Recent Advances in Femtolaser Technology for Corneal Surgery

BY ANTON C. WIRTHLIN, PhD

In recent years, using a femtosecond laser has become an accepted standard for a variety of lamellar corneal surgery applications, particularly in LASIK surgery. To a lesser degree, femtolasers are also in routine use for the creation of intrastromal tunnels (for insertion of intrastromal ring segments), pockets (for corneal inlays), and lamellar keratoplasty. Use of femtosecond lasers in penetrating keratoplasty has also been reported in the literature.

The attention of researchers and clinicians has recently begun to shift away from corneal applications and toward the use of femtosecond lasers in cataract surgery and other applications focusing on the crystalline lens, such as the treatment of presbyopia. These types of applications hold significant promise due to the large number of cataract and presbyopia cases that are potentially amenable to femtosecond laser treatment. The manufacturers and researchers currently active in this field are mainly focusing their activities on developing optics and delivery systems that permit dissecting lens tissue using established femtosecond laser technology, characterized by high laser energy and pulse power (>5 µJ) at moderately short pulse lengths (>500 fs) and moderate pulse frequencies (<500 kHz).

Based on this high-power, low-frequency technology, manufacturers and users of femtosecond lasers are also promoting novel “femtolaser-only” corneal procedures. These procedures that consist of shaping the cornea to achieve presbyopic correction by applying vertical, concentric incisions with the femtosecond laser or dissecting stromal lenticules to achieve refractive (myopic) corrections have also garnered a lot of attention because they seem to promise potential commercial benefits by enabling refractive surgery without an excimer laser.

A fundamental problem with
These procedures may be that the underlying high-power, low-frequency laser technology is not capable of delivering the precision, predictability, and reproducibility required for viable refractive procedures. Poor focus and large cavitation bubbles cause aberrations and insufficient predictability of refractive outcomes and cannot therefore currently compete with established refractive procedures such as femto-LASIK. Some of these procedures may be rather short-lived, soon to be replaced by newer, “even better” modifications.

Although Ziemer Group (Port, Switzerland) has refrained from promoting speculative applications, its research and development engineers have continued to develop and optimize the fundamental technology.

For more information on Ziemer’s products, visit www.ziemergroup.com.

Anton C. Wirthlin, PhD, is the senior vice president of Ziemer Group AG, Port, Switzerland. Dr. Wirthlin may be reached at +41 32 332 7052; anton.wirthlin@ziemergroup.com.