**LASER CAPSULOTOMY**

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**Introduction**

Laser cataract surgery (LCS) integrates high-resolution anterior segment imaging with a femtosecond (FS) laser allowing key steps of the procedure to be performed with computer-guided laser precision. These are important points because the quality of the anterior capsulotomy is crucial to the safety and refractive outcome of cataract surgery. A poorly constructed capsulorrhexis can lead to anterior capsule tears and serious intraoperative complications, as well as influencing anterior chamber depth and effective intraocular lens (IOL) position.\(^1\)\(^2\)\(^3\)\(^4\) Creating a perfectly shaped and consistent capsulorrhexis is, however, one of the most difficult steps for trainees and inexperienced surgeons to master.\(^5\)\(^6\)

**Importance of capsulotomy**

One of the key drivers of the uptake of LCS has been the reported safety, accuracy and predictability of the laser capsulotomy. The increasing use of presbyopia-correcting and toric IOLs has focused greater attention on the quality of the capsulotomy as these IOLs require optimal centration and effective lens position to achieve the desired refractive result. There is significant evidence in the literature showing that use of a femtosecond laser consistently creates a capsulotomy with precise geometry, circularity, and
sizing. The literature also indicates that there is a learning curve during the early stages of LCS, with reported anterior capsule tear rates ranging from 0% to 8% (Table 1). These studies differ with respect to the size of the study (ranging from 50 to 2941 procedures), stage of learning curve, level of surgeon experience, type of cataract and FS laser platform used.

**Table 1.**

**Published Rates of Anterior Capsule Tears with Laser Cataract Surgery**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Study design and Population</th>
<th>AC tear rate (%)</th>
<th>Surgeon Level</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nagy et al (2009) [7]</td>
<td>Prospective (n=100)</td>
<td>4</td>
<td>Learning Curve</td>
<td>LenSx</td>
</tr>
<tr>
<td>Bali et al (2012)</td>
<td>Prospective (n=200)</td>
<td>4</td>
<td>Learning Curve</td>
<td>LenSx</td>
</tr>
<tr>
<td>Roberts et al (2013)</td>
<td>Prospective (n=1300)</td>
<td>0.3</td>
<td>Experienced</td>
<td>LenSx</td>
</tr>
<tr>
<td>Reddy et al (2013)</td>
<td>Prospective (n=56)</td>
<td>0</td>
<td>Learning Curve</td>
<td>Technolas</td>
</tr>
<tr>
<td>Alio et al (2014)</td>
<td>Prospective (n=50)</td>
<td>4</td>
<td>Learning Curve</td>
<td>LenSx</td>
</tr>
<tr>
<td>Chang et al (2014)</td>
<td>Prospective (n=170)</td>
<td>5.3</td>
<td>Learning Curve</td>
<td>LensAR</td>
</tr>
<tr>
<td>Abell et al (2014)</td>
<td>Prospective (n=804)</td>
<td>4.9</td>
<td>Experienced</td>
<td>Catalys</td>
</tr>
<tr>
<td>Day et al (2014)</td>
<td>Prospective (n = 1000)</td>
<td>0.1</td>
<td>Experienced</td>
<td>Catalys</td>
</tr>
<tr>
<td>Chee et al (2015)</td>
<td>Prospective (n=1105)</td>
<td>0.8</td>
<td>Learning Curve</td>
<td>Victus</td>
</tr>
<tr>
<td>Roberts et al (2015)</td>
<td>Prospective (n=3355)</td>
<td>0.2</td>
<td>Experienced</td>
<td>LenSx</td>
</tr>
</tbody>
</table>

**Evidence-based review of laser-cut capsulotomy**

Data from recent large studies has established that the laser procedure is now associated with a very low rate of anterior capsule tears. Our experience using the LenSx in a prospective consecutive series of 3842 eyes, found a break in the anterior capsule rim in 7 eyes (0.18%). The rate dropped significantly to
0.08% when the new soft contact lens patient interface (SoftFit) replaced the original rigid curved interface (0.08%, 2/3108 eyes vs 0.68%, 5/734 eyes, \( P=.004 \)). This series was a consecutive cohort and included complex cases that may be at increased risk for anterior capsule tear, eg, eyes with floppy iris syndrome, white cataract, pseudoexfoliation, and traumatic zonulopathy. Another recent paper similarly reported a very low anterior capsule tear rate of 0.1% when analyzing outcomes for 1000 eyes operated on with the Catalyst laser at Moorfield’s Eye Hospital.\(^{22}\) In contrast, an earlier study from 2014 using the Catalys system reported a high rate of 1.8%.\(^{21}\) This paper stirred controversy about femtosecond laser capsulotomy by hypothesizing that treating the capsule with a laser, irrespective of the platform, may produce a germinative defect, rendering the capsule intrinsically weak.

There are ultrastructural differences in the capsule when the capsulotomy is created with a laser versus manually, but the important question is, from an evidence-based perspective: What, if any, are the clinical implications of these differences? Published results of nearly 5000 consecutive laser procedures from our group and the Moorfield’s group, using different laser systems, indicate that surgeons can now be confident that optimal laser settings and appropriate surgical technique will result in a perfectly circular, evenly sized and intact capsulotomy in nearly every case. We can be reassured that earlier studies showing high complications rates are now outliers and are not indicative of current practice and outcomes.
Surgical technique

Surgical technique should be altered to minimize capsular stress by dividing the nucleus into small segments, not stretching the capsule edge during cross-action manipulation with the phaco hand piece and side instrument and ensuring meticulous attention is given to maintaining a stable anterior chamber to prevent trampolining of the capsule and iris. Energy settings should be optimised for the individual patient and perfect docking achieved for capsulotomy quality.

Summary

For surgeons considering taking up this technology, it is reassuring to note that the learning curve was associated with early first generation technology and relative surgeon inexperience. Current laser platforms are more advanced, safer and faster and the increasing use of femtosecond lasers worldwide has seen a significant increase in surgeon experience. Peer-reviewed studies and face-to-face instruction courses are now available which can provide the transitioning surgeon with a comprehensive overview of safe and effective surgical techniques. The observation of most surgeons is that LCS results in a consistently round, intact, accurately-sized and safe capsulotomy.

Further information:

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References


