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(54) **Title**: A METHOD AND A SYSTEM FOR LASER PHOTOABLATION WITHIN A LENS

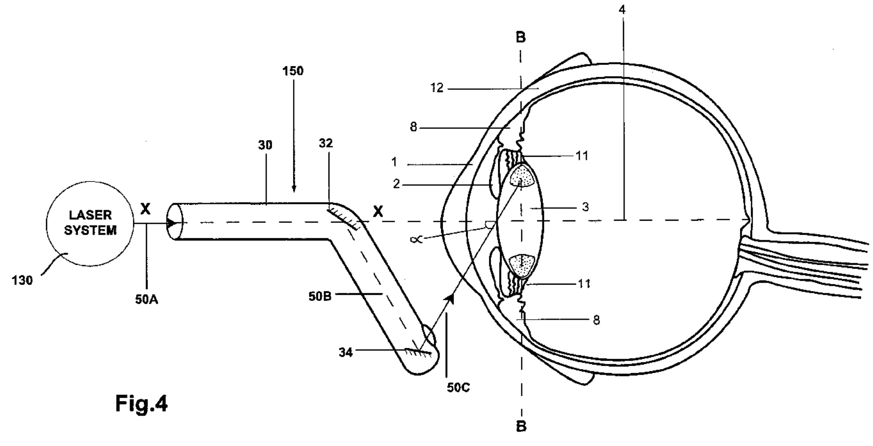

Fig.4

(57) **Abstract**: The present invention provides a method for ablating a presbyopic lens for restoring accommodation in human eye and a system thereof wherein a laser beam is directed obliquely to carry out multiple photoablations in circular way within the lens behind the iris and preferably near the edge or equator of the lens and/or in the vicinity of zonules to re-establish accommodation of the lens lost due to presbyopia.

AMENDED CLAIMS
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1. A method for restoring accommodation of a lens having vision defect/problem such as Presbyopia in eye, said method comprising steps of:

   surveying a lens to be treated;

   establishing accommodation amplitude for the lens;

   estimating actual accommodation amplitude for the lens and determining the volume of the lens proteins to be photoablated;

   dividing the lens into parallel coronal planes;

   locating a zone for photoablation within the lens behind the iris;

   selecting a coronal plane for photoablation;

   directing an incidental laser beam obliquely at a predetermined angle towards the coronal plane behind the iris to bring out a spot photoabaltion within the selected zones behind the iris; and

   performing plurality of spot photoablation in substantially circular way on the coronal plane behind the iris within the selected zone thereby reducing the coronal diameter and thickness at sub-equatorial region of the lens causing reduction in circumlental crowding in the sub-cialiary region of the eye including crowding of zonular fibers resulting tensing of zonular fibres thereby re-establishing accommodation in the eye of the ocular lens.

2. A method as claimed in claim 1 further comprising step of selecting further coronal plane anterior or posterior to the said coronal plane for photoablation behind the iris and photo-ablating in toroidal way in the selected zone depending on volume of the lens proteins to be removed.

3. A method as claimed in claim 2 wherein the further coronal plane is preferably selected anterior to the photoablated coronal plane.

4. The method as claimed in claim 2 wherein distance between the two adjacent coronal planes is about 20 microns.

5. A method as claimed in claim 1 wherein the photoablation is preferably carried from posterior to anterior.

6. A method as claimed in claim 1 wherein directing incidental laser beam obliquely step comprises steps of

matching central axis of the laser system with the central axis of the lens; and

directing laser beam and pulsing the laser beam on periscopically arranged mirrors to direct laser beam obliquely toward the zones selected behind the iris.

7. A method as claimed in claim 1 or 6 wherein the laser beam is directed obliquely at an angle between 15 and 75 degrees to carry photoablation within the lens behind the iris of the eye.

8. A method as claimed in claim 1 wherein the zones to be photoablated are selected preferably near the edge or equator of the lens and/or in the vicinity of zonules.

9. A method as claimed in claim 1 wherein selecting a coronal plane atleast 50 microns away from the anterior of the lens.

10. A method as claimed in claim 1 or 2 wherein photo-ablating zone is at least 50 microns within the lens away from the equator of the lens and 2mm from the central axis of the lens.

11. A method as claimed in claim 1 wherein distance between the two adjacent photoablated spots in the same coronal plane or parallel coronal planes is about atleast 10 microns.

12. A method as claimed in claim 1 wherein the laser beam emitted has pulse duration of laser beam not exceeding 500 femto-second.

13. A method as claimed in claim 1 wherein fluence of the laser beam is between 3-15 Joules per sq. cm and a repetition rate is in excess of 100 Kilo Hz.

14. A method as claimed in claim 1 wherein the laser beam emitted has a diameter between 4 to 100 microns.

15. A method as claimed in claim 1 wherein laser beam emitted has preferably diameter between 4 to 20 microns.

16. A method as claimed in claim 1 wherein volume of the lens proteins to be removed is calculated for one year by formula I:

Formula I = = $\chi \pi r^2$

Wherein

χ = growth rate of the lens per year

r = radius of the normal lens.

17. A method for restoring accommodation of a presbyopic lens in eye, said method comprising steps of:

obtaining a three-dimensional image of the lens;

selecting a zone for ablating behind iris of the eye;

ablating the said zone by passing a laser to reduce the coronal diameter and thickness at sub-equatorial region of the lens for re-establishing accommodation in the eye of the ocular lens.

18. A method as claimed in claim 17 wherein the zones to be photoablated are selected preferably near the edge or equator of the lens and/or in the vicinity of zonules.

19. A method as claimed in claim 17 wherein said three-dimensional image is obtained by surveying coherence optical tomography system including but not limited to Optical Coherence Tomography system (OCT) including ultrasound imaging, magnetic resonance imaging, electromagnetic radiation based on tomographic or photonic imaging apparatus.

20. A system for performing photoablation of a lens having vision defect/problem such as Presbyopia, said system comprising:

    a. a means for surveying the lens and anterior parts thereof for establishing and estimating actual accommodation amplitude for the lens and to select a zone for photoablation within the lens behind the iris;

    b. a laser system for ablating within the lens; and

    c. a means for monitoring and controlling the photoablation process in real time;

    characterized in that

    said system comprises

    d. a means to direct adapted rotatably on the laser system for diverting a laser beam obliquely at a predetermined angle with the central axis within the lens behind the iris for photo-ablating the selected zone behind the iris to re-establish accommodation in the eye of the ocular lens.

21. A system as claimed in claim 20 wherein means to direct comprises an articulated arm tube rotatable about an axis and atleast two mirrors adapted periscopically in the said tube wherein first mirror receives the incident laser beam and directs towards the second mirror, which reflect the laser beam obliquely towards the zone selected behind the iris for photoablation.

22. The system as claimed in claim 21 wherein second mirror is adapted pivotally movable to direct the laser beam at the selected zone.

23. The system as claimed in claim 22 wherein a means to direct directs the laser beam at an angle between 15 and 75 degrees.

24. The system as claimed in claim 20 wherein a laser beam emitted has pulse duration of laser beam not exceeding 500 femto-second.

25. The system as claimed in claim 20 wherein fluence of the laser beam is between 3-15 Joules per sq. cm and a repetition rate is in excess of 100 Kilo Hz.

26. The system as claimed in claim 20 wherein the laser beam emitted has a diameter between 4 to 100 microns.

27. The system as claimed in claim 20 wherein the laser beam has a diameter about 4 to 20 microns.

28. The system as claimed in claim 20 wherein a means for surveying is a surveying coherence optical tomography system such as Optical Coherence Tomography system (OCT) including ultrasound imaging, magnetic resonance imaging, electromagnetic radiation based on tomographic or photonic imaging apparatus.