Another Perspective on Pediatric Laser Refractive Surgery

It is time to consider this treatment modality a mainstream therapeutic option.

BY WILLIAM F. ASTLE, MD, FRCSC; AND PETER T. HUANG, MD, FRCSC

We have been performing laser refractive surgery in children (Figure 1) at Alberta Children's Hospital in Canada for more than 12 years.[1-8] Our indications (Table 1) include any child who is not responding to normal treatment with glasses and/or contact lenses and any child who did not respond to standard amblyopia treatment with patching and/or atropine 1% drops. Most of these children have extreme refractive errors, representing large myopic, hyperopic, and astigmatic refractive errors in one or both eyes. Congenital high myopia and other associated ocular and medical disorders may also make standard optical treatment ineffective or impossible. This group can also include, but is not limited to, children with Down syndrome, autism, multiple neurological disorders, albinism, and various forms of nystagmus. It is important to note that these children are functionally blind without the laser refractive procedure, as standard optical treatment fails to reverse their visual problem.[9]

The editors of *CRST Europe* invited us to share our experience with pediatric laser refractive surgery as a counterpoint to "Refractive Surgery in Children: Indications and Contraindications," which appeared in the September 2009 issue (page 42). Pediatric laser surgery is a controversial topic in refractive surgery, but many surgeons worldwide experience positive results. With now more than 300 children in our database, many of whom have been followed more than 12 years,[1-8] we can confidently say that pediatric laser refractive surgery is a viable treatment option for children when traditional optical treatments have failed.

PRK AND LASEK

We decided to avoid LASIK treatments in this population of complex patients because we were concerned that LASIK flap issues would occur.[9] Consequently, we started treating children with PRK surface ablations in 1998. In 2002, we published our first study of 40 eyes (27 children)[1] in which PRK successfully treated myopia as high as -25.00 D. At 1 year post-PRK, visual acuity in these patients improved from 20/70 to 20/40, and the mean spherical equivalent (SE) decreased from -10.68 D to -1.37 D. Retreatments were required in some cases with significant haze; patients who fell into this category had original refractions greater than -15.00 D. All patients maintained clear corneas and appropriate refractive results over time, with only a few requiring repeat phototherapeutic keratectomy (PTK) with 0.02% mitomycin-C.

With haze as the only minor complication, we switched

Figure 1. Pediatric laser vision correction is a treatment option in patients not responsive to less invasive treatments.

TABLE 1. CURRENT CLINICAL INDICATIONS FOR LASER REFRACTIVE SURGERY IN CHILDREN AT THE ALBERTA CHILDREN'S HOSPITAL VISION CLINIC

1. Any child who does not respond to standard treatment (including glasses, contact lenses, patching, atropine) and has:
- Anisometropic amblyopia
  - hyperopic, astigmatic, myopic (or combinations thereof)
  - postcataract–surgery anisometropia with or without myopic shift
- Bilateral high refractive errors (usually a form of congenital high myopia)

2. In addition, these children may have underlying medical conditions and associated ocular pathology that induces a refractive error, or is associated with a refractive error, that cannot be corrected with standard treatment. This may include, but is not limited to, children with monocular and/or binocular refractive errors secondary to:
- Ocular, lid, and orbital hemangiomas
- Goldenhar syndrome
- Ocular dermoids
- Autism
- Cerebral palsy
- Pelizaues-Merzbacher leukodystrophy (secondary nystagmus)
- Klippel-Trenaunay-Weber syndrome (upper/lower eyelid involvement)
- Angelman syndrome
- Congenital motor nystagmus
- Oculocutaneous albinism
- Down syndrome
- Various strabismic disorders (most commonly esotropia)

3. Children with superficial corneal opacities, surface irregularities, superficial corneal dystrophies, epithelial instability, and reepithelialization failure (PTK treatment)
- Herpetic scarring, traumatic corneal scarring, and band keratopathy

4. Older children (usually 16 to 17 years of age) who have not outgrown their refractive errors:
- Associated with accommodative esotropia
- Associated with other strabismic disorders
- Strabismus that may be eliminated by reduction of the refractive error to normal
- Aphakes who do not outgrow their residual hyperopia
- Potential for fusion maximized by the laser refractive procedure:
  - Usually accommodative esotropia patients with residual hyperopia and/or astigmatism
  - Exotropes for whom correction of the residual refractive error restores fusion (usually myopes and patients with astigmatism)

our treatment exclusively to LASEK in 2002 and added mitomycin-C to our protocol in any eye lasered for greater than -5.00 D or 5.00 D SE in 2006.[2-8] The issue of haze has been virtually eliminated with this combination,[1-8] and as technology and surgical techniques continue to improve our clinical indications and range of treatment continue to expand. We have successfully treated children with refractive errors ranging from -27.00 D to 13.50 D.

In our initial LASEK cohort[2] of 36 eyes (25 patients), the mean SE decreased from -8.03 to -1.19 D. Most eyes (78%) had clear corneas immediately after LASEK, and patients did not experience haze. At 8-year follow-up in 56 eyes (39 patients), visual acuity improved by a mean 1.6 lines, and no patient lost vision or fusion.

TAKE-HOME MESSAGE

- Pediatric laser vision correction may be used to treat extreme refractive errors.
- The combination of LASEK and mitomycin-C has decreased haze in this pediatric population.
- PRK and LASEK are effective treatments for children with refractive problems associated with underlying medical conditions such as nystagmus, oculocutaneous albinism, neurologic disorders, and amblyopia.

ANISOMETROPIC AMBLYOPIA

We treat children with myopic and/or hyperopic anisometropia for whom traditional amblyopia therapy failed after 6 months of treatment.[1-4] Children with anisometropic amblyopia who have not responded to traditional treatment tend to respond to laser, with overall improvement in both vision and fusional ability. We found that myopic, astigmatic, and hyperopic anisometropic amblyopia (71 eyes total in two studies) could be effectively treated with laser refractive surgery.[3,4] Therefore, we maintain that laser represents an effective and safe alternative for any child who is not responding appropriately to traditional amblyopia treatment. This option should be considered earlier rather than later in a child's treatment regime to obtain long-term effective visual results. LASEK is also helpful in aphakic children who have not outgrown anisometropic or bilateral hyperopia. These patients may have the same ongoing amblyopiogenic issues.[1-4]

IMPROVEMENTS AFTER LASER

It is sometimes difficult to obtain objective measurements of vision because of the patients' young age and associated developmental or medical issues; however, virtually all children improve after laser treatment.[1-8] They see better, have better fusional ability, and demonstrate improvement in functional ability. In many autistic children, behavior improves dramatically after laser treatment because they see and function better in their environments.[1-9]

PRK and LASEK are effective treatments for children with refractive problems associated with underlying medical conditions including nystagmus, oculocutaneous albinism, neurologic disorders, and amblyopia induced by lid or orbital lesions (eg, hemangiomas, dermoids).[8] During the period of visual cortical plasticity, refractive surgery—by eliminating the refractive component of amblyopia and by promoting fusional ability—provides considerable functional improvement in these children.[1-9]

Many children face combinations of problems. In our series, an older child (16–18 years old) with previous multiple strabismus surgeries had not outgrown ongoing refractive issues (both myopic and hyperopic) and had no documented fusional ability.[5] LASEK and strabismus surgery successfully restored vision and fusion in this patient and others for whom this was previously not thought possible. Additionally, other centers have demonstrated success in treating accommodative and nonaccommodative strabismus associated with refractive errors.[10-12] Visual acuity and fusional status improved, and children with and without concomitant strabismus surgery achieved spectacle independence.

Autrata and colleagues[13] reported using PTK for the treatment of superficial corneal opacities, surface irregularities, epithelial instability, and reepithelialization failure in pediatric patients. They found that PTK was effective and safe for the treatment of various surface corneal disorders in children, improving BCVA and eliminating ocular pain and irritation. Preoperative myopia and hyperopia were also reduced by a combination of PTK and PRK, as anisometropic amblyopia complicates a child's ongoing corneal pathology. We have observed the same in our patient cohort.[8]

CONCLUSION

Pediatric laser refractive surgery has been discussed in the literature since the mid 1990s, and many surgeons have reported experiencing success similar to ours. Paysse et al[14] treated 11 children with severe anisometropic amblyopia and concluded that PRK resulted in long-term stable reduction in refractive error and improved visual acuity. Wang et al[15] and Utine et al[16] independently found that LASIK was safe and effective in correcting high hyperopic anisometropia in patients who could not successfully wear appropriate refractive correction. Tychsen[17] found a low prevalence of complications after laser refractive surgery in children. Magli and coworkers[18] showed that in 18 children undergoing PRK for myopic anisometropia, the treatment was safe and effective and improved vision, ocular alignment, and stereopsis. Most recently, a literature review by Daoud et al[19] concluded that refractive surgery is appropriate in children with severe anisometropia or bilateral high ametropia who are not responding to traditional therapy. Large prospective, multicenter, randomized, controlled trials are needed to confirm these and other results.

Although laser refractive surgery is still considered controversial by some, there is now significant and sufficient clinical proof to suggest that it should be considered a viable treatment option for children. When traditional optical methods of treatment have failed, pediatric laser refractive surgery is a safe and appropriate procedure to

improve vision and overall lifestyle for these children. Our 12 years of documented success at the Alberta Children's Hospital and the indications we have outlined in this editorial, supported by our publications and the world literature, represent evidence-based guidelines for pediatric laser refractive surgery. Study results demonstrate that, regardless of the specific technique used, pediatric laser refractive surgery is an appropriate treatment for these children. ■

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