

Photorefractive keratectomy for moderate myopia with the VISX and Summit excimer lasers: A retrospective study

Cerectomia fotorrefrativa para correção de miopia moderada com excimer lasers VISX e Summit: Estudo retrospectivo

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SUMMARY

Purpose: To present photorefractive keratectomy (PRK) results for myopia ranging from -4.00 to -6.00 diopters performed with the VISX and Summit excimer lasers.

Methods: To be eligible for this study, patients had to be 20 to 45 years of age, have -4.00 to -6.00 diopters of myopia and have no more than 1 D of astigmatism. The Summit group was composed of 51 eyes. The baseline preoperative spherical equivalent of myopia was -5.22 ± 0.17 and surgeries were performed with the Excimed UV 200 LA Excimer Laser. In the VISX group, there were 53 eyes and the baseline refractive error was -4.85 ± 0.16 and surgeries were performed with the Twenty/Twenty Excimer Laser.

Results: At six-month examination, haze ranged from 0 to 1 (M: 0.56 ± 0.07) in the VISX group and from 0 to 3 (M: 0.58 ± 0.08) in the Summit group. Uncorrected vision at six months was 20/20 or better in 22% of eyes and 20/40 or better in 83% of eyes in the VISX group. In the Summit group, 25% of eyes were 20/20 or better and 71% were 20/40 or better at the six-month examination.

Conclusion: It is reassuring that PRK of patients with -4.00 to -6.00 D of myopia results in acceptable results.

Keywords: Excimer laser; Myopia; Correction.

INTRODUCTION

Since the introduction of the 193 nm argon-fluoride excimer laser for cornea surgery in 1983 ¹, much progress has been made in the use of this pulsed gas laser to treat myopia. Currently, photorefractive keratectomy (PRK) and laser assisted *in situ* keratomileusis (LASIK) are the two primary procedures used for the correction of myopia. PRK has become a common technique worldwide for the treatment of low to moderate myopia but recently it has been suggested that LASIK may be a procedure preferred to PRK for higher degrees of myopia ².

Seiler et al ³ reported that after a single PRK treatment for myopias up to -3.0 diopters, 100 % of eyes were within 1.0 diopter of emmetropia and 97% of eyes had an uncorrected visual acuity of 20/40 or better. For higher degrees of myopia, PRK results are said to be less predictable and stable.

The purpose of this study is to evaluate the efficacy of PRK, in the treatment of myopia ranging from - 4.00 to - 6.00 diopters with the VISX and Summit excimer lasers.

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PATIENTS AND METHODS

To be eligible for this study, patients had to be 20 to 45 years of age, have -4.00 to -6.00 diopters of myopia, have best spectacle-corrected visual acuity of 20/40 or better in both eyes, and have no more than 1 D of astigmatism. Other criteria included no active or residual diseases that were likely to affect wound healing such as keloids or excessive dermal scarring. Patients wearing soft contact lenses or rigid gas permeable contact lenses were required to discontinue lenses 2 weeks before baseline evaluation and patients wearing polymethylmethacrylate (PMMA) hard contact lenses were required to discontinue wearing them 3 weeks before baseline evaluation and to demonstrate regular keratometry mires and less than 0.50 diopters of variation in both meridians on manifest refraction during at least two of three weekly visits thereafter.

The Summit group was composed of 51 eyes. The baseline preoperative spherical equivalent of myopia ranged from -4.00 to -6.00 diopters (M:-5.22 ± 0.17). There were 23 males and 28 females. Ages ranged from 21 to 42 years (M:30.94 ± 0.86). Surgeries were performed at the Hospital A. Paré, Paris, with the Excimer UV 200 LA Excimer Laser (Summit Technology, Waltham, Massachusetts). The wavelength of the argon-fluoride laser was 193 nm, the fluence 180 mJ/cm², and the pulse repetition rate 10 Hz. Ablation zone ranged from 3.7 to 5.0 mm. At the beginning of each treatment session a homogeneity test was carried out to monitor beam quality. The surgical procedure is described elsewhere ⁴.

In the VISX group, there were 53 eyes and the baseline refractive error ranged from -4.00 to -6.00 diopters (M:-4.85 ± 0.16). Ages ranged from 20 to 44 years (M:33.13 ± 1.00) and there were 42 males and 11 females. Surgeries were performed at the Louisiana State University Eye Center, New Orleans, with the Twenty/Twenty Excimer Laser (VISX Inc., Santa Clara, California), as previously described ⁵. The wavelength was 193 nm, fluence 160 to 168 mJ/cm², repetition rate of 5 Hz and ablation zone 5.00 to 6.00 mm in diameter.

Preoperative examinations included measurement of uncorrected and best corrected visual acuity, manifest refraction, pachymetry, keratometry, intraocular pressure measurement, grading of corneal clarity and mapping of corneal topography.

Visual acuity data originally recorded in Snellen notation were converted to minutes of visual angle, and logarithms of the minutes of visual angles were used for statistical analysis ⁶.

Attempted correction was the spherical equivalent at the corneal plane for that eye. Corneal haze was graded at each examination according to the following scale: 0 indicated clear, no haze; 0.5 indicated barely detectable haze; 1 indicated mild haze not affecting refraction; 1.5 indicated haze mildly affecting refraction; 2 indicated moderate haze with refraction possible but difficult; 3 indicated opacity preventing refraction but anterior chamber easily viewed and 4 indicated

opacity impairing view of anterior chamber. Topographic analysis was performed to evaluate the ablation with the EyeSys Corneal Analysis System (EyeSys Laboratories, Houston, TX) in the Summit group and with TMS-1 (Tomey-Computed Anatomy, Tomey Technology Inc., Cambridge, MA) in the VISX group.

In the VISX group, immediately after laser surgery, one drop of 1% atropine sulfate was applied. Afterwards, 0.3% ciprofloxacin.HCl 0.3% drops 4 times a day and 0.1% diclofenac sodium drops 4 times a day were applied and a therapeutic contact lens placed on the eye. Treated eyes were examined for infection every 24 to 48 hours until reepithelialization was completed. Thereafter, only topical fluorometholone drops were administered at a tapering dosage for 5 months, as follows: 4 times a day for 1 month, 3 times a day for the second month, twice a day for the third month, once a day for the fourth month, and once every other day for the fifth month. Postoperative examinations, which consisted of the same tests and measurement as the preoperative examinations, were performed at 1-, 3- and 6- month visits.

The Summit group received no medication immediately after laser surgery and all eyes were patched till the second postoperative day. According to the reepithelialization rate, corticotherapy and antibiotic therapy (dexamethasone-neomycin-polymyxin drops 5 times a day) were started on the second postoperative day or delayed one or two days. Thereafter, it was tapered for the next 5 months. The postoperative examinations were the same as for the VISX group.

Data variable was analyzed with SAS-PC software, using the procedure for general linear models with the Ismeans options for multicomparison evaluations.

RESULTS

The procedure was completed successfully in all patients. The epithelial defect was closed after 5 days in all eyes. There were no ophthalmic complications during the six-month follow-up.

Corneal Clarity: All eyes were graded as clear prior to the surgery. At one-month examination, haze ranged from 0 to 1.5 (M:0.7 ± 0.07) in the VISX group and from 1 to 2 (M:1.2 ± 0.07) in the Summit group. After 6 months, these values ranged from 0 to 1 (M:0.56 ± 0.07) and from 0 to 3 (M:0.58 ± 0.08) respectively. Figure 1 shows mean corneal clarity scores plotted over time for both groups.

Visual Acuity: Mean uncorrected visual acuity was FC (range: 20/200 to FC) preoperatively and improved to 20/50 (range: 20/20 to FC) by month 1 and to 20/40 (range: 20/20 to 20/200) by month 6 in the VISX group. In the Summit group, mean uncorrected visual acuity was not determined prior to surgery or at one-month examination. At 6 months, uncorrected visual acuity was 20/40 (range: 20/20 to 20/200). Uncorrected visual acuity at six months was 20/20 or better in

22% of eyes and 20/40 or better in 83% of eyes in the VISX group. In the Summit group, 25% of eyes were 20/20 or better and 71% were 20/40 or better at 6-month examination. The evolution of uncorrected visual acuity over time for both groups is shown in Figure 2.

Best spectacle-corrected visual acuity: In the VISX group it was 20/20 (range: 20/15 to 20/25) preoperatively, 20/25 (range: 20/15 to 20/60) at month one, and 20/20 (range: 20/15 to 20/40) at month 6. In the Summit group, it was 20/20 (range: 20/20 to 20/30) preoperatively, undetermined at month one, and 20/20 (range: 20/20 to 20/30) at month 6. In the VISX group, 22.2 % of patients lost one line and 13.8% lost two lines of best corrected visual acuity; in the Summit group 22.8 % lost one line and 5.7% lost two lines. No patient in either group lost more than 2 lines of

best-corrected visual acuity. Figure 3 shows the evolution of best spectacle-corrected acuity plotted over time for both groups.

Refraction: Average spherical equivalent (SE) changed from -4.85 ± 0.16 D preoperatively to $+0.71 \pm 0.17$ D (range: -1.63 to $+4.63$) 1 month after surgery and to -0.62 ± 0.20 D (range: -4.00 to $+2.00$) by month 6 in the VISX group. The Summit group had a mean SE of -5.22 ± 0.17 D before the surgery. At 1 month, average SE was $+0.80 \pm 0.17$ D (range: -1.23 to $+3.38$), and at 6 month, it was -0.49 ± 0.20 D (range: -3.36 to $+2.58$). At 6-month examination, 61.2% of eyes in the VISX group and 65.7% of eyes in the Summit group were ± 1 D of emmetropia and 94.5% and 85.7% were ± 2 D of emmetropia respectively. Figure 4 shows mean SE over time for both groups.

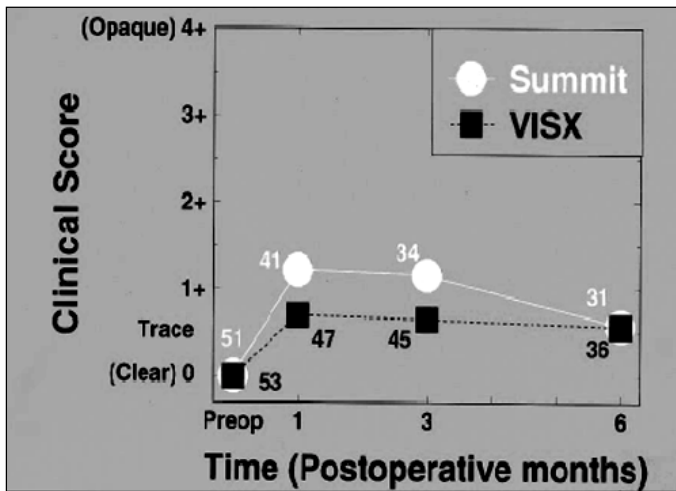


Figure 1 - Corneal haze after PRK with the VISX and Summit excimer lasers.

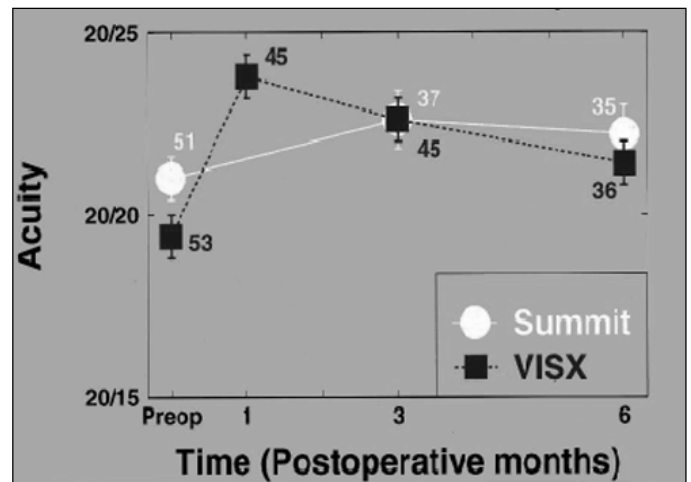


Figure 3 - Best corrected visual acuity after PRK with the VISX and Summit excimer lasers.

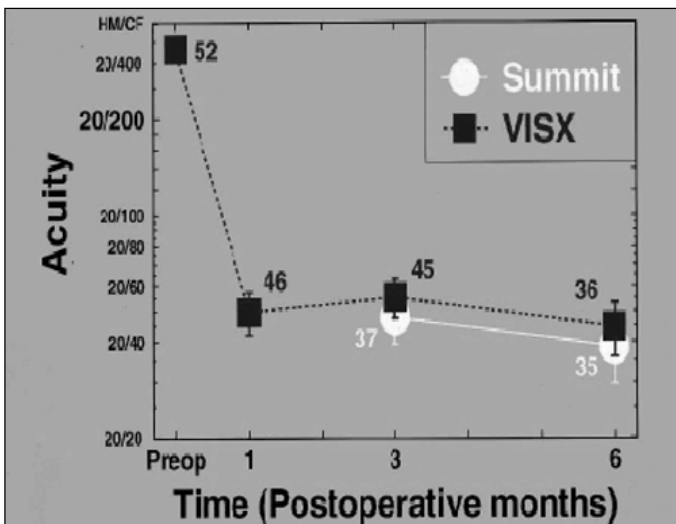


Figure 2 - Uncorrected visual acuity after PRK with the VISX and Summit excimer lasers.

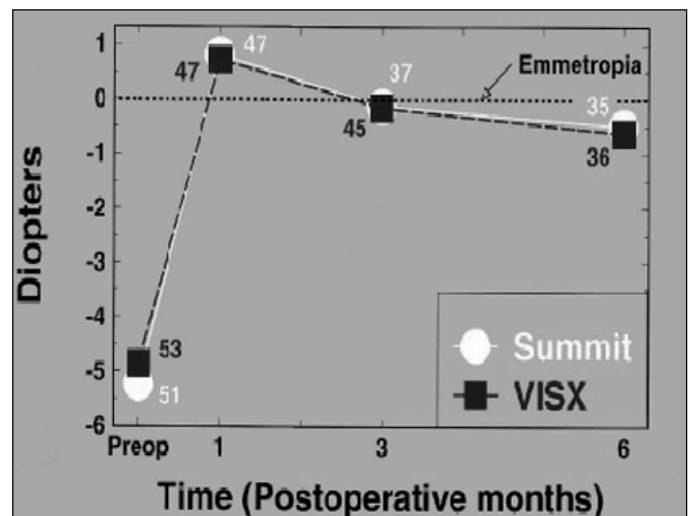


Figure 4 - Evolution of the spherical equivalent after PRK with the VISX and Summit excimer lasers.

Complications: There were no complications in both groups during the follow-up period.

There were no significant differences in clinical results between lasers.

DISCUSSION

The main motivation of patients undergoing refractive surgery is to decrease their dependence on contact lenses or spectacles. After a single PRK treatment for myopia ranging from -1,5 to -6,0 diopters, 85 % and 90,7 % of eyes had a visual acuity of 20/40 or better with the VISX and Summit excimer lasers respectively^{7,8}.

Photorefractive keratectomy appears to be less effective for moderate to high myopia. This technique presents a trend towards a loss of best spectacle-corrected visual acuity due to loss of corneal clarity and corneal topography irregularity, and a tendency to regression that renders the final visual outcome less predictable^{9,10}.

In this double-center, retrospective study, there were no significant differences in clinical results between lasers. For both lasers at six months, haze averaged trace, uncorrected vision averaged 20/40, best corrected vision averaged 20/20, and spherical equivalents averaged approximately -0.50 D. In both groups of eyes, approximately 75% saw 20/40 or better uncorrected, 20% lost one line of best corrected acuity while none lost more than two lines, and 60% were within ± 1 D of emmetropia.

Many of these surgeries were performed with smaller ablation zones, which are believed to cause greater regression and corneal haze. Larger ablation zones appear less likely to stimulate an aggressive wound healing response, thus resulting in improved predictability of PRK¹¹.

Despite a more rapid improvement in uncorrected visual acuity and less discomfort with LASIK, Hersh et al.² found similar outcomes between this procedure and PRK for the correction of 9.2 diopters of myopia. Photorefractive keratectomy has the advantage of greater ease of surgery without complications associated with a corneal flap. For higher degrees of myopia, Pallikaris and Siganos¹² found LASIK to be more predictable and stable than PRK.

The present data have limitations including limited follow-up (although 6 months may be an adequate period of time to achieve refractive stability after PRK, refractive changes may continue after this period) and steroid regimen after PRK (steroid therapy after surgery was left to the individual surgeons).

In this study however, because one laser was used in France and the other used in the United States, the differences between lasers are confounded with differences between patient populations, surgeons, treatment strategies, and postoperative care. The lasers used in this study were first generation lasers. How much these factors contribute to the results obtained here is unknown.

Nevertheless, it is reassuring that PRK of patients with -4.00 to -6.00 D of myopia results in acceptable results, despite the fact that patients may be from different cultures, treated with different lasers operated by different surgeons using different strategies.

RESUMO

Objetivo: Apresentar os resultados obtidos com ceratectomia fotorrefrativa (PRK) para a correção de miopia variando de -4,0 a -6,0 dioptrias realizadas com os excimer lasers VISX e Summit.

Métodos: Para o estudo foram avaliados os resultados de PRK realizadas em pacientes com idade entre 20 e 45 anos, miopia entre -4,0 e -6,0 dioptrias e astigmatismo até 1,0 dioptria. O grupo operado com o laser da marca Summit era composto de 51 olhos. O equivalente esférico médio pré-operatório era de $-5,22 \pm 0,17$ dioptrias e as cirurgias foram realizadas com o Excimer UV 200 LA Excimer Laser. O grupo operado com o laser VISX, era composto de 53 olhos e o erro refrativo pré-operatório era de $-4,85 \pm 0,16$ dioptrias e as cirurgias foram realizadas com o Twenty/Twenty Excimer Laser.

Resultados: Exame seis meses após a cirurgia revelou "haze" variando de 0 a 1 ($M:0,56 \pm 0,07$) no grupo VISX e variando de 0 a 3 ($M:0,58 \pm 0,08$) no grupo Summit. Neste mesmo exame, acuidade visual sem correção era de 20/20 ou melhor em 22% dos olhos e 20/40 ou melhor em 83% dos olhos no grupo VISX. No grupo Summit, 25% dos olhos tinham visão melhor ou igual a 20/20 e 71% melhor ou igual a 20/40.

Conclusão: Ceratectomia fotorrefrativa realizadas em olhos com miopia variando de -4,0 a -6,0 dioptrias apresenta resultados aceitáveis.

Palavras-chave: Excimer laser; Miopia; Correção.

REFERENCES

1. Trokel SL, Srinivasan R, Braren B. Excimer laser of the cornea. *Am J Ophthalmol* 1983;96:710-5.
2. Hersh PS, Brint SF, Malony RK, Durie DS, Gordon M, Michelson MA, Thompson VM, Berkeley RB, Schein OD, Steinert RF. Photorefractive keratectomy versus laser in situ keratomileusis for moderate to high myopia. A randomized prospective study. *Ophthalmology* 1998;105:1512-22.
3. Seiler T, Wollensak J. Results of a prospective evaluation of photorefractive keratectomy at one year after surgery. *Ger J Ophthalmol* 1993;2:135-42.
4. Bokobza Y, Ancel JM, Aron JJ. Résultat clinique de la photo-kératectomie réfractive. Etude préliminaire sur 57 yeux. *J Fr Ophthalmol* 1993;16:225-34.
5. McDonald MB, Frantz JM, Klyce SD et al. Central photorefractive keratectomy for myopia. The blind eye study. *Arch Ophthalmol* 1990;108:799-808.
6. Holladay JT, Prager TC. Mean visual acuity.(Letter) *Am J Ophthalmol* 1991;111:372-4.
7. Seiler T, McDonnell. Excimer laser photorefractive keratectomy. *Surv Ophthalmol* 1995;40:89-118.
8. Thompson KP, Steinert RF, Stulting RD. Photorefractive keratectomy with the Summit excimer laser: the phase III U.S. results In: Salz JJ (ed): *Corneal Laser Surgery*. St Louis: Mosby-Yearbook, 1995; p. 57-63.

9. Ribeiro JC, McDonald MB, Klyce SD. Photorefractive keratectomy after radial keratotomy in a patient with severe myopia. *Am J Ophthalmol* 1994;118:106-8.
10. Ribeiro JC, McDonald MB, Klyce SD. Excimer laser photorefractive keratectomy resulting in more myopia postoperatively than preoperatively. *Arq Bras Oftal* 1998;61:181-3.
11. Halliday BL. Refractive and visual results and patient satisfaction after excimer laser photorefractive keratectomy for myopia. *Br J Ophthalmol* 1995;79:881-7.
12. Pallikaris IG, Siganos DS. Excimer laser in situ keratomileusis and photorefractive keratectomy for correction of high myopia. *J Refract Corneal Surg* 1994;10:498-510.

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