

# **Applications of Femtosecond Laser in Corneal and Refractive Surgery**

*Essay*

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# تطبيقات ليزر الفيمتو ثانية في جراحات القرنية و تصحيح الأخطاء الإنكسارية

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## **ABBREVIATIONS**

**AC:** anterior chamber

**AK:** astigmatic keratotomy

**AL:** applanation lens

**ALK:** anterior lamellar keratoplasty

**AMO:** Advanced Medical Optics

**BCVA:** best corrected visual acuity

**BDD:** beam delivery device

**BSCVA:** best spectacle corrected visual acuity

**CCT:** central corneal thickness

**CL:** contact lens

**CPD:** cycle per degree

**CQ:** clinical quality

**CS:** Contrast sensitivity

**CXL:** Collagen Cross-linking

**D:** dioptre

**DALK:** deep anterior lamellar keratoplasty

**DIC:** differential interference contrast

**DLEK:** deep lamellar endothelial keratoplasty

**DLK:** diffuse lamellar keratitis

**DSAEK:** Descemet stripping automated endothelial  
keratoplasty

**DSEK:** Descemet stripping endothelial keratoplasty

**EK:** endothelial keratoplasty

**FDA:** Food and Drug Administration

**FLEX:** femtosecond lenticule extraction

**FLK:** femtosecond laser keratomileusis

**FS:** femtosecond

**FSL:** femtosecond laser

**HOAs:** high order aberrations

**ICRS:** Intrastromal corneal ring segments

**IOLs:** intraocular lenses

**IOP:** intraocular pressure

**IRIS:** Intra-tissue Refractive Index Shaping

**J:** joule

**KHz:** kilo hertz

**KP:** keratoplasty

**LAR:** laser arcuate wedge shaped resection

**LASIK:** laser in situ keratomileusis

**LIOB:** laser induced optical breakdown

**LK:** lamellar keratoplasty

**mJ:** milli joule

**MHz:** mega hertz

**MK:** microkeratome

**mm:** millimeter

**n:** nano

**Nd:** neodymium-doped

**Nd: YAG:** neodymium-doped yttrium aluminium garnet

**Nd: YLF:** neodymium-doped yttrium lithium fluoride

**nJ:** nanojoul

**nm:** nanometer

**ns:** nanosecond

**OBL:** opaque bubble layer

**OCT:** optical coherence tomography

**PCT:** peripheral corneal thickness

**PK:** penetrating keratoplasty

**PLD:** posterior lamellar disc

**PLK:** posterior lamellar keratoplasty

**PMCD:** Pellucid marginal corneal degeneration

**PMMA:** poly methyl methacrylate

**PRK:** photorefractive keratectomy

**ps:** picoseconds

**RI:** refractive index

**S:** second

**SBK:** Sub-Bowman's Keratomileusis

**SD:** standard deviation

**SEM:** scanning electron microscope

**SMILE:** Small-Incision Lenticule Extraction

**SRA:** suction ring assembly

**TLSS:** transient light sensitivity syndrome

**μ:** micron

**UCVA:** uncorrected visual acuity

**μJ:** microjoul

**μm:** micrometer

**US:** United States

**VA:** visual acuity



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## Introduction

**Femto-** (symbol **f**) is a prefix in the metric system denoting a factor of  $10^{-15}$  or 0.000000000000001. Adopted by the 11th *Conférence Générale des Poids et Mesures*, it was added in 1964 to the *SI (Système international d'unités)*. It is derived from the Danish word *femten*, meaning "fifteen". While Ahmad H. Zwail the famous Egyptian scientist, won the Noble prize in 1999 for his work on femtochemistry. (**Wikipedia online**)

The development of the Ruby laser almost a half-century ago by T. H. Maiman was an epiphany that opened up wide new vistas in ophthalmology, resulting in a flood of practical clinical applications of lasers in eye surgery (**Soong and Malata, 2009**).

Ultra short pulse generation remains the subject of active research. Rapid progress in this field has led to the creation of practical and useful lasers that can now produce pulses on the femtosecond FS ( $10^{-15}$  s) time scale (**Wayne and Knox, 2000**)