Pediatric Laser Cataract Surgery

The femtosecond laser creates clean capsulotomies in young, elastic eyes.

BY SHACHAR TAUBER, MD, AND WENDELL SCOTT, MD

There is perhaps nothing more rewarding for an ophthalmologist than to restore vision to a child blinded by a congenital cataract. Cataract surgery offers children with this condition the best chance for a full life. The challenges ophthalmologists face in pediatric cataract surgery are considerable, because decision making is fraught with uncertainty.

Because we believed there was great potential that laser cataract surgery could improve cataract surgical outcomes in children, Mercy Hospital acquired two femtosecond lasers. Our team had completed more than 3,000 cataract procedures before performing laser cataract surgery on a 4-year-old girl. The patient, the daughter of a hospital employee, was referred by her optometrist for an evaluation due to worsening vision from bilateral congenital cataracts and amblyopia. After review and consideration by the surgical team and an extensive informed consent process with the family, we elected to proceed with laser cataract surgery and IOL implantation in both eyes.

CHALLENGES

Posterior capsular opacification is a common postoperative complication in pediatric eyes.[1] Given the difficulty of performing an Nd:YAG procedure on an infant or young child, the standard of care is phacoemulsification with a planned posterior capsulotomy at the time of surgery. Although similar to an anterior capsulotomy, a posterior capsulotomy is technically more difficult due to the awkward location and angle as well as the higher likelihood of a radial tear and potential for vitreous loss.

Additionally, the creation of both anterior and posterior capsulotomies is complicated by the elasticity of the capsule in young eyes. Manually creating a capsulorhexis is like trying to tear plastic wrap by pulling it apart. The tissue stretches, making it difficult to start the capsulorhexis and then continue it in a controlled fashion. The younger the child, the more elastic the capsule. This is a major reason for the relatively high rate of complications in pediatric cataract surgery.

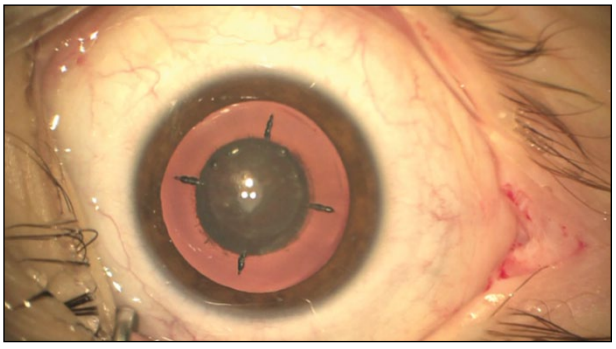

Figure 1. The patient's right eye immediately after the anterior capsulotomy and lens segmentation with the femtosecond laser.

Implantation of an IOL also presents significant challenges. Infants' eyes may temporarily be left aphakic. In an older child, the surgeon must consider whether an IOL can be safely placed in the bag or if another method of fixation or entrapment is required. Obtaining biometric measurements for calculating the IOL's power is arduous. It is difficult to set a refractive target, because children's eyes are still growing and the refraction will continue to change after surgery.

In this case, our patient was unusually cooperative for her age. We obtained immersion A-scans for both eyes and excellent keratometry readings on her left eye with the IOLMaster (Carl Zeiss Meditec). We also considered the results of the Hoffer Q and SRK/T formulas.

SURGICAL COURSE

We first performed laser cataract surgery with the Catalys Precision Laser System (Abbott Medical Optics), under general anesthesia, on the patient's right eye. We then created a small lateral cantholysis of less than 2 mm to accommodate the laser's interface, which is available outside of the United States in a smaller size and awaits FDA approval. After docking, the lens was segmented into four quadrants, with no additional softening (Figure 1).

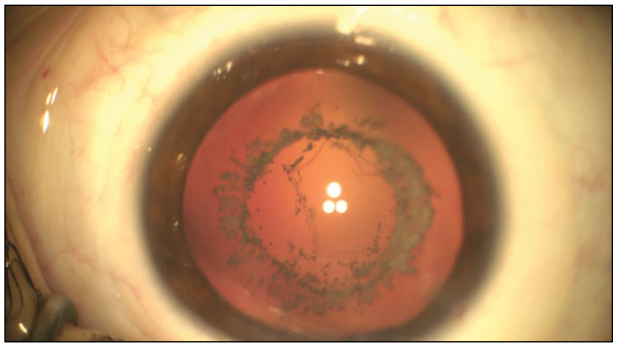

Figure 2. The same eye after the posterior capsulotomy with the laser. The star-shaped image in the middle is the free-floating posterior capsule that has fallen through Bergmeister space and is resting on the anterior hyaloid (vitreous) face.

Next, we used the laser to create corneal incisions and the anterior capsulotomy, with scanned capsular centration selected for locating the capsule's opening. To accommodate the capsule's elasticity, we opted for a 3.8-mm capsulotomy, with the expectation that it would stretch postoperatively to approximately 5 mm.

We rotated the laser bed to the left to perform the nonlaser portion of the procedure under a surgical microscope. We implanted a capsular tension ring to help distribute the zonular tension more evenly and maintain the normal tensile strength of the capsule as the eye grows. We performed phacoaspiration in a fashion similar to other pediatric cataract cases.

After the phaco portion of the procedure, the bed was rotated under the laser again. The eye was re-docked for the posterior capsulotomy, this time using the laser's customized setting and the anterior capsulotomy to guide centration of the posterior capsular opening. The posterior capsulotomy was cleanly cut; it did not require grabbing or tearing, and it essentially fell through Bergmeister space onto the anterior hyaloid face (Figure 2).

We elected to perform an anterior vitrectomy, as we commonly do in pediatric cataract surgery, and implanted an aspheric, single-piece Tecnis IOL (Abbott Medical Optics) with a power of 23.00 D. Both capsulotomies were easy to visualize and were well aligned during the IOL's implantation (Figure 3). Given the perfect overlap of the optic by the capsule on both the anterior and posterior sides, optic capture was deemed unnecessary. We believe that the one-piece IOL will remain stable due to the ideal overlap and centration.

Surgery on the left eye was performed 2 weeks later and proceeded exactly as the first procedure, except the power of the IOL was 28.00 D instead of 23.00 D. We aimed for mild hyperopia to obtain the best possible near-term UCVA, with the understanding that the patient will become more myopic over time. We stressed to the family that this refractive error could be corrected in the future.

CLINICAL OUTCOME

The patient's refraction was balanced 6 weeks postoperatively, with a cycloplegic spherical equivalent of +0.50 D OS and +1.00 D OD. Her UCVA was 20/40 OS and 20/70 OD, which was an improvement from 20/125 earlier in the postoperative period. The patient's visual acuity continues to change as she undergoes amblyopia therapy. Thus far, she has responded well and is expected to continue to improve. More importantly, the little girl is delighted with her vision. Her family reports that she has blossomed socially and has already experienced a marked improvement in daily functioning.

We are very pleased with the results, grateful for the family's trust in us, and proud to help "one of our own" on the hospital staff. From our perspective, the major advantage of the laser in this case was the vast improvement in the quality of the capsulotomies compared to what we could have expected manually. The desired IOL could be implanted in the capsular bag as planned.

WHAT WE LEARNED

To our knowledge, this is the first pediatric laser cataract surgical case performed in the United States. In order to use the laser in pediatric cataract surgery, it must be located in the same OR as the phaco system so that the surgeon can alternate between the two under sterile conditions. It is also important that the laser interface is one that allows a safe second docking with fresh corneal incisions. It is not known whether this could be done safely with an applanating and/or higher pressure interface. Additionally, many of the laser settings had to be customized for this case; we plan to publish recommended settings in the future.

We are fortunate to have been mentored in this endeavor by H. Burkhard Dick, MD, PhD, who has performed 20 pediatric cases with the same laser in Germany.

Figure 3. Both the anterior and the posterior capsulotomies can be seen as the IOL is placed in position.

> "The major advantage of the laser in this case was the vast improvement in the capsulotomies compared to what we could have expected manually."

Thus far, he has published a case series of laser cataract surgery on four infants,[2] one case on a child with Marfan syndrome,[3] and a large series with the bag-in-the-lens technique,[4] which, although reported for adults, also involves a posterior capsulotomy with the laser.

We are currently seeking Institutional Review Board approval for a prospective series of 20 pediatric laser cataract cases. It is our hope that this study will help us to establish the safety and efficacy of laser cataract surgery in children, document its complications, and assess the impact on postoperative vision and visual performance. We expect laser cataract surgery to become the preferred method for removing cataracts in children. ■

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