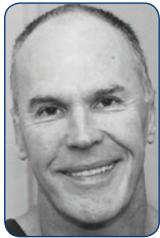


ANTERIOR CAPSULAR INTEGRITY IN LASER CATARACT SURGERY

Studies suggest that, as laser technology evolves, the incidence of intraoperative complications decreases.

BY MICHAEL LAWLESS, MBBS, FRANZCO, FRACS



A precisely sized, well-centered capsulorhexis with strong edges is critical to the success of cataract surgery and IOL centration.¹ A key driver of the uptake of femtosecond laser cataract surgery has been the reported safety, accuracy, and predictability of the laser capsulotomy.²⁻⁴ Concerns have been raised, however, over the integrity of the laser-cut capsule and the potential for intraoperative complications. For this reason, it is necessary to examine both the laboratory and clinical literature.

MANUAL VERSUS LASER CAPSULOTOMY

Based on their observation of capsular edge ultrastructure, Abell et al suggested that laser cataract surgery may produce a “germinative capsular defect, which may render the laser-cut capsule intrinsically weak.”⁵ They found that, after laser cataract surgery, capsules had “postage-stamp” perforations in contrast to the relatively smooth edge of the manual capsulotomy. Furthermore, they reported that tags, skip lesions, and additional aberrant pulses were indicated across several samples related to possible fixational eye movements. The investigators suggested that these complications might affect the force-displacement relationships, potentially increasing the rate of anterior capsular tears. In their additional analysis of laser and manual cohorts, Abell et al reported a significantly increased rate of tears in laser cases.⁵ Although this study represents a significant contribution to the literature on laser cataract surgery, other research suggests that their interpretation of the ultrastructure findings may not define the true impact of the laser on capsular integrity.

Bala et al performed a morphological comparison of the capsulotomy edges of various femtosecond laser platforms with those of a manual capsulorhexis.⁶ Although they objectively confirmed the original findings of Abell et al (ie, that laser capsulotomies were rougher than manual ones by 1% to 3%), interestingly, Bala et al found that the edges improve

as laser technology continues to improve. Based on these findings, as the settings for the various femtosecond laser platforms are optimized, it is reasonable to assume that the routine morphological differences between manual and laser capsulotomies will be further reduced.

Auffarth et al previously showed that the mean rupture force and stretching ratios were significantly higher in laser samples compared with a manual cohort.⁷ These results reflect general findings in other studies across various platforms,⁸⁻¹⁰ although a lack of consistent methodology between the studies somewhat mitigates the overall message. The use of porcine eyes in these studies adds variability and possibly reduces comparability with the clinical setting, but the results should not be discounted, as they provide a platform for further studies.

DIAMETER AND CAPSULAR ANATOMY

More recently, Packer et al attempted to define the ideal laser capsulotomy.¹¹ The investigators studied the effect of different capsulotomy diameters on the extensibility and



AT A GLANCE

- Although the edges of laser capsulotomies were initially reported to be rougher than those of manually created ones, investigators have found improvement as laser technology continues to evolve.
- The larger the diameter of the initial capsulotomy, the more resilient and extensible the capsular rim.
- The incidence of anterior capsular tears during laser cataract surgery has decreased with improvements in laser technology.

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Technique and technology appear to make a significant difference.”

break force in porcine eyes. Their results indicate that both measures are related to the initial capsulotomy's diameter. Specifically, the larger the diameter, the more resilient and extensible the capsular rim. The researchers further suggested that combining the larger capsulotomy diameter with centration on the anterior pole of the lens capsule axis might optimize the capsular anatomy and, thus, the effective safety and efficacy of the procedure.

INCIDENCE OF ANTERIOR TEARS

Clinical data are available to support laboratory analysis and provide relevance to clinicians. My colleagues and I reported an anterior capsular tear rate of 4.4% based on our initial experience.¹² Nagy et al also describe a 4% incidence of capsular tears across their initial 100 procedures.¹³ Given that surgeons may routinely expect a 2% incidence of anterior capsular tears, both our results and those of Nagy et al suggest a significant learning curve.¹⁴ The context of these publications is important, however, because the lasers used in both studies are the earliest available version (2010-2011) of the LenSx Laser (Alcon). Our follow-up studies, which used more advanced instrumentation, indicate a considerably lower rate of capsular tears of between 0.2% and 0.31%^{4,15} and support the assertions of Bala et al that technological developments have improved the integrity of the capsulotomy.⁶ Not surprisingly, early cohorts using other femtosecond lasers also reported higher rates of anterior capsular tears (4.4%-5.3%).^{16,17}

TECHNIQUE AND TECHNOLOGY

Technique and technology appear to make a significant difference. Data from a study by Abell et al support this assertion. They reported a 1.9% incidence of anterior capsular tears in their laser cohort with the Catalys (Abbott Medical Optics).⁵ The mean size of the capsulotomy in the laser cohort was less than 5 mm (“typically” 4.7 mm). The capsulotomy time was 4.5 seconds. Comparative data with the same unit exist. Day et al describe an early prospective evaluation using software with similar parameters.¹⁸ Their results mirror the earlier findings reported by Abell et al of a 1.7% incidence of capsular tears. The subsequent larger

cohort, treated with upgraded software and a decreased capsulotomy time (1.5 seconds), had a 0.1% incidence of capsular tears. Scott also used the Catalys and reported an incidence of 0.43%.¹⁹ Although the laser settings are not described by the investigator, the size of the cohort suggests that upgraded technology was used.

CONCLUSION

A growing archive of clinical data suggests that the femtosecond laser produces a capsulorhexis that is as strong—if not stronger than—a manual continuous curvilinear capsulorhexis with the advantage of better reproducibility and precision, a more consistent diameter, and more accurate placement.^{2,15,18,19} Anterior capsular tears are an unwelcome part of manual surgery, even more so for less experienced surgeons. With current laser systems, the anterior tear rate of 0.1% to 0.5% is better than that usually reported for manual surgery, suggesting that laser-cut capsulotomies confer advantages of stability and strength, not just precision and repeatability. ■

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