Facilitation of Amblyopia Management by Laser In situ Keratomileusis in Children with Myopic Anisometropia

By

Ibrahim T. EL Adawy, MD

Professor of Ophthalmology
Mansoura University
Egypt

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Amblyopia

➢ Amblyopia is a decrease in visual acuity in one eye due to abnormal visual stimulations, or in both eyes as a result of pattern vision deprivation during visual immaturity.

Anisometropia

➢ Anisometropia refers to a difference in sphero-cylindrical refractive error between both eyes.

Anisometropic amblyopia (Refractive amblyopia)

➢ Co-occurrence of anisometropia and amblyopia
Potential amblyogenic refractive errors

include anisometropia greater than:

1.50D for astigmatism,
1.00D for hyperopia, and
3.00D for myopia
The incidence of anisometropia of 1 D or more in full-term infants has been reported to be 1% to 2%.

- De Vries reported a 4.7% prevalence among pre schooler age.
- Hirsch found the prevalence 3.1% of schooler age.
- 3.6% of children between the ages of 7 and 15 year
- 5.6% of children between the ages of 16 and 19 years.
Challenges

- Aniseikonia
- Refusal of glasses
- Bad compliance for patching
- Recurrence of amblyopia

Amblyopia is strongly associated with the presence of anisometropia and/or strabismus during early childhood
Association of Ocular Dominance and Anisometropnic Myopia

Ching-Yu Cheng, May-Yung Yen, Hsin-Yi Lin, Wei-Wei Hsia, Wen-Ming Hsu

Abstract

PURPOSE. To determine the association between ocular dominance and degree of myopia in patients with anisometropia.

METHODS. Fifty-five subjects with anisometropic myopia were recruited. None of them had amblyopia. Refractive error and axial length were measured in each subject. Ocular dominance was determined using the hole-in-the-card test and convergence near-point test.

RESULTS. There was a threshold level of anisometropia (1.75 D) beyond which the dominant eye was always more myopic than the nondominant eye. Of the 33 subjects with anisometropia of ≤1.75 D, the dominant eye was more myopic in 17 (51.5%) subjects. Dominant eyes, determined by the hole-in-the-card test, had a significantly greater myopic spherical equivalent (−5.27 ± 2.45 D) than nondominant eyes (−3.94 ± 3.10 D; \( P < 0.001 \)). Dominant eyes also had a longer axial length than nondominant eyes (25.15 ± 0.96 mm vs. 24.69 ± 1.17 mm, respectively; \( P < 0.001 \)).
- Myopia greater than 3D in any meridian is considered a significant risk factor for developing amblyopia.

- If the refractive error is corrected with glasses, improved vision in the amblyopic eye is usually associated with intolerable aniseikonia.
Myopic anisometropia amblyopia is a common cause of failure of treatment amblyopia.

### TABLE 2. Suspected Risk Factors for Failure of Treatment for Anisometropic Amblyopia among Children 3 to 8 Years Old

<table>
<thead>
<tr>
<th>Factor</th>
<th>No. (%)</th>
<th>No. Relative Failure (%)</th>
<th>No. Functional Failure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age $\geq 6$ yr</td>
<td>25 (24.0)</td>
<td>7 (28)</td>
<td>17 (68)</td>
</tr>
<tr>
<td>Strabismus present</td>
<td>66 (63.4)</td>
<td>20 (30.4)</td>
<td>34 (51.5)</td>
</tr>
<tr>
<td>SE of the amblyopic eye $\geq 3$ PD</td>
<td>70 (67.3)</td>
<td>18 (40)</td>
<td>30 (42.9)</td>
</tr>
<tr>
<td>Cylinder of amblyopic eye $\geq 1.50$ PD</td>
<td>30 (28.8)</td>
<td>13 (43.4)</td>
<td>19 (63.4)</td>
</tr>
<tr>
<td>Interocular difference of SE $\geq 3.00$ PD</td>
<td>25 (24)</td>
<td>6 (24)</td>
<td>12 (48)</td>
</tr>
<tr>
<td>Initial visual acuity of amblyopic eye $\leq 20/200$</td>
<td>35 (33.6)</td>
<td>7 (20)</td>
<td>25 (71.5)</td>
</tr>
<tr>
<td>Fair or poor treatment compliance</td>
<td>23 (22.1)</td>
<td>12 (52.2)</td>
<td>14 (71.9)</td>
</tr>
<tr>
<td>Patients with myopia</td>
<td>23 (22.1)</td>
<td>8 (34.5)</td>
<td>12 (50)</td>
</tr>
</tbody>
</table>

Functional failure: final visual acuity $< 20/40$ PD in the amblyopic eye. Relative failure: failure of vision to improve by at least three lines of logMAR acuity in the amblyopic eye. PD = prism diopeters; SE = spherical equivalent.

Traditional treatments to correct and rehabilitate the refractive status in children with myopic anisometropic amblyopia include:

- Glasses or
- Contact lenses with
- Appropriate patching of the dominant eye.
➢ Spectacles does not have the desired effect in eyes with a refractive difference greater than 3.00 diopters due to aniseikonia.

➢ Contact lenses have the advantages of a larger visual field and better quality of vision.

➢ However, contact lens intolerance and poor compliance or lack of adaptation leads to treatment failure.

➢ Also a full-time contact lens use by a child is impossible.
Laser in Situ Keratomileusis (LASIK) has been successfully used for the treatment of myopia, hyperopia, and astigmatism in adults.

➢ Functionally, refractive laser surgery improves the corrected visual acuity, restores stereopsis and binocular fusion in some patients.

➢ Also it has a positive effect on patient’s visual and social functions in their environment.
Recent studies show that Refractive Laser Surgery is effective and safe alternative treatment of myopic anisometropic amblyopia in children Especially those with concurrent medical problem as Autism, cerebral palsy, and Down syndrome Also it facilitate the treatment of the resultant myopic anisometropic amblyopia.
Facilitation of amblyopia management by laser in situ keratomileusis in children with myopic anisometropia.

Ghanem AA, Nematahllah EH, El-Adawy IT, Anwar GM.

Abstract

PURPOSE: To evaluate the effects of Laser in situ keratomileusis (LASIK) in decreasing myopic anisometropic amblyopia in children with spectacles or contact lens intolerance and its validity in facilitating treatment of resultant myopic anisometropic amblyopia.

PATIENTS AND METHODS: LASIK was performed for 18 eyes of 18 children having myopic anisometropic amblyopia not successfully treated with the standard amblyopia treatment for 6 months. Children were followed up at 1 week, 1, 2, 6, 12, 18, and 24 months. Postoperative amblyopia therapy was continued with occlusion of the dominant eye for 6 hr daily for the first 3 months and then for 4 hr per day as long as possible.

RESULTS: The mean spherical equivalent refraction in the operated eye had reduced significantly from -9.25 +/- 3.43D preoperatively to -1.5 +/- 1.23D at 2 years postoperatively. The mean spherical equivalent in the non operated fellow eye was -1.0 +/- 1.18D preoperatively and -2.25 +/- 1.05D at 2 years. The mean spherical equivalent myopic anisometropia was -7.75 +/- 2.34D preoperatively and -0.5 +/- 0.31D at 2 years, representing a 93.5% reduction in myopic anisometropia. At 6 months, 14 eyes (77.8%) were within +/-1D of the targeted refraction and at 2 years, 10 eyes (55.6%) were within +/-1.0D. The mean regression value was -2.25 +/- 1.7D, however, 15 eyes (83.3%) were within 3.0D of the fellow eye. The mean BCVA was significantly improved from 0.26 +/- 0.21 preoperatively to 0.82 +/- 0.17 by 2 years after LASIK with amblyopia treatment.

CONCLUSION: LASIK is a safe and effective alternative method for correcting myopic anisometropia facilitating treatment of amblyopia, only considered in children with spectacles or contact lens intolerance, with more improved visual acuity and binocular vision.
The main purpose of this study was to reduce the refractive error in the amblyopic eye so it became more equal to the fellow eye, thereby improving:

- Spectacle tolerance
- Amblyopia therapy,
- BCVA
- Binocular sensory outcome
All eyes (25 eyes) were amblyopic and not successfully treated with the standard amblyopia treatment (occlusion and/or optical penalization) for 6 months.

Conventional correction using various combinations of spectacles and/or contact lenses (CL) had failed.
➢ All parents were given a detailed explanation of the procedure and the risk/benefits of laser treatment.

➢ They were instructed that laser treatment aimed at alleviating the refractive difference between the two eyes rather than getting rid of glasses.

➢ Also they were informed that LASIK would not stop the progression of the refractive error or alleviate the need for occlusion therapy.
Exclusion criteria

- Children with previous intraocular surgery, corneal scarring, active inflammation
- Pachymetry value less than 450 micron, keratoconus, a Schirmer test of less than 5.0 mm, and narrow palpebral fissure
- Intraocular pressure more than 21 mmHg, and associated posterior segment pathology.
Postoperative improvement of both myopic errors and visual acuity in studied group.
Laser in situ keratomileusis was performed under general anaesthesia with inhalation induction while the airway was maintained with a laryngeal airway.

No patient required intubation.
The intended correction was emmetropia if the refractive error was present only in the amblyopic eye, or achievement of bilateral balance in refraction of both eyes to facilitate wearing of glasses.

Followed by full binocular correction and occlusion of the better eye postoperatively.

A part time occlusion regimen was used, i.e., all children were patched 25–50% of waking hours.
Results

There was good compliance with spectacle correction of the residual refraction because of the successful reduction of anisometropia in all eyes.
The targeted vs achieved refraction at 6 months and 2 years was determined.

➢ **At 6 months**, 17 eyes (68%) were within ±1.0D of the targeted refraction.

➢ **At 2 years**, 12 eyes (48%) were within ± 1.0D.

There were significant changes in refraction at 2 years postoperatively compared with the 6th month postoperative (ongoing trend of myopic shift)
BCVA was significantly improved from 0.47 ± 0.13 preoperatively to 0.72 ± 0.17 by 2 years after surgery with amblyopia treatment.
Figure 1 Mean keratometry (A) and mean pachymetry (B) values in the operated eyes showed stability after 6–24 months.

Stabilization of pachymetry after 2 years follow up
No significant complications were noted. No general anesthesia complications were observed,
Conclusion

Children with anisometropia and high myopia who cannot tolerate spectacles and contact lenses, have unacceptable vision despite adequate amblyopia therapy, and are still at the age at which amblyopia can be critically influenced.

Lasik surgery offer a hope
LASIK surgery in children
M O’Keefe, L Nolan

Aims: To report success in the treatment of high myopia in children with LASIK. To report the visual results, complications and postoperative management of children with high myopia.

Methods: Six children (seven eyes) with high myopia were included in this series. Preoperative and postoperative refraction, visual acuity, and pachymetry were compared.

Results: Six children with high myopia ranging from −5.00DS to −1.6DS were treated. There were three males and three females. Five children had improved refraction and visual acuity post-LASIK. Age ranged from 2 to 12 years. Five of the children had unilateral amblyopia preoperatively. One had bilateral high myopia.

Conclusion: High myopia in children may be treated safely and effectively with LASIK.

Although it is estimated that over 2.5 million refractive surgical procedures are performed annually, it is an uncommon procedure in paediatric patients. A few studies have suggested that LASIK is indicated in the treatment of high myopia in children.1-2

SUBJECT AND METHODS
Six children (seven eyes) with high myopia underwent LASIK.

Selection of patients was on the basis of failed conventional amblyopia treatment with contact lenses, spectacles, and occlusion therapy. Older children were non-compliant with spectacle or contact lens correction.

Informed consent for the procedure was obtained from the parents. The patients received a full eye examination preoperatively, including visual acuity, dilated fundoscopy, refraction, corneal topography, and pachymetry. Visual acuity was measured with Cardiff acuity cards, Kays pictures, or Snellen chart, according to age. Pachymetry in uncooperative patients was performed using the mechanical ultrasound. Improvemetry was not performed. None of the children had

In summary, refractive surgery, particularly LASIK, at present offers hope in myopic anisometropia, particularly where traditional therapy has failed. There are specific considerations, including anaesthesia, preoperative examination, surgical technique and postoperative care. With careful follow up and long term experience, LASIK may also be extended to other indications including post-cataract surgery and refractive accommodative esotropia. Conventional management strategies afford excellent outcome in terms of visual acuity, binocular single vision, and ocular alignment. Glasses are the current treatment of choice in accommodative esodeviations.16 However, the majority of children never get out of glasses and long term spectacle wear may inhibit emmetropisation as the lens removes the retinal blur, which is most likely the stimulus for the myopic shift towards emmetropisation.19

Larger studies and long term follow up are necessary to fully elucidate the safety and efficacy profile of LASIK in children. In the meantime, we advocate the use of LASIK in children with anisometropia and high myopia to treat amblyopia refractory to conventional management regimes.
Facilitation of amblyopia management by laser in situ keratomileusis in high anisometropic hyperopic and myopic children

Zheng Qin Yin, MD, Hui Wang, MD, Tao Yu, MD, Qian Ren, MBc, and Li Chen, DSc (Tech)

PURPOSE
To assess the efficacy of laser in situ keratomileusis (LASIK) in facilitating amblyopia management of children from 6 to 14 years old, with high hyperopic and myopic anisometropia.

PATIENTS AND METHODS
Between 2000 and 2005, 42 children with high hyperopic anisometropic amblyopia and 32 children with high myopic anisometropic amblyopia underwent LASIK to reduce their anisometropia. LASIK was performed under topical or general anesthesia. Pre- and postoperative best-corrected visual acuity, cycloplegic refraction, and binocular vision were recorded. Follow-up ranged from 6 months to 3 years, the averages of which were 17.45 months in the hyperopic group and 18.31 months in the myopic group.

RESULTS
Hyperopic anisometropia correction ranged from +3.50 D to +7.75 D, and the mean postoperative anisometropia was +0.56 ± 0.75 D at 3 years. Myopic anisometropia correction ranged from −15.75 to −5.00 D and the mean postoperative anisometropia at 3 years was −2.20 ± 1.05 D. The best-corrected visual acuity for distance and reading in the myopic group improved from 0.4 ± 0.25 and 0.58 ± 0.27, respectively, before surgery to 0.59 ± 0.28 and 0.96 ± 0.35, respectively, 3 years after surgery. In the hyperopic group, best-corrected visual acuity for distance and reading improved from 0.23 ± 0.21 and 0.34 ± 0.32, respectively, before surgery to 0.33 ± 0.31 and 0.80 ± 0.33, respectively, 3 years after surgery. The proportion of patients who had stereopsis increased from 19.1% preoperatively to 46.7% postoperatively in the hyperopic group and from 19% to 89% in the myopic group.

CONCLUSIONS
LASIK reduced high hyperopic and myopic anisometropia in children, thus facilitating amblyopia management and improving their visual acuity and stereopsis. (J AAPOS 2007;11:571–576)

Laser in situ keratomileusis (LASIK) has been successfully used for the treatment of myopia, hyperopia, and astigmatism in adults. Refractive surgery by excimer laser has been applied in children as well as in special cases of high myopic anisometropia associated with amblyopia. It has been reported that visual acuity and binocular vision outcomes were significantly better in children who received permanent surgical correction of anisometropia than in those who were conventionally treated with glasses or contact lenses. However, the long-term effects of LASIK in children are not well established.

Further studies with longer follow-up after refractive surgery in children are necessary. Our study presents the effects of the LASIK procedure in lowering high hyperopic and myopic anisometropia in children, with up to 3 years of follow-up, to assess its validity in facilitating the treatment of high anisometropic amblyopia in children older than 6 years.
Laser in situ keratomileusis for treated myopic anisometropic amblyopia in children

Assad A. Ghanem, MD *, Ashraf I. Moad, MD, Ehab H. Nematallah, MD, Ibrahim T. El-Adawy, MD, Ghada M. Anwar, MD

Mansoura Ophthalmic Center, Faculty of Medicine, Mansoura University, Mansoura, Egypt

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KEYWORDS
Amblyopia;
LASIK;
Children;
Myopic anisometropic

Abstract Purpose: To evaluate the effects of laser in situ keratomileusis (LASIK) in decreasing myopic anisometropia in children with spectacles or contact lens intolerance and its validity in facilitating treatment of resultant myopic anisometropic amblyopia.

Patients and methods: LASIK was performed in 18 eyes of 18 children having myopic anisometropic amblyopia not successfully treated with the standard amblyopia treatment for 6 months. Children were followed up at 1 week, 1, 2, 6, 12, 18 and 24 months. Postoperative amblyopia therapy was continued with occlusion of the dominant eye for 6 h daily for the first 3 months and then for 4 h per day as long as possible.

Results: The mean spherical equivalent refraction in the operated eye had reduced significantly from $-9.08 \pm 1.86D$ preoperatively to $-0.97 \pm 1.16D$ at 2 years postoperatively. The mean spherical equivalent in the non-operated fellow eye was $-1.0 \pm 1.15D$ preoperatively and $-2.50 \pm 1.15D$ at 2 years. The mean spherical equivalent myopic anisometropia was $-7.75 \pm 2.25D$ preoperatively and $-0.50 \pm 0.31D$ at 2 years, representing a 93.5% reduction in myopic anisometropia. The mean regression value was $-2.2\% \pm 1.62D$, however, 18 eyes (73%) were within $\pm 0.9D$ of the
Pediatric photorefractive keratectomy for anisometropic amblyopia: a review

Somayeh Tafaghodi Yousefi (MD)”, Mohammad Etezad Razavi (MD), Alireza Esfampour (MD)

Eye Research Center; Khatam Eye Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

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Abstract
Amblyopia is one of the most important reversible eye disorders in children and different treatments are suggested. Early diagnosis and effective treatment in amblyogenic age are important criteria. These critical periods correspond to the period when the child’s developing visual system is sensitive to abnormal input caused by stimulus deprivation, strabismus or significant refractive errors. Traditional treatments such as glass wearing, contact lens used with patch therapy have limitations. Laser corneal refractive surgeries introduce an alternative for the treatment of anisometropic amblyopia. Current indications for refractive surgery include anisometropia, bilateral high myopia and accommodative esotropia. Several reports confirmed that with recent development in keratorefractive surgery, it could be a safe method to be used in children. The goal of the permanent surgical treatment is to reduce refractive errors, treat amblyopia and make better the binocular function. Corneal haze is certainly a major concern in children receiving surface ablation, especially in high myopic treatments. However, controversies still exist on whether it could be done in this population or not. This article reviews the available data about refractive surgery for treating anisometropic amblyopia.
LASIK is a safe and effective alternative method for correcting myopic anisometropia facilitating treatment of amblyopia, not responding to conventional methods of treatment, with more better visual acuity and binocular vision.
Thank You