

# Visual outcome after excimer laser refractive surgery in adult patients with amblyopia

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**PURPOSE.** To evaluate the visual and refractive outcome in adult patients with refractive and anisometropic amblyopia treated with photorefractive keratectomy.

**METHODS.** An interventional non-comparative study was performed on 50 consecutive patients with amblyopia treated with photorefractive keratectomy. Sixty-eight eyes of 18 participants with bilateral refractive amblyopia and 32 participants with unilateral anisometropic amblyopia were studied. The photorefractive keratectomy was performed with MEL 70 G-Scan excimer laser. Follow-up was 1, 3, 6, and 12 months after the treatment.

The mean outcome measures were uncorrected visual acuity (UCVA), best spectacle corrected visual acuity (BCVA), refraction, and corneal transparency.

**RESULTS.** In 64.7% of eyes, the UCVA at 12 months after the treatment was better than or equal to their preoperative BCVA. A total of 82.4% of eyes improved their BCVA one or more lines. No eye lost lines of BCVA, 17.6% remained unvaried, 50% gained one line, 20.6% gained two lines, and 11.8% gained three lines of BCVA. The number of lines gained correlated strongly with diopters of anisometropia between eyes ( $p < 0.01$ ). The mean sphere changed from  $-5.62 \pm 3.37$  D to  $-0.47 \pm 1$  D, mean cylinder varied from  $-2.36 \pm 1.57$  to  $-0.18 \pm 0.41$  D, and the spherical equivalent varied from  $-6.82 \pm 3.1$  to  $-0.45 \pm 1.08$  D. No clinically significant haze was observed.

**CONCLUSIONS.** Excimer laser refractive surgery appears to be a safe and efficient procedure in the treatment of ametropic and anisometropic amblyopia in adults. Adult patients with anisometropic and refractive amblyopia could benefit from the refractive treatment with significant improvement of the visual acuity. (*Eur J Ophthalmol* 2006; 16: 214-8)

**KEY WORDS.** Amblyopia, Anisometropia, Myopia, Photorefractive keratectomy, Refractive surgery, Excimer laser

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## INTRODUCTION

Amblyopia is referred to as reduced best-corrected visual acuity (BCVA) in the absence of any other cause.

Refractive amblyopia is successfully treated in children with appropriate correction of refractive errors with contemporary occlusion (1, 2). In the adult population, such treatment proves to be less efficient.

However, some authors report encouraging data (3). Excimer laser refractive surgery in patients with anisometropic amblyopia is used mainly with a pediatric population, but this approach remains controversial (4-11). In the literature we found only three reports concerning visual outcome in amblyopic adults after refractive surgery and they exhibit a small number of eyes. Dedhia and Behl, Barequet et al, and Sakatani

et al reported improvement in visual acuity in amblyopic adults after refractive procedure, but their reports include a small number of eyes with high variability of amblyopia (12-14). Due to the high incidence of anisometropic amblyopia in the adult amblyopic population (50% documented) the improvement of visual outcome in such patients should be seen as a social goal (15). The purpose of this study is to evaluate the visual acuity in an adult population with anisometropic or refractive amblyopia who have received excimer laser correction of refractive errors.

## PATIENTS AND METHODS

This interventional non-comparative study was conducted in two ophthalmic centers, at the University of Messina, Italy, and University of Catania, Italy. Fifty consecutive patients with amblyopia, selected for excimer laser procedure, were enrolled in the study. In this multicenter investigation the preoperative examinations and follow-up were made by two different equipments who adopted the same inclusion criteria and examination protocol.

In amblyopic eyes the BCVA was less than 20/25 and in anisometropia the dioptric difference between eyes was greater than 1.5 D of spherical equivalent. Only patients who completed 12 months follow-up were considered for this investigation. Eighteen participants were male and 32 participants were female.

The age ranged from 25 to 41 years (average  $32.82 \pm 6.02$ ). Eighteen subjects presented bilateral refractive amblyopia (36 eyes) and 32 participants had unilateral anisometropic amblyopia (32 eyes). In total, 68 eyes were examined. Preoperative examination included uncorrected visual acuity (UCVA), BCVA, cycloplegic refraction, corneal topography, pachymetry, pupillometry, specular microscopy, tonometry, ophthalmoscopy, and ocular motility.

Patients with heterotropia were excluded from this study. Informed consent was obtained from all the participants and the photorefractive keratectomy was performed by two of us (A.R. and S.B.) with MEL 70 G-Scan excimer laser provided with gaussian flying spot. Ablation zone ranged from 6 to 7 mm with extension of 1.8 mm of transition.

Eight eyes with high myopia received a partial correction. At the end of surgery contact lens was ap-

plied for 4 to 5 days and antibiotic, non-steroid anti-inflammatory drops and artificial tears were instilled four times daily until epithelium healed. Then, steroid drops treatment started. Follow-up was 1, 3, 6, and 12 months after the treatment. No additional anti-amblyopia treatment, such as patching, was performed during the study. No enhancement was done during the follow-up period.

The mean outcome measures were UCVA, BCVA, refraction, and corneal transparency. The statistical test for linear regression and correlation was applied.

## RESULTS

### *Visual acuity*

Preoperative uncorrected visual acuity ranged from 20/50 to less than 20/200. It was equal to or better than 20/200 in 13 eyes (19.1%), it was equal or better than 20/100 in 4 eyes (5.9%), and it was worse than 20/200 in 55 eyes (80.9%).

At 1 year from the treatment the UCVA was comprised between 20/20 and 20/200 (8 eyes received partial correction).

It dropped to 20/20 in 9 eyes (13.2%), it was equal to or better than 20/25 in 32 eyes (47.1%), equal to or better than 20/40 in 53 eyes (77.9%), 20/100 or better in 56 eyes (82.3%), and 20/200 or better in 68 eyes (100%) (Fig. 1). BCVA before the treatment ranged from less than 20/25 to 20/40.

Postoperatively, the values ranged between 20/20 and 20/40 and 100% were equal to or better than 20/40, in 41 eyes (60.3%) it was 20/25 or better and in 12 eyes (17.6%) it dropped to 20/20. Fifty-six eyes (82.4%) improved BCVA one or more lines. No eye lost lines, 12 eyes (17.6%) remained unvaried, 34 eyes (50%) gained one line, 14 eyes (20.6%) gained two lines, and 8 eyes (11.8%) gained three lines of BCVA (Fig. 2).

In 44 eyes (64.7%) UCVA at 1 year after the treatment was better than or equal to their preoperative BCVA. These eyes did not need any correction.

In the patients with anisometropic amblyopia, all amblyopic eyes gained lines of BCVA.

The number of lines gained correlated strongly with diopters of anisometropia between eyes. The correlation coefficient was 0.53 and this correlation was

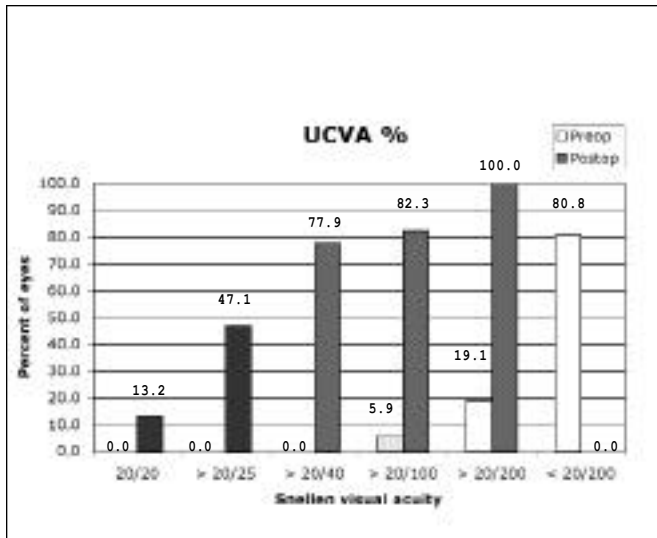


Fig. 1 - Uncorrected visual acuity overtime bar graph.

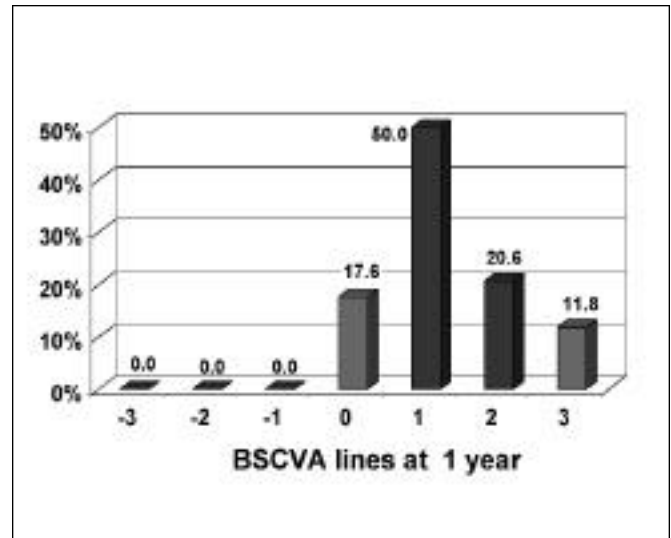


Fig. 2 - Change in best spectacle corrected visual acuity bar graph.

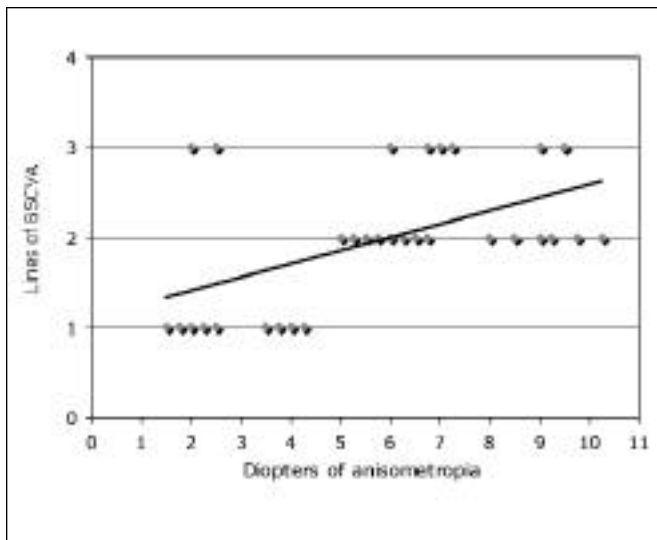


Fig. 3 - Correlation between diopters of anisometropia and lines gained. Coefficient of correlation  $r=0.53$ ,  $p=0.002$ .

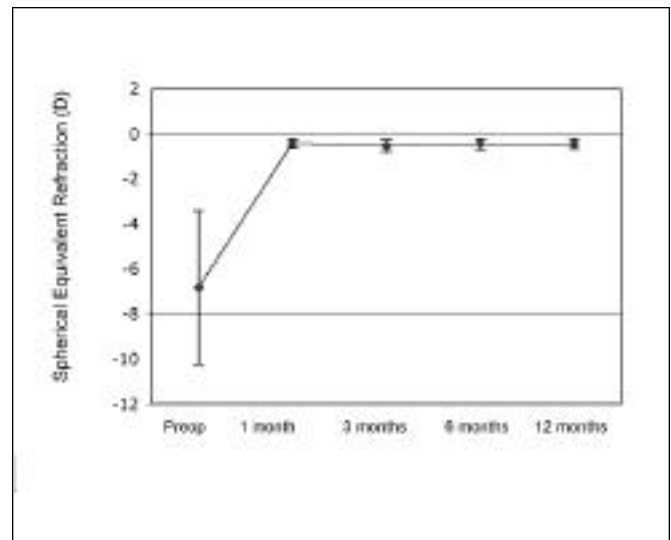


Fig. 4 - Stability of refraction graph.

statistically significant with  $p=0.002$  (Fig. 3).

An optical correction was required in 22 eyes (32.4%), 14 eyes (20.6%) had a refraction within  $\pm 1.5$  D, and 8 eyes (11.8%) had a residual refractive error because of the partially treated high refractive error.

### Refraction

The refractive errors were high myopia and compound myopic astigmatism.

The sphere ranged from  $-0.50$  to  $-13$  D (mean  $-5.62 \pm 3.37$ ), cylinder varied from  $-0.5$  to  $-5$  D (mean  $-2.36 \pm 1.57$ ), and the spherical equivalent varied from  $-2.5$  D to  $-13.5$  D (mean  $-6.82 \pm 3.1$ ).

At 1 year the mean sphere changed to  $-0.47 \pm 1$  (range 0 to  $-4$  D) and the mean cylinder varied to  $-0.18 \pm 0.41$  D (ranged from 0 to  $-1.5$  D). SE dropped to  $-0.34 \pm 1.14$  D (range 0 to  $-4.25$ ).

Figure 4 shows the mean values of spherical equivalent toward the follow-up.

Stability of the results is evident among all of the follow-up examinations and it is achieved at the first month after the laser surgery.

### Corneal transparency

At 1 month a slight haze of 0.5 was observed in 13 eyes (19.1%) and moderate haze of 2 was present in 1 eye (1.5%).

At 3 months a slight haze was present in 17.6% of eyes, a moderate haze was observed in 1.5% of eyes; at 6 months follow-up the haze 0.5 was present in 8.8% (6 eyes) and the haze of 1 in 1.5% (1 eye). Finally, 1 year after the correction the trace haze was present in 3 eyes (44%).

## DISCUSSION

The existing reports regarding laser refractive surgery in amblyopic eyes refer mainly to the pediatric population and only a small number of the eyes are available. Nano et al obtained interesting visual results in five patients, but severe haze appeared in 50% of the eyes (4).

Aliò et al treated six anisometropic eyes with PRK and observed good visual outcome with only one eye having severe haze (5). Rashad treated 14 anisometropic children with laser-assisted in situ keratomileusis (LASIK) and obtained good results without any complications (8). Nucci and Drack reported photorefractive keratectomy (PRK) and LASIK treatment in 14 anisometropic eyes and observed no lines lost and visual improvement in 50% of the eyes (6). Nassaralla and Nassaralla performed LASIK in nine children's eyes and report impressive results (7). Paysse et al obtained good refractive and visual outcome in 11 anisometropic children treated with PRK (10). Atrata and Rehurek compared refractive surgery with conventional treatment of anisometropic amblyopia in children and concluded that the refractive procedure appeared more effective with significantly better visual improvement (11). Dedhia and Behl treated a mixed group of patients with LASIK: 3 were children and 18 were adults. In total 61.9% of eyes gained lines of BCVA and 4.8% lost one line of visual acuity and the remaining 33.3% were unvaried. The results obtained exclusively in adult eyes show BCVA

improvement in 66.7%, unvaried in 27.8%, and one line loss in 5.6% (12). Recently, Barequet et al reported encouraging visual and refractive results in adult patients with amblyopia treated with LASIK, but the study was done on a very small number of eyes ( $n = 8$ ) and the follow-up was 6 months (13). In a study performed on 21 eyes with different refractive errors and different types of amblyopia, Sakatani et al found the postoperative BCVA to be better in 42.8% of amblyopic eyes (14).

In the present study, a considerable number of patients were enrolled, 68 eyes were examined, and it exclusively included an adult population with refractive or anisometropic amblyopia.

A total of 82.4% of eyes improved BCVA, 17.6% remained unvaried, and none lost lines of preoperative BCVA. No clinically significant haze was observed.

The most important data obtained in the present study are related to the group of patients with anisometropia. In fact, significant correlation between diopters of anisometropia and visual improvement was detected ( $p < 0.01$ ). Therefore, it can be stated that high dioptric differences led to high visual recovery in eyes with anisometropic amblyopia.

Excimer laser refractive surgery appears to be a safe and effective procedure in the treatment of ametropic and anisometropic amblyopia in adults. This study demonstrates that adult patients with anisometropic and refractive amblyopia benefit from refractive treatment and a good visual outcome can be expected. Especially in patients with anisometropic amblyopia can important results be expected with improvement of optical quality of the eye.

Such a therapeutic approach could therefore be recommended for the treatment of ametropic and, above all, anisometropic amblyopia also in adults.

The visual improvement in amblyopic subjects should be investigated further, especially in relation to the other refractive errors and dense amblyopia.

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