DOI: 10.14744/eer.2022.17363
Eur Eye Res 2022;2(2):47–53

EUROPEAN EYE RESEARCH

ORIGINAL ARTICLE

Results of wavefront excimer laser correction of refractive errors in adult amblyopic patients

Almila Sarigul Sezenoz, Leyla Asena, Sezin Akca Bayar, Gulsah Gokgoz, Dilek Dursun Altinors

Department of Ophthalmology, Baskent University Faculty of Medicine, Ankara, Turkey

Abstract

Purpose: The objective of the study was to evaluate the refractive outcome in corrected distance visual acuity (CDVA) of adult amblyopic eyes after Wavefront Excimer Laser Correction (WELC) surgery and determine the pre-operative factors that affect the possible visual improvement.

Methods: Sixty-two patients (>21 years) with refractive anisometropic, ametropic amblyopia who underwent WELC surgery between 2014 and 2021 in our clinic were enrolled. Patients with an ocular pathology causing a decrease in vision, abnormal corneal topography, abnormal slit lamp, and fundus examinations were excluded from the study. Medical records of the pre-operative and post-operative 6th month–1 year were retrospectively reviewed for CDVA values, refractive status under cycloplegia, manifest refraction values, the binocular sensory status, and the near stereoacuity measurements. The statistical analyses were held by IBM® SPSS® Statistics 19.0 (SPSS Inc., Chicago IL, USA).

Results: Sixty-two eyes of 62 patients were included in the study. Correlation analysis revealed that pre-operative logMAR CDVA (r=0.495, p=0.04) and pre-operative astigmatism values (r=0.563, p=0.03) had a statistically significant correlation with increase in visual acuity. It was observed that more significant increase in CDVA was obtained in the high astigmatism (≥3D) group (p=0.045). No statistically significant correlations were detected between post-operative increase in CDVA and age (r=–0.08, p=0.78) and type of refractive error (r=–0.19, p=0.50). There was a significant improvement in near stereoacuity measurements postoperatively (p<0.05).

Conclusion: Improvement in CDVA and binocular function was observed in all adult amblyopic eyes after WELC. In adult amblyopic patients, WELC surgery of refractive errors can be an alternative treatment technique.

Keywords: Amblyopia; laser-assisted *in situ* keratomileusis; refractive surgery.

Amblyopia is the reduction in corrected distance visual acuity (CDVA) to worse than 20/30 in one eye or a two-line difference from the fellow eye without any structural pathologies.[1] It is widely believed that amblyopia cannot be treated after a critical period in childhood, however, there is evidence that the treatment responsive period continues in adulthood to some extent.[2] Increase in visual acuity was reported before in amblyopic eyes of patients

Cite this article as: Sarigul Sezenoz A, Asena L, Akca Bayar S, Gokgoz G, Dursun Altinors D. Results of wavefront excimer laser correction of refractive errors in adult amblyopic patients. Eur Eye Res 2022;2:47-53.

Correspondence: Almila Sarigul Sezenoz, M.D. Department of Ophthalmology, Baskent University Faculty of Medicine, Ankara, Turkey
Phone: +90 536 686 97 63 **E-mail:** almilasarigul@gmail.com
Submitted Date: 18.01.2022 **Accepted Date:** 10.03.2022

after visual deprivation in fellow healthy eyes.[3,4]

Recent studies have shown that amblyopia may be a primarily binocular disorder and the adult brain may retain sufficient plasticity for cortical modification to occur even after the critical period.[5] Therefore, newer therapeutic strategies involving the restoration of cortical plasticity and reduction of interocular suppression to re-establish binocular function and stereopsis have been gaining more importance.[6–9]

Laser-assisted *in situ* keratomileusis (LASIK) surgery is a commonly used safe and effective treatment method for a wide range of refractive errors. The range may change according to the laser device, patient characteristics, corneal factors, and surgeon's own experience.[10,11] Visual acuity improvement has been shown after LASIK refractive surgery in both pediatric and adult amblyopic eyes before.[2,12–15]

In this study, our purpose was to evaluate the changes in CDVA of adult amblyopic eyes after Wavefront Excimer Laser Correction (WELC) surgery and to determine the pre-operative factors that affect the possible visual improvement.

Materials and Methods

In this retrospective study, the medical records of all patients who underwent WELC surgery between January 2014 and January 2021 were analyzed. The study was approved by the local ethics committee of our university (Project number: KA17/62) and adhered to the tenets of the Declaration of Helsinki. Written informed consent was obtained from all subjects to participate in this study. All procedures were performed by the same experienced refractive surgeon (DDA) with WELC (WaveLight® Allegretto Wave® Eye-Q Laser, Alcon Laboratories, Inc., Fort Worth, Texas, USA). Unlike conventional laser platforms, the WELC quantifies and corrects the higher-order corneal aberrations and is expected to produce better visual acuity results.[16] Only adult patients (>21 years) with refractive anisometropic and ametropic amblyopia, using contact lenses or glasses for refractive correction, were enrolled in the study. Amblyopia was defined as a difference of two lines in CDVA between the two eyes or a CDVA of 20/30 or worse in at least one eye. Patients who had an ocular pathology that caused a decrease in vision, patients with a tropia, abnormal corneal topography, abnormal slit lamp, and fundus examination were excluded from the study. All patients were diagnosed with amblyopia in childhood and had a course of amblyopia treatment in the first 12 years of their lives. In anisometropic amblyopia; 1.5 diopter (D) difference in between the two eyes in myopic and hypermetropic spherical equivalent values and 1.5 D difference in astigmatism were considered as anisometropia.

The medical records of the patients were reviewed for the pre- and post-operative CDVA values, the refractive status (myopia/hypermetropia/astigmatism) under cycloplegia, the binocular sensory status, and the near stereoacuity measurements. The binocular sensory status was evaluated with the Worth four dot (W4D) test. The test consists of four lights that are arranged in a diamond shape with a red light at the top, two green lights at the left and right sides, and a white light at the bottom. During the test, the patients wore red-green glasses with a red lens over the right eye and a green lens over the left eye. The red lens blocks green light and the right eye can see only the top and bottom lights, whereas the green lens blocks red light and the left eye can see only the side and bottom lights. The bottom light is seen in both eyes and a patient with normal binocular vision will appreciate four lights with a flickering red-green light at the bottom because of binocular rivalry.[17] The results of the test were interpreted as suppression when the patient saw two or three dots, normal binocular fusional response when the patient saw four dots, and diplopia when the patient saw five dots.

The stereoacuity measurements were performed with Randot Stereotest booklet (Precision Vision, Woodstock, New York State, USA). Under standard illumination, the booklet was held at 40 cm and viewed through polarizing glasses after best visual acuity correction. Only the amblyopic eye of patients with anisometropic amblyopia and the right eye of patients with ametropic amblyopia were included in the study. The pre-operative values were compared with the post-operative 6th month values of each parameter. We grouped the patients as high myopia (≥6 D), moderate myopia (<6 D), high hypermetropia (≥5 D), moderate hypermetropia (<5 D), high astigmatism (≥3 D), and moderate astigmatism (<3 D). High myopia was defined according to the previous studies.[17] There was no consensus in the previous literature for hypermetropia and astigmatism values; therefore, we grouped our patients according to the distribution of the refractive status in this cohort.[18–21] The mean thinnest corneal thickness was 554±23 μm. The mean scotopic pupil size of the patients was 5.2±0.9 mm.

A standard surgical protocol was performed on each patient. Before surgery, two drops of topical anesthetic (Alcaine® 0.5% proparacaine hydrochloride ophthalmic solution, Alcon Laboratories, Inc., Fort Worth, Texas, USA) were instilled. A corneal flap was created with the help of Moria M2 mechanical microkeratome with 130 μm head (Moria,

Antony, France). The Wavelight Allegretto Eye-Q excimer laser system was used for corneal ablation using the wavefront optimized treatment program. In all patients, the optical zone was fixed at 6.5 mm for myopia and 7 mm for hypermetropia and mixed astigmatism as recommended by the manufacturer. In all cases, the corneal flap was lifted, and excimer laser ablation was delivered to the stroma. The interface was irrigated with balanced salt solution removing any debris and the flap was replaced. Mild topical steroids and antibiotics were given for 4 days postoperatively.

According to spherical equivalent of pre-operative refraction, 20 patients (32.3%) with high hypermetropia (≥5 D), 16 (25.8%) with moderate hypermetropia (<5 D), 18 (29.0%) with moderate myopia (<6 D) and 8 (12.9%) with high myopia (≥6 D), 55 patients (88.7%) with moderate astigmatism (<3 D), and 7 patients (11.3%) with high astigmatism (≥3 D) were included in the study. Within the patients with moderate astigmatism, 22 patients had with-the-rule, 8 had against-the-rule, and 25 had oblique astigmatism. In the high astigmatism group, three patients had against-the-rule, three patients had oblique, and one patient had with-the-rule astigmatism.

The statistical analyses were held by IBM® SPSS® Statistics 19.0 (SPSS Inc., Chicago IL, USA). Student's t-test, Wilcoxon test, Pearson correlation analysis, one-way analysis of variance tests, and Bonferroni correction for *post hoc* analyses were used.

Results

Sixty-two eyes of 62 patients were enrolled in the study (42 females and 20 males). The mean age was 36.4±9.7 years (range: 21–56 years). Fourteen patients (22%) used contact lenses, 38 patients (62%) used glasses, and 10 patients (16%) used both glasses and contact lenses for refractive correction preoperatively.

Eighteen patients (29.0%) had CDVA ≤20/200 with Snellen scale, 24 patients (38.7%) between 20/200 and 20/40, and 20 patients (32.3%) between 20/40 and 20/25. Postoperatively, 44 patients (71.0%) had increased CDVA values, while in others, there was no improvement in vision. Twenty eyes (32.3%) had an increase in CDVA of one Snellen line, 17 (27.4%) had an increase of one to three lines, and 7 (11.3%) had an increase of more than three lines (Fig. 1). The mean post-operative follow-up time was 7.5±2.5 months (range: 6–12 months). The post-operative spherical equivalent values and the stability of the mean spherical equivalent values in follow-up visits are shown in Figures 2 and 3. Changes in refractive status and visual acuity are given in Table 1. The mean visual acuity in the sound eye of the patients with ametropic and anisometropic amblyopia was 0.38±0.26 logMAR and 0.03±0.05 logMAR, respectively. The mean amount of anisometropia in anisometropic amblyopic eyes was 4.56±2.13 D (2.0 D–8.8 D).

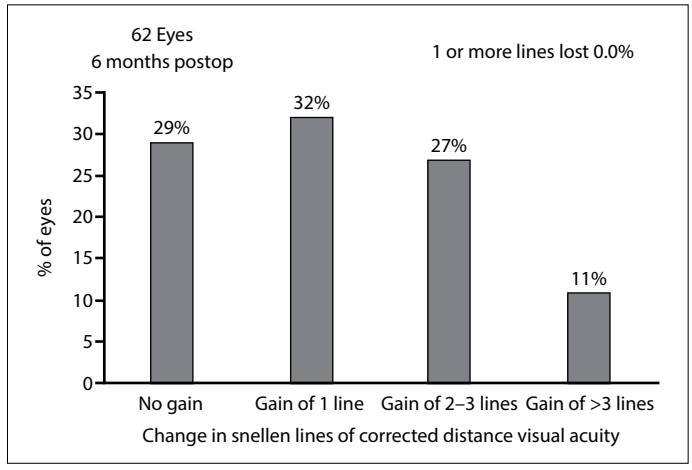

Fig. 1. Change in corrected distance visual acuity at 6 months postoperatively.

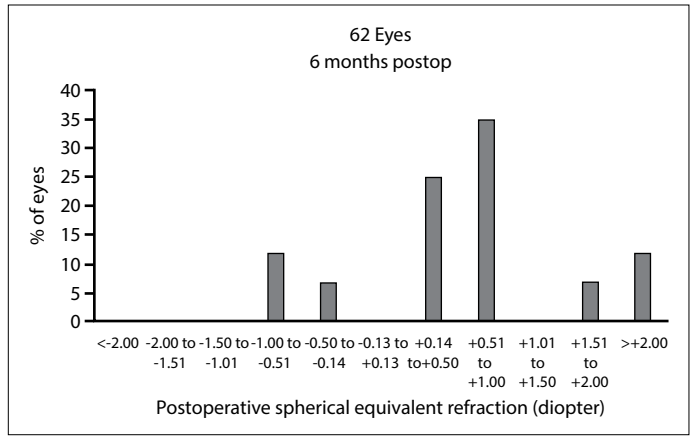

Fig. 2. The post-operative 6 months spherical equivalent refractive accuracy.

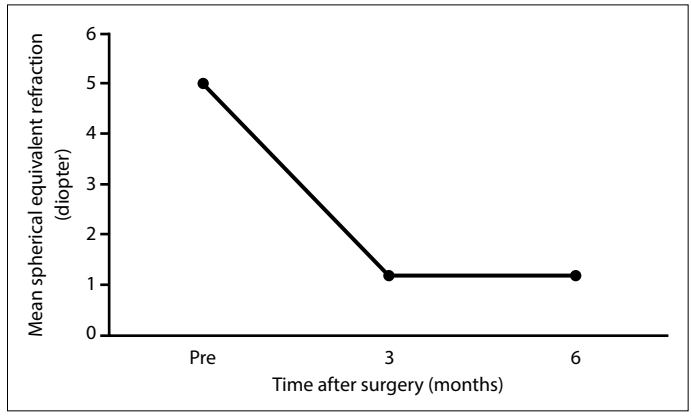

Fig. 3. The post-operative stability of spherical equivalent refraction.

Table 1. The refractive status and visual acuity of patients pre- and post-operative

	Pre-operative (Mean±SD)	Post-operative (Mean±SD)	p-value
Sphere (D)	5.19±3.17	1.28±1.69	<0.01
Cylinder (D)	1.02±1.04	0.58±0.34	0.047
Spherical equivalent (D)	5.07±2.99	1.33±1.81	<0.01
Visual acuity (LogMar)	0.29 ± 0.25	0.19 ± 0.28	0.02

SD: Standard deviation, D: Diopter.

The pre-operative W4D test revealed fusion in nine patients, suppression in 18 patients, and diplopia in 35 patients while the post-operative W4D test revealed fusion in nine patients, suppression in three patients, and unsteady diplopia in 50 patients. None of the patients showed loss of fusion post-operatively. None of the patients had a complaint of clinical diplopia after surgery. None of the patients had tropia.

The circles stereoacuity ranged between 200 and 70 s of arc in patients with a CDVA of 20/200–20/40 and between 200 and 50 s of arc in the group with CDVA between 20/40 and 20/25. The animals stereoacuity ranged between 400 and 200 s of arc in patients with a CDVA of 20/200–20/40 and between 400 and 100 s of arc in the group with CDVA between 20/40 and 20/25. The Randot stereoacuity ranged between no Randot stereopsis and 250 s of arc in patients with a CDVA of 20/200–20/40 and in the group with CDVA between 20/40 and 20/25. Post-operative stereoacuity measurements were held on the 3rd month. Preoperatively, none of the patients with a CDVA ≤20/200 had any recordable stereopsis. None of the patients had decreased stereoacuity in any of the tests postoperatively. No improvement of stereoacuity was observed in any of the patients with CDVA ≤20/200. The overall median circles test value was 140 s of arc (range: 50–200) preoperatively and 100 s of arc (range: 50–140) post-operatively. There was a statistically significant difference between the pre- and post-operative stereoacuity measurements with circles test (p=0.01). The overall median animals test value was 200 s of arc (range: 100–400) preoperatively and 200 s of arc (range: 100–400) postoperatively. There was a statistically significant difference between the pre- and post-operative stereoacuity measurements with animals test (p=0.046). The overall median Randot test value was 250 s of arc (range: 250–500) preoperatively and 250 s of arc (range: 250–500) postoperatively. There was no statistically significant difference between the pre- and post-operative stereoacuity measurements with Randot test (p=0.91).

When CDVA increase and pre-operative values were evaluated with correlation analysis, it was detected that pre-operative logMAR CDVA (r=0.495, p=0.04) and pre-operative astigmatism values (r=0.563, p=0.03) had a statistically significant correlation with increase in visual acuity. The pre-operative and post-operative astigmatism values are given in Figure 4. When the relation between astigmatism values and CDVA increase was evaluated, it was observed that more significant increase in CDVA was obtained in the high astigmatism (≥3D) group (p=0.045) (Fig. 5). The visual improvement and refractive outcomes in patients with different pre-operative refractive status were also evaluated (Fig. 6). In making this comparison, astigmatism <0.75 was

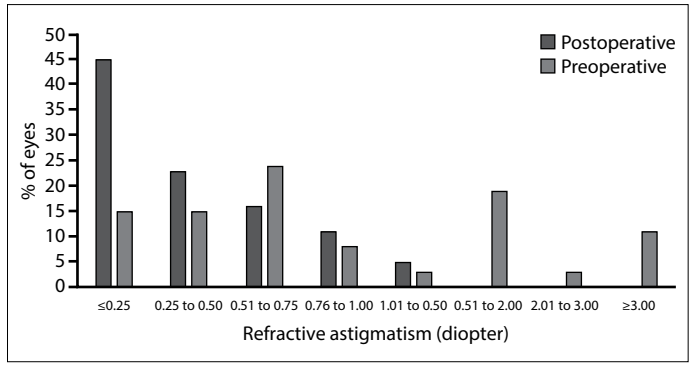

Fig. 4. The distribution of refractive astigmatism (D: Diopters).

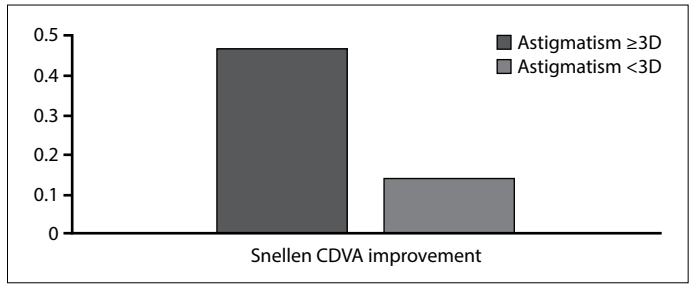

Fig. 5. Change in Snellen visual acuity in low and high astigmatism groups (CDVA: Corrected distance visual acuity; D: Diopters).

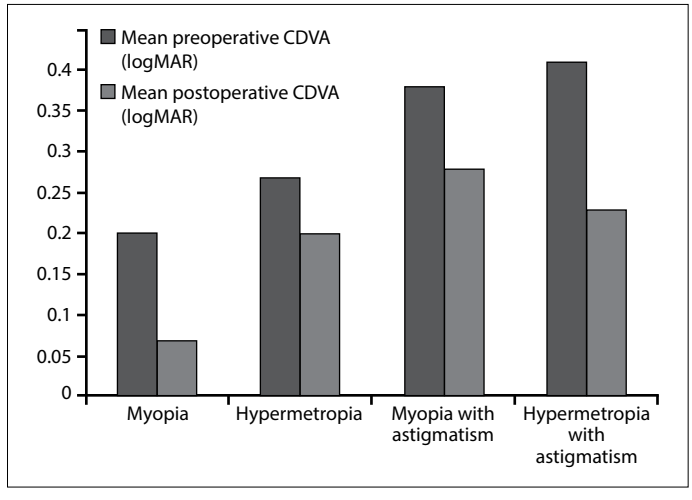

Fig. 6. The pre-operative and post-operative corrected distance visual acuity values in different pre-operative refractive states.

neglected. In myopic only eyes without astigmatism, the post-operative visual acuity improvement was found to be statistically significant (p=0.04). In hypermetropic only eyes without astigmatism, the visual acuity improvement was not found to be statistically significant (p=0.06). In myopic eyes with accompanying astigmatism, the visual acuity improvement was not found to be statistically significant; while it was found to be significant in hypermetropic eyes with astigmatism (p=0.06 and p=0.01, respectively). In all groups, a statistically significant improvement in refractive outcome was obtained (p=0.04, p=0.005, p= 0.04, and p=0.002).

No statistically significant correlations were detected between post-operative increase in CDVA and age (r=–0.08, p=0.78) or type of refractive error (r=–0.19, p=0.50).

Discussion

Laser *in situ* keratomileusis surgery has become a common choice of treatment for a wide range of refractive errors. The traditional way to correct refractive errors is by glasses or contact lenses. However, especially adult patients who have not been using glasses since early childhood have trouble tolerating correction of high refractive errors with glasses and complain of aniseikonia or asthenopia. Furthermore, contact lenses are not always easily adopted and manipulated by some patients. For high and especially against the rule astigmatism, it is difficult to perform full correction by spectacles or contact lenses due to resultant meridional magnification, visual aberrations, and distortions.[22] Therefore, refractive surgery becomes a preferred choice of treatment by many patients. Amblyopia is common among adult patients with high refractive errors who were not properly treated in the critical childhood period. Although recent studies claim that it is possible to obtain an increase CDVA with LASIK surgery in both pediatric and adult amblyopic patients, there is no established consensus on the use of this technique in amblyopic eyes.[2,12–14,18–21]

In our study, we found that WELC surgery can lead to increase in CDVA in amblyopic eyes. We detected positive correlations of CDVA increase with pre-operative logMAR CDVA and pre-operative astigmatism values. Interestingly, increase in visual acuity was more prominent in patients with pre-operative high astigmatism and low visual acuity. Our results are comparable with the previous studies in the literature.[18,22] Arruabarrena et al.[18] also found an inverse relationship between pre-operative CDVA and visual improvement. In another study by Erdem et al.,[22] the researchers found that decreased pre-operative CDVA and high pre-operative mixed astigmatism were correlated with post-operative CDVA increase like in our study. The more significant improvement in eyes with high astigmatism in our study can be explained by the decreased corneal toricity and increased optical quality after wavefront guided laser refractive surgery.[18] And also as it is more difficult to find the convenient contact lenses for high astigmatic patients, their life quality can improve dramatically after surgery.

There are different arguments suggested in the literature for the improvement in CDVA after LASIK surgery. Gonzalez-Lopez et al.[23] have compared the results of LASIK surgery and insertion of posterior chamber phakic intraocular lens in adult amblyopic eyes and found out that the CDVA increased after these procedures. The authors suggested that the improvement in CDVA could be attributed to the reduction of visual aberrations caused by spectacles and the relative magnification of the retinal image as the correction is closer to the nodal point of the eye in these procedures.[23] In another study, Agca et al.[2] have concluded that a significant improvement in CDVA became detectable 1 month after LASIK surgery and CDVA continued to increase in the following months. The authors explained that finding by the role of neural mechanisms and visual system plasticity.[2] Many recent studies also support that visual cortex plasticity can be restored or enhanced later in life, paving the way for new strategies for the treatment of both children and adult amblyopia.[24–26]

Amblyopia is regarded as a binocular disorder.[27] Therefore, in our study, we also evaluated binocular sensory status and stereopsis of the patients. We used W4D and Randot stereoacuity tests for that purpose. There are several studies investigating the effects of refractive surgery procedures on binocular visual functions. Sarkar et al.[28] have shown that LASIK surgery can cause deterioration of binocular depth related visual functions due to impairment of optical quality. Unlike that study, none of the patients in our study demonstrated worsening of binocular function after WELC of the amblyopic eyes. The stereoacuity of the patients either improved or stayed the same after the surgical procedure. W4D test is used to assess the degree of binocular vision. It has three possible results; suppression, diplopia, and fusion. We have demonstrated that after WELC surgery of the amblyopic eyes, the suppression of the amblyopic eye in W4D test was reduced and unsteady diplopia was detected. This result showed that although the patients could not fuse the images from the two eyes properly, the suppression of one eye was overcome. Therefore, unsteady diplopia in W4D testing was a positive out-

come for our patient group which is a sign of improvement of binocular function. Singh et al.[29] have shown that stereoacuity shows significant improvement after LASIK correction regardless of the type of refractive error. Furthermore, Mravicic et al.[30] have also demonstrated that binocular function improved after LASIK surgery in anisometropic patients. Our results are compatible with these previous studies in the literature and show that WELC surgical correction of amblyopia not only improves CDVA but it also improves binocular function evaluated by stereoacuity and W4D tests. The limitations of the present study were the retrospective study design and having a relatively limited number of patients.

Conclusion

We observed CDVA and binocular function improvement in adult amblyopic eyes after WELC surgery. We detected that the improvement of CDVA was correlated with pre-operative astigmatism values and pre-operative CDVA values. Therefore, based on our results, WELC refractive surgery can be considered as a preferable method of treatment in adult amblyopic patients.

Ethics Committee Approval: This study was approved by Baskent University Faculty of Medicine Ethics Committee (date: 07.03.2017; number: KA17/62).

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: A.S.S., L.A., S.A.B., G.G., D.D.A.; Design: A.S.S., L.A., S.A.B., G.G., D.D.A.; Supervision: A.S.S., L.A., S.A.B., G.G., D.D.A.; Resource: A.S.S., L.A., S.A.B., G.G., D.D.A.; Materials: A.S.S., L.A., S.A.B., G.G., D.D.A.; Data Collection and/or Processing: A.S.S., L.A., S.A.B., G.G., D.D.A.; Analysis and/or Interpretation: A.S.S., L.A., S.A.B., G.G., D.D.A.; Literature Search: A.S.S., L.A.; Writing: A.S.S., L.A., S.A.B., G.G., D.D.A.; Critical Reviews: A.S.S., L.A., S.A.B., G.G., D.D.A.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Zhao PF, Zhou YH, Wang NL, Zhang J. Study of the wavefront aberrations in children with amblyopia. Chin Med J (Engl). 2010;123:1431-5.
2. Agca A, Ozgürhan EB, Baz O, Bozkurt E, Ozkaya A, Yaşa D, et al. Laser in situ keratomileusis in adult patients with anisometropic amblyopia. Int J Ophthalmol 2013;6:362–9.
3. Lengyel D, Valmaggia C. Visual improvement of an amblyopic eye in an adult patient after visual loss in the non-amblyopic eye. Klinische Monatsblatter Fur Augenheilkunde. 2006;223:462–4. [CrossRef]
4. Wilson ME. Adult amblyopia reversed by contralateral cataract formation. J Pediatr Ophthalmol Strab 1992;29:100–2. [CrossRef]
5. Vagge A, Nelson LB. Amblyopia update: New treatments. Curr Opin Ophthalmol 2016;27:380–6. [CrossRef]
6. Hess RF, Thompson B. New insights into amblyopia: Binocular therapy and noninvasive brain stimulation. J AAPOS 2013;17:89–93. [CrossRef]
7. Hoyt C. What is next in amblyopia treatment? Ophthalmology 2015;122:871–3. [CrossRef]
8. Wong AM. New concepts concerning the neural mechanisms of amblyopia and their clinical implications. Can J Ophthalmol 2012;47:399–409. [CrossRef]
9. Tsirlin I, Colpa L, Goltz HC, Wong AM. Behavioral training as new treatment for adult amblyopia: A meta-analysis and systematic review. Investig Ophthalmol Visual Sci 2015;56:4061–75. [CrossRef]
10. Sugar A, Rapuano CJ, Culbertson WW, Huang D, Varley GA, Agapitos PJ, et al. Laser in situ keratomileusis for myopia and astigmatism: Safety and efficacy: A report by the American academy of ophthalmology. Ophthalmology 2002;109:175–87. [CrossRef]
11. Sutton G, Lawless M, Hodge C. Laser in situ keratomileusis in 2012: A review. Clin Exp Optom 2014;97:18–29. [CrossRef]
12. Yin ZQ, Wang H, Yu T, Ren Q, Chen L. Facilitation of amblyopia management by laser in situ keratomileusis in high anisometropic hyperopic and myopic children. J AAPOS 2007;11:571–6. [CrossRef]
13. Dedhia NC, Behl S. Laser in situ keratomileusis for anisometropic amblyopia. J Refract Surg 2000;16:S264–7. [CrossRef]
14. Sakatani K, Jabbur NS, O'Brien TP. Improvement in best corrected visual acuity in amblyopic adult eyes after laser in situ keratomileusis. J Cataract Refract Surg 2004;30:2517–21. [CrossRef]
15. Sorkin N, Varssano D, Smadja D, Klein A, Mimouni M, Rosenblatt A. Visual outcomes of laser vision correction in eyes with preoperative amblyopia. J Cataract Refract Surg 2017;43:383–8. [CrossRef]
16. Li SM, Kang MT, Wang NL, Abariga SA. Wavefront excimer laser refractive surgery for adults with refractive errors. Cochrane Database Syst Rev 2020;12:CD012687. [CrossRef]
17. Bak E, Yang HK, Hwang JM. Validity of the worth 4 dot test in patients with red-green color vision defect. Optom Vis Sci 2017;94:626–9. [CrossRef]
18. Arruabarrena C, Teus MA, Hernandez-Verdejo JL, Canones R. Visual acuity after laser in situ keratomileusis to correct high astigmatism in adults with meridional amblyopia. Am J Ophthalmol 2011;152:964–8. [CrossRef]
19. Ghanem AA, Moad AI, Nematallah EH, El-Adawy IT, Anwar GM. Laser in situ keratomileusis for treated myopic anisometropic amblyopia in children. Saudi J Ophthalmol 2010;24:3–8. [CrossRef]
20. Lin XM, Yan XH, Wang Z, Yang B, Chen QW, Su JA, et al. Long-term efficacy of excimer laser in situ keratomileusis in the management of children with high anisometropic amblyopia. Chine Med J 2009;122:813–7.
21. Phillips CB, Prager TC, McClellan G, Mintz-Hittner HA. Laser in situ keratomileusis for treated anisometropic amblyopia

in awake, autofixating pediatric and adolescent patients. J Cataract Refract Surg 2004;30:2522–8. [CrossRef]
22. Erdem U, Muftuoglu O. Optical factors in increased best spectacle-corrected visual acuity after LASIK. J Refract Surg 2006;22:S1056–68. [CrossRef]
23. Gonzalez-Lopez F, Alonso-Santander N, Mompean B, Bilbao-Calabuig R, Calvache JA, Beltran J. Visual outcomes in adult amblyopic eyes with moderate myopia after corneal laser surgery versus copolymer phakic intraocular lens implant. J Cataract Refract Surg 2015;41:2513–23. [CrossRef]
24. Sengpiel F. Plasticity of the visual cortex and treatment of amblyopia. Curr Biol 2014;24:R936–40. [CrossRef]
25. Pescosolido N, Stefanucci A, Buomprisco G, Fazio S. Amblyopia treatment strategies and new drug therapies. J Pediatr Ophthalmol Strabismus 2014;51:78–86. [CrossRef]
26. Bochner DN, Sapp RW, Adelson JD, Zhang S, Lee H, Djurisic M, et al. Blocking PirB up-regulates spines and functional synapses to unlock visual cortical plasticity and facilitate recovery from amblyopia. Sci Transl Med 2014;6:258ra140. [CrossRef]
27. Spiegel DP, Baldwin AS, Hess RF. The relationship between fusion, suppression, and diplopia in normal and amblyopic vision. Invest Ophthalmol Vis Sci 2016;57:5810–7. [CrossRef]
28. Sarkar S, Bharadwaj SR, Reddy JC, Vaddavalli PK. Longitudinal changes in optical quality, spatial vision, and depth vision after laser refractive surgery for myopia. Optom Vis Sci 2020;97:360–9. [CrossRef]
29. Singh D, Saxena R, Sinha R, Titiyal JS. Stereoacuity changes after laser in situ keratomileusis. Optom Vis Sci 2015;92:196–200. [CrossRef]
30. Mravicic I, Bohac M, Lukacevic S, Jagaric K, Maja M, Patel S. The relationship between clinical measures of aniseikonia and stereoacuity before and after LASIK. J Optom 2020;13:59–68.