a general shape similar to a meniscus lens.

14. OBP measuring and monitoring device according to claims 10-13, characterized in that the inner portion is smaller in dimension compared to the outer portion and is centered in the contact lens.

15. OBP measuring and monitoring device according to claims 10-14, characterized in that the inner portion comprises a rigid insert.

16. OBP measuring and monitoring device according to claim 15, characterized in that the rigid insert comprises a plurality of through holes.

17. OBP measuring and monitoring device according to claim 15 or 16, characterized in that the rigid insert is made of a material chosen in the group of polymers, biopolymers, ceramics, glasses, metals and RGP and/or the outer portion

of said contact lens is made of a material chosen in the group of hydrogels, silicone-hydrogels and silicones.

18. OBP measuring and monitoring device according to claims 10-17, characterized in that any one of the inner portion and the outer portion of said contact lens is made of a material having a tunable stiffness or a stiffness gradient.

19. OBP measuring and monitoring device according to claims 15-18, characterized in that the pressure sensor is in direct contact or in indirect contact with the eye of the user and is located within a cavity formed in an inner concave side of the rigid insert, and wherein the cavity is filled with a pressure transmitting filler material that covers the pressure sensor such that a layer of the filler material is located between the pressure sensor and the inner surface of the contact lens.

20. OBP measuring and monitoring device according to claim 19, characterized in that the filler material is a material softer than the inner portion and/or the outer portion or is the same material as the material of the outer portion.

21. OBP measuring and monitoring device according to claims 19-20 characterized in that the cavity is formed in the inner portion.

22. OBP measuring and monitoring device according to claims 19-21, characterized in that the inner surface of the contact lens beneath the cavity presents a surface softness softer or similar than the rest of the inner surface beneath the inner portion.

23. OBP measuring and monitoring device according to claim 1, characterized in that the sensing unit comprises a plurality of sensors adapted to measure the same OBP.

24. Kit comprising:

- an OBP measuring and monitoring device according to any one of claims 1 to 23;

- a portable recording device configured for communicating with said OBP measuring and monitoring device and for storing data received from said OBP measuring and monitoring device.

25. OBP monitoring system comprising:

- an OBP measuring and monitoring device according to any one of the claims 1 to 23;

- a portable recording device configured for communicating with said OBP measuring and monitoring device and for storing data received from said OBP measuring and monitoring device;

- a computing device configured for communicating with said portable recording device for receiving and/or processing and/or storing data received from said portable recording device.

26. OBP monitoring system according to claim 25, wherein the OBP monitoring system comprises two OBP measuring and monitoring devices, one for a left eye, one for a right eye, and the portable recording device is configured for communicating with the two OBP measuring and monitoring devices and for storing data received from the two OBP measuring and monitoring devices.

27. OBP measuring and monitoring method comprising placing a contact lens on an eye of a user, said contact lens presenting an inner surface and an outer surface and a sensing unit, said sensing unit being united with said contact lens such that it is applied against an eye of a user for sensing at least a first OBP and a second OBP of said eye when said contact lens is worn by said user, simultaneously or consecutively measuring the first and second OBPs with said sensing unit and transmitting these OBPs to a CPU such that said CPU receiving said measurement carries out a biomarker determining step where it determines at least one new biomarker based on a combination between at least these two OBPs.

28. OBP measuring and monitoring method according to claim 27, comprising the steps of measuring a temperature of the eye and use the temperature for running a fine tuning of the OBP measurements.