GUEST EDITORIAL

Femtolaser Cataract Surgery: How to Evaluate This Technology, Read the Literature, and Avoid Possible Complications

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Femtosecond laser use in cataract surgery is a rapidly evolving technology and is attracting great attention worldwide because cataract procedures are the most frequently performed surgery within ophthalmology. Our group published the first clinical studies in 2009; since then a number of publications, including the article by Conrad-Hengerer et al in this issue of the Journal of Refractive Surgery, have appeared in the peer-reviewed literature, and an abundance of nonpeer-reviewed “information” has become available for surgeon and patient alike.

In the past 30 years more development has occurred in ophthalmology than during the previous 1000 years, from intracapsular cataract extraction to the extracapsular cataract technique to the eventual acceptance of phacoemulsification as the standard technique for cataract surgery. The description of central continuous circular capsulotomy (CCC) by Neuhann and Gimbel provided surgeons with a good, safe, and reasonably reproducible method for safer cataract surgery. However, CCC is executed manually and its accuracy and reproducibility are inherently limited by surgeon variability. As patient demands have increased, the importance of effective lens position (ELP) has increased dramatically. New technology intraocular lenses (IOLs), including aspheric, toric, and multifocal IOLs, have also driven this need for improved ELP. A reproducible central and circular capsulorrhexis is a prerequisite for good postoperative ELP. Irregular capsulotomy might cause refractive surprises such as myopic or hyperopic shifts, unwanted surgically induced astigmatism (SIA), posterior chamber lens tilt, increase in higher order aberrations, and glare and halo phenomena as well.

Once the problem of optically and efficiently delivering the femtobeam into the eye was solved, a successful central and guaranteed capsulorrhexis diameter became available. Moreover, effective fragmentation of the crystalline lens up to cataract grade +4.0, liquefaction of softer lenses with or without cataract, and corneal wound creation together with arcuate keratotomy for preoperative corneal astigmatism have been developed and recognized by official authorities such as the United States Food and Drug Administration, CE mark in Europe, and ophthalmologists worldwide.

The femtosecond laser has made its great entrance into cataract surgery and is rapidly becoming an accepted, if not yet fully established, surgical technique. Based on more than 4 years of personal experience and having performed more than 1000 femtosecond laser cataract cases, I would like to share my personal thoughts, experiences, and concerns about this new technology as we move forward.

CRITICALLY REVIEW THE LITERATURE AND “DATA”

Femtosecond laser–assisted cataract surgery is a rapidly developing and changing technology, but it is still in its infancy. Large, devoted teams are working on more efficient capsulotomies and lens fragmentation processes, including optimal geometrical fragmentation patterns and liquefaction to reduce the energy needed for phacoemulsification, to reduce SIA and to develop better nomograms to increase the predictability of arcuate keratotomy. None of these elements of the procedure are yet perfected. Large volumes of scientific and promotional articles in this field will be disseminated in the near future; read them carefully, filter out suspiciously perfect results if they are not based on a high number of eyes and longer follow-ups, and if they are not stringently peer-reviewed. If an article reports an ideal outcome was achieved in at least 95% to 100% of eyes studied, doubts should arise in the reader’s mind, especially if/when other manufacturers/companies have published lower success rates. In a developing technology, results exclusively above 95% success rate are possible, but usually not realistic.

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RESPECT THE SURGICAL LEARNING CURVE

For all surgeries and all surgeons, a certain learning curve exists for any new technique. Everyone should acknowledge and respect stricter adherence to particular standards and rules during the learning curve, which in my experience appears to be approximately 30 to 50 eyes, depending on the dexterity of the surgeon and type of femtosecond laser utilized. After overcoming this initial learning process, some variations in surgical technique may be implemented successfully.

Before operating, patients should be screened for ocular surface issues that could complicate the laser docking and use. The corneal surface needs frequent wetting, especially in cases where the docking is tried multiple times, as can happen for the less experienced surgeon. Patients with recurrent epithelial erosions are not good candidates for initial femtosecond laser-assisted treatments due to the risk of epithelial sloughing, and severe diabetic patients might also have less healthy epithelium. In these cases, special attention is needed to insert the patient interface quickly and efficiently to minimize the risk of epithelial trauma.

Corneal wounds should be well designed before surgery to avoid tension and rupture intraoperatively, which could result in increased SIA and wound leak. Wounds created with the femtosecond laser seem to be tighter compared to ones created with blades. Beginning surgeons should check wound edges during opening of the wound with the specific blunt tipped spatula to ensure full opening prior to proceeding.

I recommend following the contour of the capsulotomy created by the femtosecond laser until it is clear that the anterior capsule is fully detached and free-floating in the anterior chamber. Small tags or bridges may not be apparent to the inexperienced surgeon, and an anterior tear might occur with resulting unwanted complications if this is not recognized, including capsular blockage syndrome with posterior capsular tear, which can arise from issues with anterior capsule removal or abrupt hydrodissection with a large cannula as opposed to smooth hydrodissection with a small diameter cannula. The “rock-and-roll” technique is also useful to avoid this complication: following smooth hydrodissection, the nucleus is gently pressed down and rolled, allowing intralenticular gas bubbles to escape toward the anterior chamber. In the future, eyes with cataract grading <3.0 may not require hydrodissection; however, hydrodissection, even with soft lenses, remains mandatory at the present time.

Femto-fragmentation might use a laser beam cross pattern or multiple cuts within the lens (6, 8, or more) referred to as a “cake-pattern” or “pizza-pattern.” Cubicles might also be formed within the nucleus. The diameter of lens fragmentation is important because of the biconvex shape of the lens to avoid posterior capsular damage. Two main planes are recommended, as surgeons should divide the lens into quadrants to facilitate phacoemulsification. In cubicule formation, if the lens is not fragmented, a nuclear or epinuclear “bowl” might be the consequence, which can be difficult to remove. Presently, I prefer a “hybrid” pattern, with a central 3.0-mm diameter liquefaction and a cross or pizza-pattern fragmentation at the periphery. This fragmentation model helps reduce phacoemulsification energy and makes chopping of the crystalline lens easier.

Femtosecond lasers should create wounds that do not need hydration at the end of surgery. However, this must be checked and not assumed for the beginning surgeon, and all surgeons should thoroughly check the integrity of the corneal wounds to avoid wound leakage or other possible complications.

FEMTOSECOND LASER-ASSISTED CATARACT SURGERY: THE NEXT STAGES

Femtosecond laser–assisted cataract surgery is a quickly developing technology. Many sources of potentially useful information have been made available during this process of development, including industry user meetings and scientific and promotional publications. However, the information presented in these forums should be continually checked and confirmed by other authors and surgeons to assure the validity of the information disseminated. Multicenter studies would be ideal, with many surgeons and potentially even many distinct laser platforms, to maximize the information concerning results and possible advantages of this technology. Femtosecond laser–assisted cataract surgery appears destined for continued market growth and utilization; it is imperative that we do our job as clinicians and surgeons to thoroughly scrutinize the data that become available to guarantee the best outcomes for our patients.

REFERENCES


