FEMTOSECOND LASER IN CORNEAL SURGERY

Essay
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Summary

One recent and interesting technical development in laser refractive surgery is the emergence of ultrashort pulse lasers. The femtosecond laser is a focusable infrared laser using pulses in the femtosecond (10-15 s) duration range. This laser delivers closely spaced spots that may be focused at a preset depth to photodisrupt tissue within the corneal stroma.

Flap creation for LASIK represents the first clinical application of the femtosecond laser. The potential advantages of the femtosecond laser over the microkeratome include precise flap thickness, increased postoperative stability of the flap, and reduced incidence of flap complications, such as buttonholes, epithelial abrasions, short flaps, free caps, blade marks, and irregular cuts.

A femtosecond laser provides an effective and safe procedure for LASIK treatment of myopia. This technology also improves contrast sensitivity and avoids the negative effect on visual performance found after microkeratome LASIK. Such improvements in visual quality after LASIK with the femtosecond laser are related to the differences in postoperative corneal higher-order aberrations found with femtosecond and microkeratome flap creation.

Femtosecond LASIK complications are rare, but include unique problems, such as interference of surgery by cavitation gas bubbles during treatment and the transient light-sensitivity syndrome (TLSS) after surgery.

The femtosecond laser has several advantages over the mechanical method for Intacs channel creation in treatment of keratoconus, post-LASIK keratectasia and pellucid marginal corneal degeneration. Because laser energy is delivered optically to a precise depth, tunnel resections and entry incisions are highly reproducible, with little risk of corneal perforation. Also, the channel size and depth as well as the side-cut position may be changed as desired. There are, however, some limitations that must be improved.

The FS laser is capable of creating straight trephination cuts or complex-pattern trephination cuts for enhanced wound integrity of the graft-host junction. The latter includes the “top-hat” (with a larger diameter cut posteriorly), the “mushroom” (with a larger diameter cut anteriorly), the tongue-groove, the zig-zag, and the “Christmas tree” patterns. The mushroom may be advantageous in keratoconus by providing a larger anterior refractive surface, while the top-hat may be advantageous in endothelial diseases by replacing more endothelial cells.

The patterned trephination is thought to not only increase the strength and structural integrity of the graft host junction, but to also reduce the number of requisite sutures, lessen the amount of astigmatism, and possibly shorten the time of visual recovery.

The femtosecond clinical laser is yet another innovation that can be programmed to produce bladeless corneal lamellar cuts at any depth with accompanying trephination cuts of desired

diameters in both anterior LKP and posterior LKP. This laser may also be used for donor tissue cutting in Descemet's stripping automated endothelial keratoplasty (DSAEK), significantly reducing its technical difficulty and improving the cut precision

The FS laser may be utilized in arcuate keratotomy and/or wedge resection for the correction of high astigmatism following PKP or cataract surgery. Laser-based corneal astigmatic surgery is easier, is more precise, and carries less risk of corneal perforation than the free-hand diamond blade method.

The FS laser may be used to cut a lenticule of central corneal stroma using intrastromal photodisruption with or without a flap (all–FS laser treatment of myopia) or to cut a toroid of midperipheral stroma (all–FS laser treatment of hyperopia).

The use of a FS laser microkeratome to aid in the creation of corneal pockets for the insertion of biopolymer keratoprostheses in human eye bank corneas has been studied.

The FS laser can be used for obtaining diagnostic corneal biopsies in suspected infectious keratitis