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Evaluation of Improvement of Best Corrected Visual Acuity Following Lasik Treatment in Anisometropic Amblyopia.

Tamer Adel Refai MD, FRCS, Olfat ahmed Hassanin, MD.

Ophthalmology Department, Research Institute of ophthalmology Giza Egypt.

Objective:
To assess the correction of refractive error with LASIK improves the best corrected visual acuity(BCVA) in anisometropic amblyopic eyes.

Design:
Case-control study.

Participants:
for 20 eyes (of 20 Egyptian patients) with anisometropic amblyopia,will undergo Lasik.

Methods:
The study included 20 anisometropic amblyopic eyes of 20 patients that had undergone the Lasik procedure using the (The ALLEGRETTO WAVE EYE-Q 1010) from January to september 2011.They were 8 males eyes and 12 females eyes. The refractive errors were 18 myopic with astigmatism, 1 hypermetropic and 1 purely myopic.Preoperative assessment included visual acuity (both uncorrected and best corrected visual acuity), subjective refraction, corneal topography, pachymetery, intraocular pressure and fundus examination.

Main Outcome Measures:
16 cases out of 20 cases (80%) has gained one to five lines of best corrected Snellen visual acuity while the remainder i.e: 4 cases (20%) has same best corrected as preoperative and no cases has lost any lines of best corrected visual acuiy. The average preoperative spherical equivalent(Sph.eq)was (–8.95 ±2.51D),while the average postoperative spherical equivalent was (–0.43 ±0.68D) The average preoperative sphere was (–7.43 ±3.50D) and astigmatism (–1.49 ±1.21D). The average postoperative sphere was (–1.28 ±1.611D) and astigmatism (–0.64 ±0.74D). The Best corrected visual acuity increased in snellen lines from an mean of 0.58 ±0.21 preoperative to 0.78 ±0.17 postoperative. The uncorrected visual acuity increased in snellen lines from an mean of 0.04 ±0.04 preoperative to 0.65 ±0.20 postoperative. The average increase in the postoperative best corrected visual acuity in snellen lines was 0.19±0.15 standard deviation.The age or sex of patients was not noted to have a significant effect on the improvement of the best corrected visual acuity but a significant correlation (0.53 ,p value <0.01) exists between the improvement of the BCVA and the extent of the preoperative refractive error.

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The author has no proprietary or commercial interest in any of the materials discussed in this article.

Anisometropia is:
the condition in which there is a difference in refractive power between two eyes of a patient. The disparity between image magnification on two retinas is known as aniseikonia. Generally, spectacle wearers become symptomatic when approximately 3 D of difference exists in spherical or cylindrical correction. Anisometropia can compromise the patient's binocular function. It may result in headache, photophobia, blurring, tearing, diplopia and blurred vision (Haili Li, MD, PhD; Guy Chan, MD, FACS 2001).

Amblyopia, also known as lazy eye is a disorder of the visual system that is characterized by a vision deficiency in an eye that is otherwise physically normal, or out of proportion to associated structural abnormalities of the eye(Weber JL,Wood Joanne 2005).The prevalence of amblyopia was found to be 50% in hypermetropes with 2 diopters and myopes 4 diopters (Hevelson EM: 1966).

Among the many methods available to correct anisometropia are correction with spectacles or contact lenses. When *spectacles* are used, the difference in image formed by either eye prevents perfect fusion of two images, causing loss of binocular vision and usually amblyopia in the affected eye. Many of these patients cannot tolerate full correction with spectacles because of aniseikonia. Undercorrection becomes mandatory to decrease these types of symptoms.*Contact lenses* are the most realistic method for correcting significant anisometropia. They yield more satisfactory visual results than spectacles. Both soft and gas-permeable contact lenses are extremely effective and remain the primary technique of visual rehabilitation for patients who cannot

Corresponding Author: Tamer Adel Ophthalmology Department, Research Institute of ophthalmology Giza Egypt.

tolerate spectacles.But contact lens correction is not always possible in patients requiring visual correction. In many cases, lens intolerance and inability to adapt the lens to the eyes' condition lead to the failure of therapy and development of amblyopia. Contact lens intolerance may be caused by ocular, occupational and systemic factors. Patients with dry eyes, blepharitis, lid abnormalities and corneal neovascularization may not tolerate contact lenses (Haili Li, MD, PhD; Guy Chan, MD, FACS 2001).

Laser in situ keratomileusis (LASIK) became a safer way to correct refractive error especially when glasses were not applicable and the patient was not interested to wear contact lenses (Alio JL, Artola A, *et al.*, 1998 & Baraquet IS, Wygnanski-Jaffe T *et al*., 2004).

Objective:

In this study,I presented my results assessing the efficacy of LASIK in treating cases of anisometropic amblyopia and its effects on the best corrected visual acuity.

Design:

Case-control study.

Participants:

20 eyes (of 20 Egyptian patients with anisometropic amblyopia), undergo Lasik at Research Institute Of Opthalmology Guiza (Egypt) with Allegretto wave light Eye-Q 1010 from January to september 2011.They were 8 males and 12`females. The age of the patients ranged from 16 y to 42 years. The refractive errors were 18 myopic with astigmatism, 1 hypermetropic and 1 purely myopic.The procedure was explained to the patient putting in mind the possibility of limited improvement of best corrected visual acuity post operative.

Exclusion Critria:

i. Progressive and unstable myopia,
ii. Very thin cornea(less than 500 microns by Pentacam).
iii. Degeneraive conditions:, keratconus, Keratoglobus and pellucid marginal degeneration).
iv. Previous history of eye inflammation e.g. HSV keratitis, herpes zoster ophtahlmicus, AIDS, uveitis.
v. Glaucoma
vi. Systemic disease: autoimmune and systemic collagen disease e.g. rheumatoid arthritis, lupus.
vii. Pregnancy.

Methods:

Preoperative assessment included visual acuity (both uncorrected and best corrected visual acuity), subjective refraction, corneal topography & pachymetry (with pentacam, Allergo), intraocular pressure (Applanation tonometer) and fundus examination with mydriatic (indirect ophthalmoscope and 3 mirror contact lens as necessary).

All cases undergo Lasik procedure (preserving at least 300 microns bed)

The LASIK Procedure:

1) Application of topical anesthesia with proparacaine hydrpchloride 0.4 % (Benox eye drops) 5 minutes just before the operation.
2) Povidone-Iodine10% (Betadine) of the eyelids.
3) Speculum is placed in the operated eye.
4) Corneal marker using surgical marker.
5) The microkeratome handle was applied over the cornea using (Moria M2 microkeratome) creating a Superior hinged corneal flap.
6) Ablation was performed by the Allegretto Wave Light Eye-Q 1010.
7) The stromal bed was irrigated with balanced salt solution (BSS).
8) The flap was reposed in position painted by get of air.
9) The flap alignment was checked using preoperative corneal marker.
10) Patient received antibiotics, corticosteroid eye drops and preservatives free tears natural

Patient was followed up first day, first week, first month for flap complications and interface debris,refraction, and visual acuity. The collected data were tabulated and analysed with the suitable statistical methods. The mean values and standard deviation were calculated for quantitive data. Comparison (t-test) and correlation tests (Pearson) were also performed.The effect of age ,sex and the degree of refractive error on the results was studied.

Main Outcome Measures:

The study included 20 eyes of 20 patients with unilateral neglected refractive anisometropic amblyopic eyes.

The age of the patients ranged from 16 years to 42 (average 28.00 ±7.91 years.) They were 8 male patients and 12 female patients. The preoperative sphere ranged from –12.5 to +3.75 D (average –7.43 ±3.50D and astigmatism ranged from 0.00 to –4.00 D (average –1.49 ±1.21D). The postoperative sphere ranged from –4.50 to 0.50 D (average –1.28 ±1.61D and astigmatism ranged from –1.0 to+1.0 D (average –0.64 ±0.74D). The preoperative spherical equivalent ranged from +3.75 to –13.25D (average –8.95 ±2.51D),while the postoperative spherical equivalent ranged from +0.50 to –2.50D. (average –0.43 ±0.68D) .Preoperative uncorrected visual acuity 0.017 to 0.2 (average 0.04 ±0.04).Preoperative Best spectacles corrected visual acuity 0.2 to 0.9 (average 0.58 ±0.21). Postoperative uncorrected visual acuity 0.3 to 1 (average 0.65 ±0.20). Postoperative Best corrected visual acuity 0.5 to 1 (average 0.78 ±0.17).Improvement in best corrected visual acuity was recorded by gaining or losing visual acuity lines.The improvement was ranged to gain one or more lines: 4 patients (20%) does not gain any line,5 patients (25%) gained one line,5 patients (25%) gained 2 lines,3 patients (15%) gained 3 lines,2 patients (10%) gained 4 lines and1 patient (5%) gained 5 lines (Table 1).No eye has lost any snellen line of Best corrected visual acuity.The average increase in the postoperative best corrected visual acuity in snellen lines was 0.19±0.15 standard deviation.

The Best corrected visual acuity increased in snellen lines from an mean of 0.58 ±0.21 preoperative to 0.78 ±0.17 postoperative with t-test showing a value of 0.001 (p value >0.05) denoting non significant difference (table 2 & chart 1).

Table 1: Showing the number of eyes that has gained lines of Best corrected visual acuity and their percentage.

Visual gain in snellen lines	0	1	2	3	4	5
No of eyes gained	4	5	5	3	2	1
Percentage of eyes gained	20%	25%	25%	15%	10%	5%

Summary:16 eyes(80%) gained from (1- 5 snellen lines) and 4 eyes(20%) did not gain any line.

The uncorrected visual acuity increased in snellen lines from an mean of 0.04 ±0.04 preoperative to 0.65 ±0.20 postoperative with t-test showing a value of 3.51 (p value <0.01) denoting a significant difference(table 2 & chart 1).

Table 2: showing mean value of preoperative and postoperative BCVA and UCVA and their comparison by t-test.

Preoperative BCVA	Postoperative BCVA	T test	P value	significance
0.58 ±0.21	0.78 ±0.17	0.001	>0.05	Non significant
Preoperative UCVA	Postoperative UCVA	T test	P value	significance
0.04 ±0.04	0.65 ±0.20	3.51	<0.01	significant

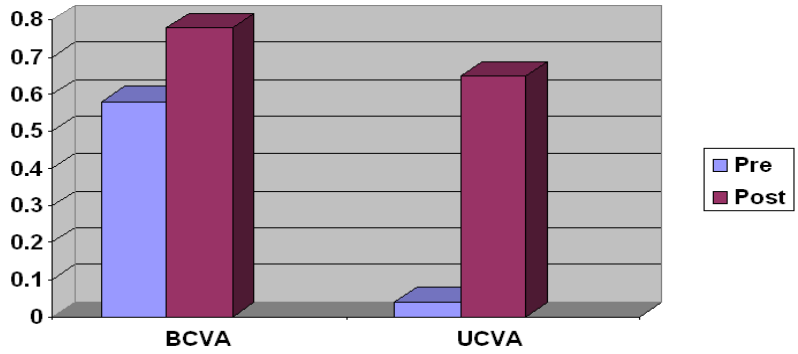

Chart 1: showing mean value for preoperative and postoperative BCVA and UCVA in snellen lines.

To Study the Effect of Age on the Postoperative Increase in Best Corrected Visual Acuity, the Patients were Divided into Two Groups:

Group A:

30 years age and below.

Group B:

Above 30 years/age.

For Group A:30 years age and below, the mean post operative increase in best corrected visual acuity in snellen lines was 0.18 ±0.15 standard deviation,while for Group B: Above 30 years, the mean post operative increase in best corrected visual acuity in snellen lines was 0.17±0.16 standard deviation.The t-test shows a value of 0.63(p=>0.05) denoting non significant difference(Table 3).

Table 3: showing the mean value postoperative increase in BCVA in patients below 30y and above 30y and their comparison by t-test.

Post-operative increase in BCVA <30y	Post-operative increase in BCVA >30y	T test	P value	significance
0.18 ±0.15	0.17±0.16	0.63	>0.05	Non significant

Correlation between the postoperative increase in the Best corrected visual acuity and the age of patients under study reveals a correlation coefficient of –0.21 (P value >0.05) denoting a non significant correlation(table 4).

Table 4: Correlation between the postoperative increase in the Best corrected visual acuity and the age of patients under study.

Item	Correlation coefficient "r"	P value	Significance
Post operative increase in BCVA Vs age of patients	-0.21	>0.05	Non significant

To Study the Effect of Sex on the Postoperative Increase in Best Corrected Visual Acuity, the Patients were Divided into Two Groups:

Group A: males.

Group B: Females

For Group A:males, the mean post operative increase in best corrected visual acuity in snellen lines was 0.15±0.14 standard deviation,while for Group B: females, the mean post operative increase in best corrected visual acuity in snellen lines was 0.21±0.16 standard deviation. The t-test shows a value of 0.43(p=>0.05) denoting non significant difference (table 5).

Table 5: showing the mean value postoperative increase in BCVA in male and female patients and their comparison by t-test.

Post-operative increase in BCVA in males	Post-soperative increase in BCVA in females	T test	P value	significance
0.13±0.13	0.21±0.16	0.43	>0.05	Non significant

Correlation between the postoperative increase in the Best corrected visual acuity and the sex of patients under study reveals a correlation coefficient of 0.19 (P value >0.05) denoting a non significant correlation (table 6).

Table 6: Correlation between the postoperative increase in the Best corrected visual acuity and the sex of patients under study.

Item	Correlation coefficient "r"	P value	Significance
Post operative increase in BCVA Vs sex of patients	0.19	>0.05	Non significant

To Study the Effect of Preoperative Spherical Equivalent on the Postoperative Increase in Best Corrected Visual Acuity, the Patients were Divided into Two Groups:

Group A: eyes with spherical equivalent up to 6 diopters.

Group B: eyes with spherical equivalent above 6 diopters

For Group A: (Sph.eq below 6D), the mean post operative increase in best corrected visual acuity in snellen lines was 0.1 ± 0.00 standard deviation,while for Group B: (Sph.eq above 6D), the mean post operative increase in best corrected visual acuity in snellen lines was 0.24 ± 0.17 standard deviation. The t-test shows a value of 0.008(p=>0.05) denoting non significant difference (table 7).

Table 7 : showing the mean value of postoperative increase in BCVA in patients below or equal to 6D spherical equivalent and those above 6 D spherical equivalent and their comparison by t-test.

Post-operative increase in BCVA in < 6D.	Post-soperative increase in BCVA in >6D.	T test	P value	significance
0.1 ± 0.00	0.24 ± 0.17	0.008	>0.05	Non significant

Correlation between the postoperative increase in the Best corrected visual acuity and the preoperative spherical equivalent of patients under study reveals a correlation coefficient of 0.53 (P value <0.01) denoting a highly significant correlation (Table 8).

Table 8: Correlation between the postoperative increase in the Best corrected visual acuity and the preoperative spherical equivalent of patients under study.

Item	Correlation coefficient "r"	P value	Significance
Post operative increase in BCVA Vs Preop sph eq of patients	0.53	<0.01	Highly significant

RESULT AND DISCUSSION

Although it was well established that therapy of amblyopia is effective only in infants and young children when the visual system is sufficiently plastic for cortical correction yet, several recent reports shown that some improvement in visual function occurs in adult amblyopic eyes when the normal follow eye has lost vision (Sakatani K,Jabbur NS etal 2004, Lanza M, Rose N, Capasso L, *et al*., 2005).

This study included 20 eyes of 20 patients with unilateral neglected refractive anisometropic amblyopic eyes. The age of the patients ranged from 16 years to 42 (average 28.00 ±7.91 years.) They were 8 male patients and 12 female patients. The preoperative sphere ranged from –12.5 to +3.75 D (average –7.43 ±3.50D and astigmatism ranged from 0.00 to –4.00 D (average –1.49 ±1.21D). The postoperative sphere ranged from –4.50 to 0.50 D (average –1.28 ±1.61D and astigmatism ranged from –1.0 to+1.0 D (average –0.64 ±0.74D). The preoperative spherical equivalent ranged from+3.75 to –13.25D (average –8.95 ±2.51D), while the postoperative spherical equivalent ranged from +0.50 to –2.50D. (average –0.43 ±0.68D). Preoperative uncorrected visual acuity ranged from 0.017 to 0.2 (average 0.04 ±0.04).Preoperative Best spectacles corrected visual acuity 0.2 to 0.9 (average 0.58 ±0.21). Postoperative uncorrected visual acuity ranged from 0.3 to 1 (average 0.65 ±0.20). Postoperative Best corrected visual acuity ranged from 0.5 to 1 (average 0.78 ±0.17). Improvement was recorded by gaining or losing visual acuity lines.The improvement was ranged to gain one or more lines. Out of 20 patients 4 patients (20%) does not gain any line while 16 patients (80%) gained from 1-5 lines as follows: 5 patients (25%) gained one line,5 patients (25%) gained 2 lines,3 patients (15%) gained 3 lines,2 patients (10%) gained 4 lines and 1 patient (5%) gained 5 lines.The average increase in the postoperative best corrected visual acuity in snellen lines was 0.19±0.15 standard deviation.

The Best corrected visual acuity increased in snellen lines from an mean of 0.58 ±0.21 preoperative to 0.78 ±0.17 postoperative with t-test showing a value of 0.001 (p value >0.05) denoting non significant difference.,

The uncorrected visual acuity increased in snellen lines from an mean of 0.04 ±0.04 preoperative to 0.65 ±0.20 postoperative with t-test showing a value of 3.51 (p value <0.01) denoting a significant difference.

To Study the Effect of Age on the Postoperative Increase in Best Corrected Visual Acuity, the Patients were Divided into Two Groups:

Group A:

30 years age and below.Group B: Above 30 years.

For Group A:

30 years age and below, the post operative increase in best corrected visual acuity in snellen lines was 0.18 ±0.15 standard deviation,while

For Group B:

Above 30 years, the post operative increase in best corrected visual acuity in snellen lines was 0.17±0.16 standard deviation. The t-test shows a value of 0.63(p=>0.05) denoting non significant difference Correlation between the postoperative increase in the Best corrected visual acuity and the age of patients under study reveals a correlation coefficient of –0.21 (P value >0.05) denoting a non significant correlation.

To Study the Effect of Sex on the Postoperative Increase in Best Corrected Visual Acuity, the Patients were Divided into Two Groups:

Group A:

Males.

Group B:

Females.

For Group A:

males, the post operative increase in best corrected visual acuity in snellen lines was 0.15±0.14 standard deviation,while for

Group B:

females, the post operative increase in best corrected visual acuity in snellen lines was 0.21±0.16 standard deviation. The t-test shows a value of 0.43(p=>0.05) denoting non significant difference . Correlation between the postoperative increase in the Best corrected visual acuity and the sex of patients under study reveals a correlation coefficient of 0.19 (P value >0.05) denoting a non significant correlation.

To Study the Effect of Preoperative Spherical Equivalent on the Postoperative Increase in Best Corrected Visual Acuity, the Patients were Divided into Two Groups:

Group A:

E eyes with spherical equivalent up to 6 diopters.

Group B:

eyes with spherical equivalent above 6 diopters.

For Group A:

(Sph.eq below 6D), the post operative increase in best corrected visual acuity in snellen lines was 0.1 ± 0.00 standard deviation,while for

Group B:

(Sph.eq above 6D), the post operative increase in best corrected visual acuity in snellen lines was 0.24 ± 0.17 standard deviation. The t-test shows a value of 0.008(p=>0.05) denoting non significant difference Correlation between the postoperative increase in the Best corrected visual acuity and the preoperative spherical equivalent of patients under study reveals a correlation coefficient of 0.53 (P value <0.01) denoting a highly significant correlation.

Faik Orucoglu, MD, Joseph Frucht-Pery, MD et al., 2011 in a study on 30 amblyopic eyes undergo laser vision correction using the Technolas 217z excimer laser (Bausch & Lomb) was performed. Mean patient age was 31.03±10.05 years (range: 18 to 53 years). Mean preoperative BCVA improved in amblyopic eyes from 0.50±0.13 to 0.57±0.20 postoperatively (average gain of 0.075±0.14; *P*=.007) Five of 30 eyes with mild to moderate amblyopia gained 2 to 4 lines of BCVA.

Valente *et al.*, 2006. in a study on a 26 eyes of adult high myopic anismetropia stressing on preoperative binocular orthoptic evaluation to avoid diplopia found that most of the amblyopic eye had improvement of BCVA without postoperative diplopia.

Lanza *et al.*, 2005. in a study on adult amblyopic (38 eyes ranging from -14.36 D to + 3.75 D) using photorefractive keratectomy (PRK) showed that most of their patients had an improvement in BCVA mainly in those with mild to moderate amblyopia.

Sakatani K,Jabbur NS *et al.*, 2004. Twenty-one eyes of 19 patients were identified as having amblyopia and LASIK surgery. Eleven eyes (52.4%) had myopic astigmatism, 7 eyes (33.3%) were hyperopic, and 3 eyes (14.3%) had mixed astigmatism. Nine eyes (42.8%) experienced more than a 1-line improvement in postoperative BSCVA compared with the preoperative BSCVA. The BSCVA was unchanged in 11 eyes (52.4%) and was worse by 2 lines in 1 eye (4.8%).

Baraquet 2004. in respective non comparative review on eight eyes amblyopic adult eyes founded a mean gain of 3 Snellen lines (range 2 to 4 lines). All patients reported significant subjective improvement in their perception of vision.

The Improvement in BCVA in the patients could be explained by the following: In post refractive surgey in amblyopic eyes, a sharper image in the operated eye could force the brain to use their previous lazy eye. The improvement after refractive surgery is probably due to relative magnification and relief from the spherical aberration rather than a real recovery from amblyopia as all these cases have a better seeing eye (Moseley M, Fielder A 2001, El Mallah MK, Chakravarthy U *et al*., 2000; Levi DM, Polat U *et al*., 1997).

Conclusion

From this study we concluded that LASIK improves best corrected visual acuity in most of adult patients with anisometropic amblyopic eyes .The extent of improvement is not affected by the age or the sex of the patients but it increases with the increase in the extent of the preoperative refractive error.

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The author has no proprietary or commercial interest in any of the materials discussed in this article.

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