

Eye Lens and Cornea Surgery with Femtosecond Laser

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(a) Background on the innovations:

1a. Correction of presbyopia with ultra-short pulse laser. The present invention relates to an apparatus and a procedure for use in human ophthalmic surgery. More specifically, the present invention pertains to the method of using ultrashort laser pulses (from about 100 femtoseconds long, where 1 fsec = 10^{-15} sec, up to 10 picoseconds long, where 1 psec = 10^{-12} sec) for restoring accommodation in the case of presbyopia, by removing tissue from the lens capsule of an eye, and refilling the eye capsule with polymeric material that has suitable material properties and refractive coefficient.

2a. Reshaping the human eye cornea. The invention is on reshaping the human eye cornea by ablation of thin layers of corneal tissue using **an ultra-short pulse laser without surgical intervention**. This invention is intended to replace the current LASIK (Laser-Assisted *In Situ* Keratomileusis) method/procedure, which uses excimer lasers and requires surgical intervention to cut a flap in the cornea.

(b) A description of the innovation:

1b. Correction of presbyopia:

There are at least three principal and important advantages of using ultrashort laser pulses for eye surgery. One advantage is that it is possible to perform much higher precision tissue cuts with such lasers when compared with nanosecond-type lasers. A second advantage is that ultrashort laser pulses produce much smaller heating effects in tissue when compared with longer laser pulses. A third advantage is that ultrashort laser pulses produce only very weak shock waves in tissue, whereas longer laser pulses produce very substantial shock waves resulting in considerable trauma. In eye surgery, this trauma can have substantial negative effects on the prognosis following surgery.

2b. Reshaping the cornea: The position of the femtosecond laser beam and the number of laser pulses directed at one spot within the cornea are controlled by a computer program which includes laser calibration data and patient specific calibration data.

(c) Potential commercial applications: **Through start-up company**

(d) Status of the work and future plans: Work is being conducted at Princeton University (PU) and NJ School of Medicine and Dentistry (UMDNJ) for more than 6 years. Five Faculty Members and their groups are working on development of these inventions : laser eye surgery - Prof. Hersh, MD (UMDNJ), eye physiology - Prof. Frederikse (UMDNJ), polymerization - Prof. Register (PU-ChE), fluid removal and computation - Prof. Smits(PU-MAE), and ultra-short pulse lasers - Prof. Suckewer (PU).

Status of Patent Applications and Disclosures: we have already Provisional Patents on **Presbyopia and Cornea Reshaping** („FsecLASIK”)(Patent Applications in preparation), and Patent Disclosures on **Hydrogel Bandage** and **Soft Lenses Reshaping**.

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