FRAGMENTATION PATTERNS IN LASER CATARACT SURGERY


A discussion of their effects on the cornea and surgical efficiency.

BY ANNIE NGUYEN, MD; AND ANGIE E. WEN, MD

COMPARISON OF HYBRID AND CROSS FRAGMENTATION PATTERNS IN TERMS OF PHACO TIME AND CORNEAL EFFECTS

Asena BS, Kaskaloglu M[1]

ABSTRACT SUMMARY

Since the first femtosecond laser cataract surgery procedure was performed in 2009, investigators have become increasingly interested in studying outcomes, including the reduction in effective phaco time (EPT) and mean phaco power (MPP).[2] Until recently, however, data on fragmentation softening patterns in laser cataract surgery were limited. In a nonrandomized, retrospective case series, Asena and Kaskaloglu compared the effects of two different patterns on phaco values, postoperative endothelial cell count (ECC), and corneal thickness.

The study included eyes with a grade 3 cataract based on the Lens Opacities Classification System III that underwent cataract surgery using the LenSx Laser (Alcon).[3] Group 1 consisted of 32 eyes that underwent a cross pattern of lens fragmentation (two perpendicular cuts into four parts), and group 2 consisted of 35 eyes that underwent a hybrid pattern of lens fragmentation (liquefaction of the 2.5-mm central core with the periphery cut into four parts with two perpendicular cuts; Figure 1). Mean age, gender distribution, preoperative distance-corrected visual acuity (CDVA), anterior chamber depth, mean keratometry, IOL power, and axial length were similar in the two groups (P = .58, .28, .21, .37, .70, .78, and .80, respectively).

The laser procedure lasted significantly longer with a hybrid pattern (P = .03), but the MPP and total ultrasound time were significantly lower. The EPT did not differ significantly between the two fragmentation patterns in this study. Corneal thickness and ECC were similar in the two groups at 1 day, 1 week, and 1 month after surgery (P = .18, .27, and .09, respectively, for corneal thickness and P = .94, .92, and .36, respectively, for ECC).

The loss in ECC as a percentage, however, was much higher with the cross pattern at 1 day, 1 week, and 1 month after surgery, although the difference did not reach statistical significance (P = .18, .49, and .07, respectively). Notably, the amount of improvement in CDVA was similar in both groups at the end of postoperative month 1.

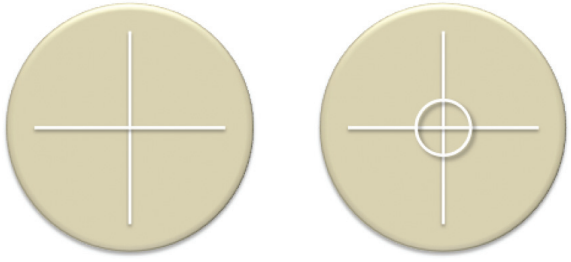

Figure 1. Cross (left) and hybrid (right) fragmentation patterns.

STUDY IN BRIEF

- A retrospective cross-sectional study compared a cross versus a hybrid fragmentation pattern for laser surgery on grade 3 cataracts. The hybrid method was associated with lower ultrasound time and phaco power as well as reduced corneal changes in the early postoperative period.

WHY IT MATTERS

Cataract surgeons seek to limit their use of ultrasound energy and phaco power in order to decrease the loss of corneal endothelial cells, which can influence corneal thickness, corneal transparency, and visual rehabilitation time. Ophthalmologists also continually strive to make cataract surgery more efficient, safer, and more tolerable for patients. Detailed fragmentation patterns require increased laser time and can necessitate greater patient cooperation and OR resources. This study's investigators showed that taking the time to perform the more involved hybrid fragmentation pattern can decrease the use of ultrasound and phaco power and reduce the percentage of endothelial cell loss during the first month after surgery. Further study is needed to determine if these benefits translate to improved visual outcomes.

DISCUSSION

Previous research has demonstrated a correlation between total ultrasound energy and endothelial cell loss.[4] Laser cataract surgery has been shown to reduce MPP and EPT significantly through nuclear softening regardless of the Lens Opacities Classification System III grade.[5,6] Additionally, previous studies have shown that smaller fragmentation patterns resulted in lower MPP and EPT; these more detailed fragmentation patterns predictably increased the duration of the laser procedure.[2,4,5,7] In this study, Asena and Kaskaloglu similarly found lower MPP and a longer laser procedure time for the more detailed hybrid fragmentation pattern versus the cross pattern, but they did not report lower EPT.

Laser cataract surgery can damage the corneal endothelium, mainly through the creation of laser automated corneal incisions.[8] Overall, laser cataract surgery has been shown to reduce ECC loss in the first postoperative month.[8,9] In this study, a cross pattern of fragmentation resulted in greater ECC loss during early follow-up visits. Given the similar laser incisions between the two groups, the investigators attributed the difference to the lower amount of phaco energy used with the hybrid versus the cross pattern.

The more detailed hybrid pattern of nuclear fragmentation resulted in the use of less phaco energy, leading to less ECC loss and more stable postoperative corneal thickness in the early postoperative period. This pattern may therefore be useful in patients with low ECCs such as those with Fuchs dystrophy or other endothelial compromise. The amount of improvement in CDVA was similar in both groups at the end of 1 month, however, which may be the endpoint of more interest to some surgeons and patients. Further, although the benefits of laser cataract surgery over standard phacoemulsification on ECC have been shown for early postoperative visits, the protective effect is more debatable at 3 and 6 months.[8,9] Long-term follow-up is necessary.

COMPARISON OF 2 LASER FRAGMENTATION PATTERNS USED IN FEMTOSECOND LASER-ASSISTED CATARACT SURGERY

Shajari M, Khalil S, Mayer WJ, et al[10]

ABSTRACT SUMMARY

Shajari and colleagues evaluated how pie-cut fragmentation versus a grid pattern (Figure 2) affected EPT during cataract surgery. In this retrospective nonrandomized case series, investigators analyzed preoperative lens density in the central 2 mm using Scheimpflug imaging (Pentacam, Oculus Optikgeräte). They matched 75 eyes treated with the pie-cut pattern to 75 eyes treated with the grid pattern based on preoperative lens density (P = 1.0), with a total of 150 eyes included in the study.

The EPT was significantly higher in the group receiving the pie-cut versus the grid pattern (P < .01). Additionally, a significantly greater number of eyes (37 of 75) in the grid-pattern group required no phacoemulsification after laser fragmentation (EPT = 0, P < .01) compared with eyes that received the pie-cut pattern (1 of 75). The investigators showed through regression analysis that EPT depended significantly on lens density in both study groups. Lastly, the researchers analyzed 18 high-density (> 12%) lenses, nine in each group, and found that significantly less EPT was required for those that received the pie-cut versus the grid pattern (P = .02).

DISCUSSION

This study assessed two groups with matching lens density grades and different fragmentation patterns. The grid pattern resulted in lower EPT than the pie-cut pattern, likely because the nucleus was disassembled into smaller pieces with the grid pattern. It has been suggested that smaller fragmentation patterns result in a shorter phaco time and lower phaco energy compared with larger fragmentation patterns.[7] Additionally, the grid pattern was superior to the pie-cut pattern in terms of the possibility of no phacoemulsification use. Longer EPT and higher MPP have been shown to contribute to greater ECC loss, as noted earlier in this article, as well as a greater risk of cystoid macular edema.[4,11,12] Interestingly, in eyes with dense (> 12%) lenses, the pie-cut pattern was associated with a significantly lower EPT than the grid pattern. The investigators postulated that, with the pie-cut pattern, the laser rays have a common central intersection that can accelerate nuclear disassembly in dense lenses.

STUDY IN BRIEF

- Investigators sought to compare the effect of grid and pie-cut laser fragmentation patterns on phaco time. They found that the grid pattern generally resulted in less phaco time and even allowed the elimination of phacoemulsification in many cases. With high-density lenses, however, the pie-cut pattern significantly decreased the use of phacoemulsification, likely because central intersecting laser rays facilitated lens fragmentation.

WHY IT MATTERS

This study suggests that the fragmentation pattern itself, not only its fragmentation density, can lessen the use of ultrasound energy and reduce the effective phacoemulsification time. Additionally, the study shows that the preferable pattern of fragmentation can vary with the density of the lens. The pie-cut pattern may be advantageous when the lens density is greater than 12%, as measured by Scheimpflug imaging.

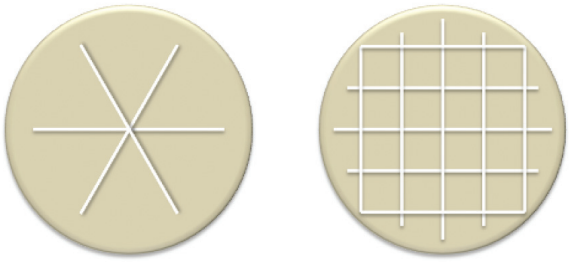

Figure 2. Pie-cut (left) and grid (right) fragmentation patterns.

This study did not report visual acuity and other measures of functional patient outcomes. Information on these endpoints would further inform surgeon choice of fragmentation pattern. It is also worth noting that Scheimpflug imaging can serve as a technique by which to objectively and reliably grade lens density.[13] ■

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