

Epi-LASIK e PRK: one-year comparative study on contralateral eyes

Epi-LASIK e PRK: um ano de estudo comparativo em olhos contralaterais

Francisco Penteadó Crestana¹, Samir Jacob Bechara², Fabiana Tambasco Blasbalg³, Marcelo Vieira Netto⁴, Adriana Mukai⁵

ABSTRACT

Objective: Compare PRK and Epi-LASIK techniques regarding postoperative visual recovery and symptoms. **Methods:** Interventional case series study including 38 eyes of 19 patients with myopia up to 5DE and astigmatism up to 1DC. Study included patients with similar refractive errors to be submitted to PRK in one eye and Epi-LASIK in the fellow eye at the same time. Follow-up was 1 year and included refractive error analysis and postoperative discomfort. **Results:** During the first 12 hours after surgery, 79% ($P=0,0003$) of patients reported more pain and discomfort in the eye submitted to Epi-LASIK. Twenty-four hours after surgery 63,2% ($P=0,012$) of patients still referred more pain in the eye submitted to Epi-LASIK and only 10,5% in the contralateral eye. Uncorrected visual acuity was better on the PRK group at the 1st day ($p=0,034$). No difference was observed at the other postoperative days after surgery. Postoperative corneal haze 0,5 (Fantes) was observed in three eyes of the PRK group and in two days of the Epi-LASIK group. **Conclusion:** Both groups presented good visual refractive results, but the Epi-LASIK group presented more discomfort immediately after surgery.

Keywords: Photorefractive keratectomy; Visual acuity; Pain; Treatment outcome; Myopia; Astigmatism

RESUMO

Objetivo: Comparar as técnicas de PRK e Epi-LASIK com relação à recuperação visual e sintomatologia pós-operatória. **Métodos:** Série de casos intervencionista que incluiu 38 olhos de 19 pacientes com miopia até 5DE e astigmatismo até 1DC. Foram selecionados pacientes com erros refracionais semelhantes nos dois olhos, realizando-se, no mesmo tempo cirúrgico, PRK em um olho e Epi-LASIK no olho contralateral. Os pacientes foram acompanhados por um ano, avaliando-se a eficácia refracional e grau de desconforto pós-operatório. **Resultados:** Durante as primeiras 12 horas, 79,9% dos pacientes ($p=0,0003$) referiram dor mais intensa no olho operado com a técnica Epi-LASIK. Após 24 horas, 63,2% dos pacientes ($p=0,012$) ainda referiam mais dor neste olho e apenas 10,5% no olho contralateral. A acuidade visual não corrigida foi melhor nos olhos do grupo PRK no primeiro dia ($p=0,034$). Nos demais dias não houve diferença significativa entre os grupos. Houve opacidade corneana grau 0,5 (Fantes) em três olhos do grupo PRK e em dois no grupo Epi-LASIK. **Conclusão:** Ambos os grupos apresentaram resultado visual refracional satisfatório, porém o grupo Epi-LASIK apresentou maior desconforto no pós-operatório imediato.

Descritores: Ceratectomia fotorrefrativa; Acuidade visual; Dor; Resultado de tratamento; Miopia; Astigmatismo

¹Assistant Physician, University Hospital of the São Paulo University (USP), São Paulo/SP, Brazil.

²Professor, University Hospital of the São Paulo University (USP), São Paulo/SP, Brazil.

³Assistant Physician, University Hospital of the São Paulo University (USP), São Paulo/SP, Brazil.

⁴Ph.D. in Ophthalmology, University Hospital of the São Paulo University (USP), São Paulo/SP, Brazil.

Study conducted at the Refractive Surgery Unit, Department of Ophthalmology, University Hospital of the São Paulo University (USP), São Paulo/SP, Brazil.

The authors declare no conflict of interest.

Received for publication: 23/5/2011 - Accepted for publication: 20/5/2013

INTRODUCTION

Photoreactive Keratectomy (PRK) consists of mechanically removing the corneal epithelium followed by photodisruption of Bowman's membrane and the anterior portion of the corneal stroma. This technique was and still is widely used to correct refractive errors⁽¹⁾. Its major limitation is the intense healing response, which not only causes discomfort to the patient, but can also lead to corneal opacities and an unpredictable outcome due to the important epithelial remodelling that occurs after surgery⁽²⁾.

Laser-assisted in situ keratomileusis (LASIK) is currently the most commonly-used technique in refractive surgery⁽³⁾. It consists of preparing a corneal flap using an automated device; after laser application the flap is repositioned to protect the residual stroma. LASIK has some advantages over PRK, such as rapid visual recovery and less discomfort in the immediate postoperative period. However, it is more invasive, with a greater risk of intraoperative complications⁽⁴⁾.

In 2003 Pallikariset al.⁽⁵⁾ proposed the technique known as epithelial laser-assisted in situ keratomileusis (Epi-LASIK), in which the epithelium is mechanically separated from Bowman's membrane using an epikeratome. The procedure is similar to laser-assisted in situ keratomileusis, but it involves using a blunt blade which oscillates at a high frequency to separate both tissues. Its main advantage over PRK is that it supposedly preserves the integrity of the basement membrane, which would act as a barrier to prevent the contact of proinflammatory cytokines with the recently-treated epithelial stroma, thus reducing the apoptotic response and haze formation⁽²⁾.

In theory, Epi-LASIK has the same advantages of LASIK, such as rapid visual recovery, while avoiding the drawbacks of PRK, such as postoperative discomfort. The aim of this study was to verify this hypothesis by comparing PRK and Epi-LASIK with regard to visual outcome and postoperative discomfort.

METHODS

The study consisted of an interventional case series of 38 eyes in 19 patients operated at the Ophthalmic Clinic of the University Hospital of the São Paulo University. The patients underwent PRK in one eye and Epi-LASIK in the other, performed in a single surgical act and by the same surgeon (FPC). All patients gave their informed consent, and the study was approved by the hospital's research ethics committee.

Inclusion criteria were patients of both sexes aged between 21 and 40 years with refractive errors between -1.00 and -5.00 D, astigmatism under 1.00 D Cyl, and without significant change in the previous 18 months. The preoperative difference in refractive error between the two eyes of the same patient did not exceed 0.5 spherical or cylindrical dioptre. No patients were excluded during the data analysis phase.

The average refractive error was -2.85 (spherical equivalent) in the PRK group and -2.84 (spherical equivalent) in the Epi-LASIK group, with standard deviations of 0.83 and 0.96, respectively.

A complete ophthalmic examination was done preoperatively, including: Assessment of corrected and uncorrected visual acuity, refraction under cycloplegia, biomicroscopy, applanation tonometry, funduscopy with assessment of the peripheral retina, computer-assisted corneal topography (EyeSys system 2000,

EyeSys Technologies, Houston, USA), pupillometry (Colvard pupillometer, Glendora, CA), corneal tomography (Bausch & Lomb's Orbscan II), contrast sensitivity test (Vistech Consultants, Inc.), and wavefront analysis (Nidek, OPD scan ARK-10000).

Both techniques involved the same preoperative preparation: Fifty minutes before surgery the patient received a 90 mg etoricoxib (Arcoxia Merck Sharp & Dohme) tablet and topical anaesthesia consisting of three applications of proparacaine hydrochloride (Anestalcon™, Alcon Laboratórios do Brasil Ltda.) eye drops every five minutes. Ophthalmic asepsis was done with 10.0% povidone-iodine, irrigating the ocular surface with sterile saline.

The eyes in the PRK group were marked (8.0 mm diameter) and submitted to mechanical de-epithelisation with a blunt spatula without alcohol. Photoablation was performed with a 6.0-mm treatment zone and a 1.5-mm transition zone using the NIDEK EC-5000 device.

In the Epi-LASIK group a Moria Epi-K™ (Moria, Antony, France) epikeratome was used to perform the epithelial flap and subsequent photoablation, using the same parameters as in the PRK group. After photoablation, the flap was repositioned with the aid of an irrigation cannula and balanced saline solution.

After photoablation both groups received one eye drop of 0.3% gatifloxacin (Zymar™, Allergan Produtos Farmacêuticos Ltda.) and one eye drop of 0.5% ketorolac tromethamine (Acular™, Allergan Produtos Farmacêuticos Ltda.), after which a bandage contact lens (Acuvue 2™, etafilcon A, Johnson & Johnson's) was applied. Postoperatively, all patients received 0.3% gatifloxacin eye drops (Zymar™, Allergan Produtos Farmacêuticos Ltda.) every 6 hours for 7 days and 0.1% prednisolone acetate (Pred Fort™, Allergan Produtos Farmacêuticos Ltda.) every 6 hours for one month.

Patients underwent follow-up for one year with the authors of the study, with visits scheduled for postoperative days 1, 3, 5, 7, 15, 60, 90, 180, and 360. All visits involved an assessment of uncorrected visual acuity, slit lamp examination, and a questionnaire to assess symptoms in each eye. In the questionnaire, patients answered questions about eye pain and foreign body sensation based on a scale ranging from 0 (very good, no pain) to 5 (complete dissatisfaction, maximum pain), known as the "faces pain scale" (Wong et al, 2001)⁽⁶⁾.

Assessment of visual acuity with best correction, topography, tomography, and wave front analysis, as well as other routine tests, were performed 1, 3, 6, and 12 months postoperatively.

The results were entered into an Excel spreadsheet and analysed using Student's t test.

RESULTS

There was only one case of free flap in the Epi-LASIK group, where the flap was positioned without difficulty. In the Epi-LASIK group the flaps were enlarged upon repositioning, with a radius approximately 1 mm larger than the treated area.

In the first 12 hours after surgery, 15 (79.0%) patients reported more pain in the Epi-LASIK eye ($p=0.0003$). On the first day after surgery, one (5.2%) patient reported no eye pain, 12 (63.2%) patients reported more pain in the Epi-LASIK eye ($p=0.012$), and only two (10.5%) reported more pain in the PRK eye. On the third day pain intensity was similar in both eyes (Figure 1). The bandage contact lens was removed from all eyes on the fifth postoperative day.

Figure 1

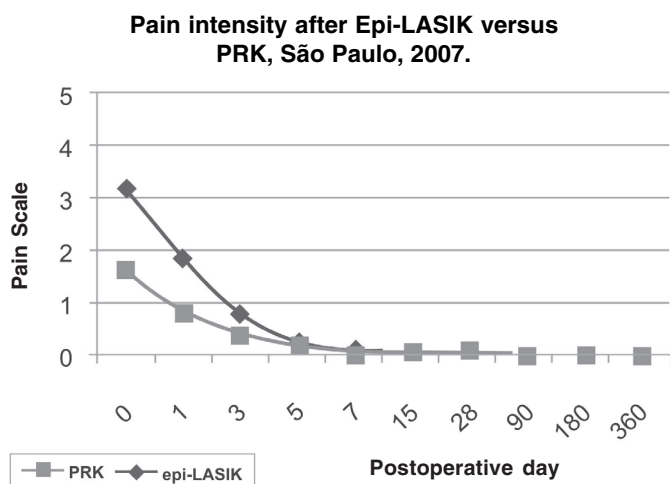
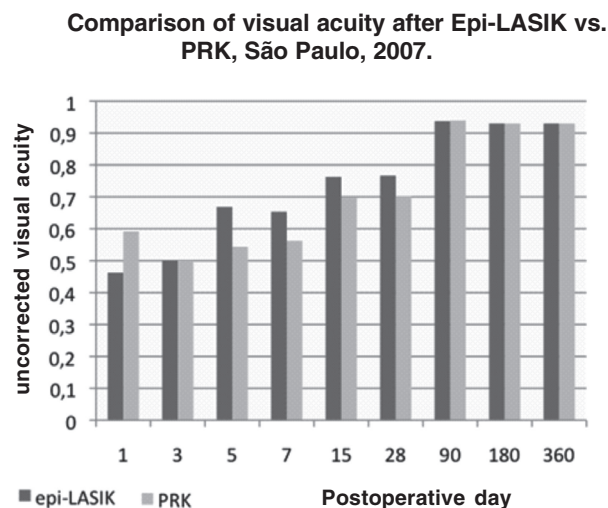


Figure 2



Recovery of visual acuity was similar in both groups. A statistically significant difference ($p=0.034$) was only observed on the first day, with better uncorrected visual acuity in the PRK group. On the third day the mean visual acuity was similar; between the 5th ($p=0.051$) and the 15th ($p=0.267$) day, the Epi-LASIK group had better visual acuity, but the difference was not significant (Figure 2). On the 5th postoperative day, four (21.0%) patients in the Epi-LASIK had 20/20 vision without correction versus only one (5.2%) in the PRK group, but the difference between groups was not statistically significant ($p=0.051$).

One month after surgery, the corrected visual acuity was 20/25 or better in all eyes (with a maximum refractive error of 0.75 D or D cyl). Only two eyes, one for each group, did not reach a visual acuity of 20/20 in the first month. When examined six months and one year after surgery, all eyes achieved a visual acuity of 20/20 with a maximum correction of 0.75 D or D cyl.

There were five (14.7%) cases of haze (Fantes grade 0.5⁽⁷⁾): three in the PRK group and two in Epi-LASIK group ($p=0.082$); none affected visual acuity and all recovered fully.

DISCUSSION

Recently, the use of improved laser devices and prophylactic mitomycin C to modulate the inflammatory response have allowed PRK to be indicated to a significantly larger number of patients, despite complaints of postoperative discomfort⁽⁸⁾. This technique has been employed for greater refractive errors in both myopia and astigmatism, as well as selected cases of hyperopia⁽⁹⁾. Despite the use of mitomycin C to reduce the incidence of haze, it still occurs in some cases and can compromise the surgical outcome. Mitomycin C has been shown to be safe in the short and medium term, but its long-term safety has yet to be demonstrated^(2,8).

LASIK has proven to be a very safe and efficient technique for correcting low to moderate refractive errors. However, due not only to intraoperative complications related to the corneal flap but also to the risk of postoperative complications such as displacement of the flap, infection, inflammation, and ectasia at

the interface, surface ablation techniques represent a safer alternative in certain cases. Pallikariset al. described Epi-LASIK as a safer and less invasive procedure which combines the safety of surface procedures with the advantages of LASIK⁽¹⁰⁾.

In the present study, Epi-LASIK proved to be a simple technique which provided good refractive results without major complications. However, Epi-LASIK did cause discomfort in the first two days after surgery, and in more than half the cases such discomfort was more intense than in the PRK group. Other studies of similar design have also demonstrated varying degrees of discomfort with Epi-LASIK⁽¹¹⁻¹³⁾.

A possible explanation for the greater levels of discomfort after Epi-LASIK is the presence and persistence of a damaged epithelium, delaying the release of pain-inducing inflammatory cytokines. Previous studies have shown that the epithelial flap does not leave the basement membrane intact, thus affecting its barrier function against inflammatory mediators^(2,14). To decrease the continuous release of proinflammatory cytokines after Epi-LASIK, removal of the epithelial flap has also been suggested. Kalyvianaket et al. suggested amputating the epithelial flap for a smoother stromal bed with less inflammation, thus reducing the pain and discomfort in the first hours after surgery⁽⁵⁾. More evidence is still needed to confirm this hypothesis.

CONCLUSION

Both techniques, Epi-LASIK and PRK, were equally effective in terms of visual outcome. Visual acuity was better in the PRK group in the first day only, with no significant difference afterwards.

Both techniques caused significant postoperative symptoms, especially in the first three days after surgery, whereas in the Epi-LASIK group the pain was greater on the day of surgery and the first postoperative day.

REFERENCES

1. Epstein D, Fagerholm P, Hamberg-Nyström H, Tengroth B. Twenty-four-month follow-up of excimer laser photorefractive keratectomy for myopia. Refractive and visual acuity results. *Ophthalmology*. 1994;101(9):1558-63; discussion 1563-4.

2. Netto MV, Mohan RR, Ambrosio R Jr, Hutcheon AE, Zieske JD, Wilson SE. Wound healing in the cornea: a review of refractive surgery complications and new prospects for therapy. *Cornea*. 2005;24(5):509-22.
3. Sandoval HP, de Castro LE, Vroman DT, Solomon KD. Refractive Surgery Survey 2004. *J Cataract Refract Surg*. 2005;31(1):221-33.
4. Iskander NG, Peters NT, Penno EA, Gimbel HV. Postoperative complications in laser in situ keratomileusis. *Curr Opin Ophthalmol*. 2000;11(4):273-9. Review.
5. Kalyvianaki MI, Kymionis GD, Kounis GA, Panagopoulou SI, Grentzelos MA, Pallikaris IG. Comparison of Epi-LASIK and off-flap Epi-LASIK for the treatment of low and moderate myopia. *Ophthalmology*. 2008;115(12): 2174-80.
6. Wong DL, Hockenberry-Eaton M, Wilson D, Winkelstein M, Schwartz P. *Whaley and Wong's essentials of pediatric nursing*. 5th ed. St. Louis: Mosby; 1997. p. 1301.
7. Fantes FE, Hanna KD, Waring GO 3rd, Pouliquen Y, Thompson KP, Savoldelli M. Wound healing after excimer laser keratomileusis (photorefractive keratectomy) in monkeys. *Arch Ophthalmol*. 1990;108(5):665-75. Comment in *Arch Ophthalmol*. 1991;109(1): 15.
8. Carones F, Vigo L, Scandola E, Vacchini L. Evaluation of the prophylactic use of mitomycin-C to inhibit haze formation after photorefractive keratectomy. *J Cataract Refract Surg*. 2002;28(12):2088-95.
9. Shalaby A, Kaye GB, Gimbel HV. Mitomycin C in photorefractive keratectomy. *J Refract Surg*. 2009;25(1 Suppl):S93-7.
10. Pallikaris IG, Katsanevaki VJ, Kalyvianaki MI, Naoumidi II. Advances in subepithelial excimer refractive surgery techniques: Epi-LASIK. *Curr Opin Ophthalmol*. 2003;14(4):207-12.
11. O'Doherty M, Kirwan C, O'Keeffe M, O'Doherty J. Postoperative pain following Epi-LASIK, LASEK, and PRK for myopia. *J Refract Surg*. 2007;23(2):133-8.
12. Torres LF, Sancho C, Tan B, Padilla K, Schanzlin DJ, Chayet AS. Early postoperative pain following Epi-LASIK and photorefractive keratectomy: a prospective, comparative, bilateral study. *J Refract Surg*. 2007;23(2):126-32.
13. Dai J, Chu R, Zhou X, Chen C, Qu X, Wang X. One-year outcomes of Epi-LASIK for myopia. *J Refract Surg*. 2006;22(6):589-95.
14. Chen WL, Chang HW, Hu FR. In vivo confocal microscopic evaluation of corneal wound healing after Epi-LASIK. *Invest Ophthalmol Vis Sci*. 2008;49(6):2416-23.

Correspondence Address :

Francisco Penteado Crestana
 Avenida Angélica, nº 1761, cj 124 - Higienópolis
 CEP 01227-200 - São Paulo (SP), Brasil
 Tel: (11) 3822-0836
 E-mail: fpcrestana@terra.com.br