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Short communication

Intense pulsed light: Results in chronic dry eye syndrome after LASIK[☆]

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ABSTRACT

A report is presented on the visual and clinical results from a retrospective case series of patients with chronic, evaporative, dry eye syndrome (DES), after refractive surgery, and treated with intense pulsed light treatment (IPL). Four sessions were performed, and the Ocular Surface Disease Index (OSDI) questionnaire was completed before initiating treatment and after the last session. Pre- and post-treatment data included: visual acuity (VA), refraction, clinical evaluation (DEWS severity grading, and Oxford corneal staining), and Orbscan topography. Twenty eyes were treated and the following data recorded: Schirmer I 14.7 ± 5.6 ; 15.6 ± 3.4 mm, tear breakup time (TBUT) 3.4 ± 1.6 ; 5.1 ± 1.2 s ($p > .003$), DEWS 3.4 ± 0.5 ; 1.6 ± 0.7 ($p < .003$), Oxford grade 0.8 ± 0.77 ; 0.4 ± 0.75 ($p > .003$), VA 0.67 ± 0.26 ; 0.90 ± 0.15 ($p < .0001$), best corrected VA 0.83 ± 0.18 ; 0.92 ± 0.14 ($p > .003$), spherical equivalent -0.31 ± 0.6 ; -0.08 ± 0.38 D ($p > .003$), OSDI 34 ± 16 ; 28 ± 11.0 points ($p > .003$), frequency artificial tear use 3.4 ± 2.0 ; 2.5 ± 1.9 times/day ($p > .03$). A significant clinical and visual improvement was observed, together with a decreased frequency in artificial tear use, in LASIK patients with chronic DES after IPL treatment.

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Luz pulsada intensa: resultados en ojo seco crónico tras LASIK

RESUMEN

Se presentan los resultados clínicos y visuales obtenidos en un estudio retrospectivo de una serie de casos de pacientes con síndrome de ojo seco (SOS) evaporativo crónico, tras cirugía refractiva, manejados con luz pulsada intensa (LPI). Se realizaron 4 sesiones de LPI. Contestaron el cuestionario Ocular Surface Disease Index (OSDI) antes del inicio de LPI y después de la última sesión. Se registró AV, refracción, valoración clínica (grado de severidad DEWS y grado de tinción Oxford) y topografía Orbscan. Se trataron 20 ojos con los

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siguientes valores pre- y post-LPI: SchirmerI $14,7 \pm 5,6$; $15,6 \pm 3,4$ mm, BUT $3,4 \pm 1,6$; $5,1 \pm 1,2$ s ($p < 0,003$), DEWS $3,4 \pm 0,5$; $1,6 \pm 0,7$ ($p < 0,003$), grado Oxford $0,8 \pm 0,77$; $0,4 \pm 0,75$ ($p > 0,003$), AV $0,67 \pm 0,26$; $0,90 \pm 0,15$ ($p < 0,0001$), AVcc $0,83 \pm 0,18$; $0,92 \pm 0,14$ ($p > 0,003$), EE $-0,31 \pm 0,6$; $-0,08 \pm 0,38$ D ($p > 0,003$), OSDI 34 ± 16 ; $28 \pm 11,0$ puntos ($p > 0,003$), uso de lágrimas $3,4 \pm 2,0$; $2,5 \pm 1,9$ veces/día ($p > 0,03$). Se registró mejoría visual y clínica significativa, mejoría sintomática y disminución de uso de lágrimas artificiales, tras LPI, en pacientes operados de LASIK con SOS evaporativo crónico.

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Introduction

The chronic dry eye syndrome (EDS), subsisting over 6 months after LASIK refractive surgery, occurs between 0.8 and 44% of cases and correlates with preoperative myopia, depth of ablation and female gender.^{1–3} Patients can present dryness and/or experience clinic alterations compatible with chronic EDS, and visual alterations could become a reason of continuous therapeutic management changes as well as numerous post-operative visits and dissatisfaction of intervened patients. In addition, post-LASIK refractive regression occurs with greater frequency in patients with chronic EDS together with an increase of high order aberrations.^{3,4}

Despite evidence to the contrary, Meibomium gland dysfunction is considered to be the most frequent cause of evaporative EDS. Until a few years ago, few methods were available for adequate management.⁵ Intense pulsated light (IPL) has demonstrated to be a promising treatment for diminishing signs and symptoms of evaporative EDS, Meibomium glands dysfunction and therefore patients who underwent refractive surgery with stubborn dry eye.^{6–9}

The results of 11 patients (20 eyes) with post-LASIK chronic EDS, Meibomium glands dysfunction is presented. Said patients were dissatisfied with their visual acuity (VA) after the application of 4 IPL sessions.

Materials and methods

A retrospective case series study that included patients who underwent LASIK surgery and were dissatisfied with their vision, grade 3–4 of chronic evaporative EDS (>6 months post-LASIK) and dissatisfied with their VA and who had completed 4 IPL sessions and were in treatment with artificial tears and palpebral hygiene. The EDS grade was recorded according to the severity classification proposed by the *Dry Eye Workshop* (DEWS).¹⁰ The study was conducted following the guidelines of the Helsinki declaration and all patients signed an informed consent before each IPL session. The study included patients who fulfilled all 3 criteria of the Japanese diagnostic group for Meibomium glands dysfunction, i.e., exhibiting associated symptoms, one or more anatomic alteration (telangiectasia, uneven palpebral edge, anterior or posterior displacement of the mucocutaneous join) and glandular obstruction (clinic observation and finger pressure).⁵

All patients continued to use artificial tears (range 2–7 times/day) and conducting palpebral hygiene at the time of treatment with IPL. The patients who used a different topical treatment, did not complete the treatment of the study or the questionnaire and those who were not willing to participate were excluded from the study.

Data recorded pre-IPL and post-IPL (4th session) included: VA, uncorrected (UCVA) and corrected (CVA), subjective refraction, Orbscan topography (Km and SimK astigmatism; 3.00 mm zone), Schirmer without anesthesia during 5 minutes, tear breakup time (BUT) (sodium fluorescein 20 mg/ml [Minims, Baush & Lomb, Madrid, Spain]) and Oxford grade staining. Patients filled in the *Ocular Surface Disease Index* (OSDI) survey before the first and after the 4th IPL session. Four IPL sessions were conducted (8 J/cm^2 , Thermaeye®, Implantec S.A., Buenos Aires, Argentina) following the protocol recommended by the distributor (day 0, 15, 45, 75). After cleaning the mylar and temporal areas with micellar water, UV protection spectacles were placed and gel was applied in the areas to be treated. Four IPL impacts were applied to each side of the face (2 in the malar area, 2 in the temporal area), the gel was cleaned off and solar protection cream was applied. Values were recorded as mean and standard deviation, and the T for student analysis was conducted (Excel 2007, Microsoft). Statistical significance was set at $p \leq 0.003$ with Bonferroni adjustment for multiple comparisons, error type II.

Results

Overall, 34 records of patients with IPL treatments were reviewed and 11 patients were included (20 eyes), 4 eyes with Bioptics after multifocal intraocular lens implant and 16 eyes post-primary LASIK (all with microkeratome cutting). Recorded pre-IPL averages were: age, 43.25 ± 15.6 years and average time from LASIK surgery, 28.3 ± 30.9 months (6–107 months). The pre- and post-IPL EDS DEWS severity grades were 3.4 ± 0.5 and 1.6 ± 0.7 ($p \leq 0.003$), respectively. On the basis of the OSDI survey, one case of slight EDS, 6 cases of moderate EDS and 4 cases of severe EDS were recorded, with a range between 21 and 58 points. Table 1 summarizes the grade of dry eye severity, previous treatments of each case, refractive data and individual pre- and post-IPL results.

The average pre- and post-IPL results were: VA 0.67 ± 0.26 ; 0.90 ± 0.15 ($p < 0.0003$); CVA 0.83 ± 0.18 ; 0.92 ± 0.14 ($p > 0.003$); EE -0.31 ± 0.6 ; -0.08 ± 0.37 D ($p < 0.003$); SimK astigmatism (area 3.0 mm) 0.95 ± 0.52 ; 0.64 ± 0.46 ($p > 0.003$); Km 40.0 ± 2.5 ;

Table 1 – Individual cases and results, pre- and post-IPL.

| Case (age) | Time from LASIK (months) | Pre-IPL VA (decimal) | Post-IPL VA (decimal) | Pre-CVA (decimal) | Post-CVA (decimal) | Pre-SE (diopters) | Post-SE (diopters) | Pre-/post IPL Severity grade (DEWS) Pre-IPL failed treatments ^a |
|------------------------------------|--------------------------|----------------------|-----------------------|-------------------|--------------------|-------------------|--------------------|--|
| 1. RE (free flap); 33 years | 26 | 0.8 | 0.9 | 1.0 | 1.0 | 1.25 | 1.0 | 4/2 |
| LE | | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 1.2.3.4 |
| 2. RE (BMD); 40 years | 16 | 0.6 | 1.0 | 0.8 | 1.0 | 0.25 | 0.0 | 4/1 |
| LE (BMD) | | 0.4 | 1.0 | 1 | 1.0 | -0.63 | 0.0 | 1.2.3.4.5 |
| 3. RE (rosacea); 27 years | 15 | 0.6 | 1.0 | 1.0 | 1.0 | -0.88 | 0.0 | 3/1 |
| LE | | 0.2 | 0.8 | 0.7 | 0.9 | -1.38 | -0.75 | 1.2.6 |
| 4. RE Bioptics; 72 years | 36 | 0.6 | 0.8 | 1.0 | 1.0 | -0.75 | -0.75 | 4/1 |
| LE Bioptics | | 0.5 | 0.8 | 0.8 | 0.8 | -0.63 | -0.38 | 1.2 |
| 5. RE Bioptics (lazy eye) | 107 | 0.3 | 0.4 | 0.3 | 0.4 | -1.0 | 0.0 | 3/1 |
| LE + Bioptics + ingrowth; 55 years | | 0.3 | 0.8 | 0.5 | 0.8 | -0.25 | 0.0 | 1.2.4 |
| 6. LE; 38 years | 6 | 0.7 | 0.8 | 0.7 | 0.9 | -0.50 | 0.0 | 3/2 |
| | | | | | | | | 1.2 |
| 7. LE Bioptics; 69 years | 6 | 0.5 | 0.8 | 0.6 | 0.8+ | -0.75 | 0.0 | 3/2 |
| | | | | | | | | 1.2.4 |
| 8. RE; 28 years | 6 | 0.8 | 1.0 | 1.0 | 1.0 | 0.25 | 0.0 | 4/2 |
| LE | | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 1.2.3.4 |
| 9. RE; 27 years | 23 | 0.6 | 1.0 | 1.0 | 1.0 | -0.63 | 0.0 | 3/2 |
| LE | | 1.0 | 1.0 | 1.0 | 1.0 | 0.25 | 0.0 | 1.2 |
| 10. RE; 29 years | 17 | 0.8 | 1.0 | 0.9 | 1.0 | 0.25 | 0.0 | 3/1 |
| LE | | 1.0 | 1.0 | 1.0 | 1.0 | 0.0 | 0.0 | 1.2.4 |
| 11. RE; 33 years | 10 | 0.8 | 1.0 | 0.8 | 1.0 | -0.25 | 0.00 | 3/1 |
| LE | | 0.6 | 0.8 | 0.9 | 1.0 | -0.75 | -0.75 | 1.2 |

Cases with and without complications during refractive surgery were recorded (1 basal membrane dystrophy and one I with transoperative full flap and 3 cases of Bioptics [one eye with epithelial endogenous growth history]).

VA: visual acuity; CVA: visual acuity with correction; DEWS: Dry Eye Workshop; BMD: basal membrane dystrophy; SE: spherical equivalent; LASIK: laser assisted in situ keratomileusis; IPL: intense pulsed light; RE: right eye; LE: left eye.

^a 1: artificial tears; 2: palpebral hygiene; 3: autologous serum; 4: corticoids; 5: antiedema; 6: doxycycline.

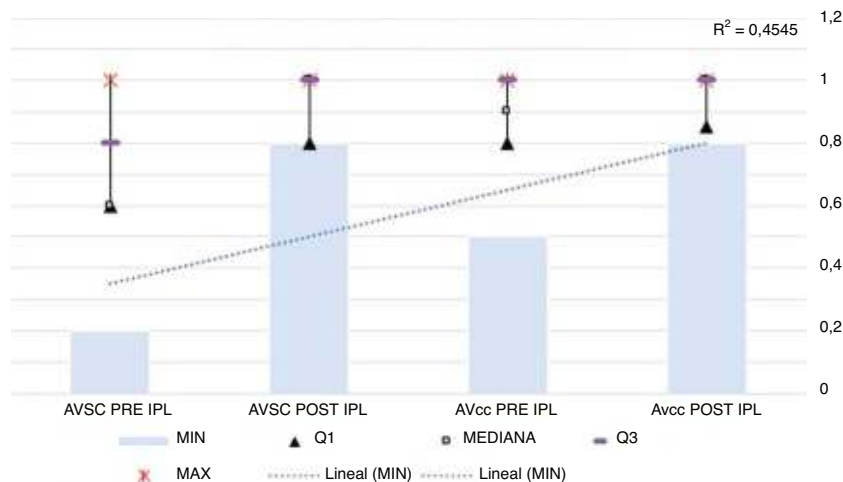


Fig. 1 – Pre- and post-IPL visual results. Visual improvements were recorded after treatment with IPL ($p = 0.004$). A positive correlation was calculated in the increase of minimum post-IPL UCVA.

40.1 ± 2.6 D ($p = 0.5$); Schirmer I 14.7 ± 5.6 ; 15.6 ± 3.4 mm; TBUT 3.4 ± 1.6 ; 5.0 ± 1.3 s ($p \leq 0.003$; ± 1.7 s); Oxford stain grade 0.8 ± 0.77 ; 0.35 ± 0.75 ($p > 0.003$); OSDI 34 ± 16.1 ; 27 ± 11 points ($p = 0.1$). Fig. 1 shows visual results before and after IPL.

The average UCVA gain was 2.5 ± 2.0 and 0.90 ± 1.2 gained CVA lines after IPL. Emmetropia was recorded in 15 eyes and

residual spherical equivalent (SE) was recorded in 5 eyes between -0.25 and $+1.0$. The highest residual SE was recorded in a patient with complicated LASIK (full flap in right eye and $+1.0$ D).

After the last IPL session, the OSDI score range was 11–47 puntos, with 6 cases registering improvement in dryness grade

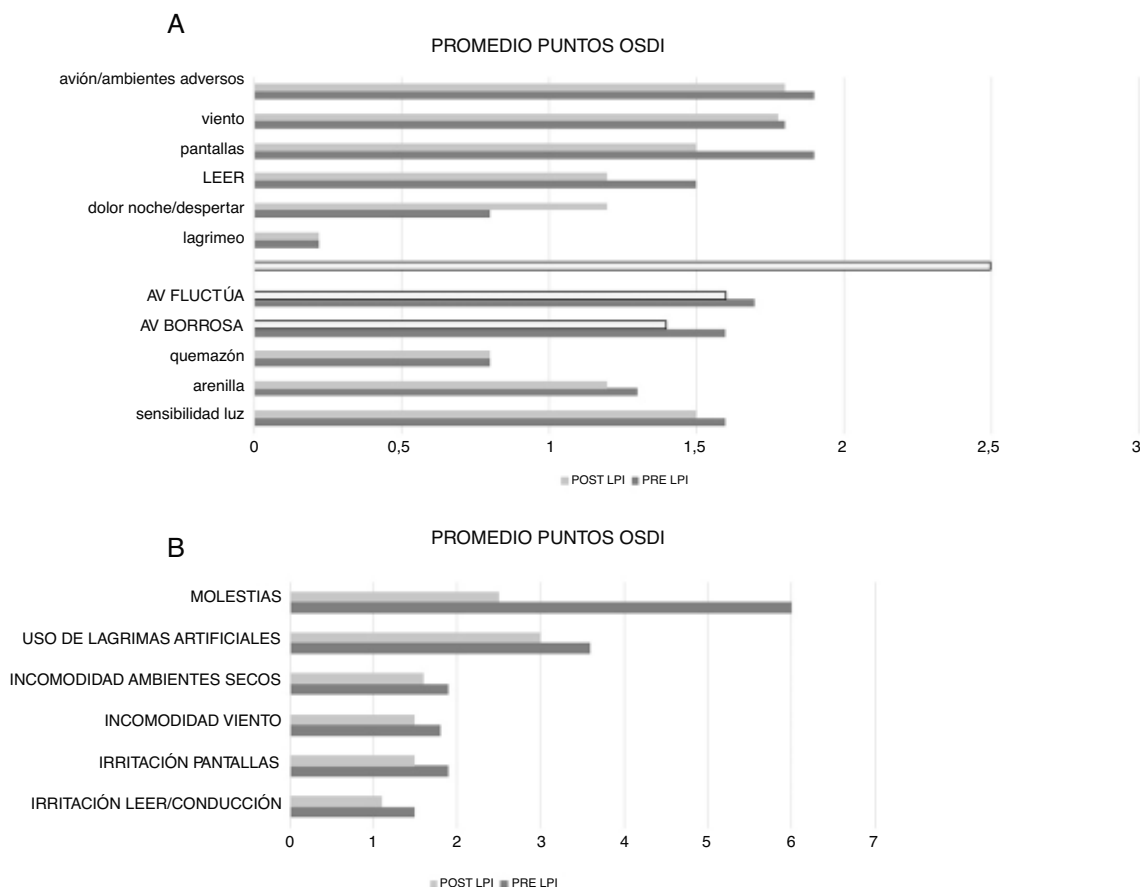


Fig. 2 – (A) Pre- and post-IPL average score of OSDI questionnaire. Reduced average was recorded in 67% of symptoms in daily activities, while the remaining 33% did not record changes or worsened ($p > 0.003$). Reduction in the average discomfort associated to visual acuity was recorded ($p > 0.003$). (B) Improvement was recorded in 100% of daily activities and the above described discomforts, as well as reduction in the average frequency of use of artificial tears per day and discomfort (range 1–7 times/day; $p > 0.003$).

(3 from severe to moderate, 1 from moderate to slight, 1 from moderate to normal, 1 from slight to normal), 2 cases remained unchanged and 1 case worsened.

Fig. 2A and B shows the OSDI score average before and after completing the 4 IPL sessions. The total average of pre- and post-IPL OSDI score was 34 ± 16 and 28 ± 11 points ($p > 0.003$) a nonsignificant reduction of all discomfort associated to vision, reading and use of screens was recorded. In addition, patients reported improvement of discomfort, irritation and reduced frequency of artificial tear use. Overall, 73% reported improvement, 18% referred no changes and 9% reported worsening, with results being not statistically significant.

The patients who did not report subjective changes exhibited improvements in VA despite the persistence of residual myopia in some eyes. One patient that reported worsening reached VA of 1.0 in both eyes and null Oxford stain. No complications were reported.

Discussion

Chronic post-LASIK EDS can express with multiple symptoms and degrade optic quality due to high order aberrations.⁴ This

occurs with 0.8 – 44% of cases, and obtaining relief from signs and symptoms usually requires multiple treatments.^{1–3} One of said treatments is IPL, a novel treatment for evaporative EDS that improves lacrimal film tear BUT by means of applying heat in the direction of the Meibomium glands.^{6,7} In patients with Meibomium glands dysfunction that are resistant to multiple treatments, IPL diminishes symptoms in 81% of cases and improves lacrimal film quality.⁶ Denoyer et al. referred that the high order aberration progression index exhibited an inverse correlation with BUT and OSDI.⁴ Accordingly, if IPL improves lacrimal quality, this could translate into VA improvements.

In a study of 109 eyes treated with IPL after LASIK, Schallhorn et al. reported an improvement of 1.9 s in tear BUT while the present study obtained a similar improvement of 1.7 s.⁷ As reported by the previous group, the DEWS severity grade as well as the BUT of the present patients exhibited a significant improvement after the 4 IPL sessions.⁷ In addition, the 11 patients of this study exhibited significant improvements in UCVA and nonsignificant in CVA.

An average improvement of 2.5 UCVA lines was observed in this study, almost 1 CVA line as well as a nonsignificant SE reduction. In addition, it is worthy of note that 75% of eyes remained emmetropic.

IPL studies that refer EDS improvement in patients who underwent LASIK operations do not include detailed refractive results.^{7,9} Petzold et al. found visual improvement in one case of post-LASIK chronic EDS, with a duration of 4 years, after 12 min of vectorized thermal pulsation.⁸ In that single case, a VA improved from 0.6 to 0.8 in both eyes and the patient reduced the frequency of artificial tear usage from 64 to 4–5 times a day.⁸

IPL also improves symptoms in refractive surgery patients and reduces the frequency of use of artificial tears.^{7–9} Overall, 55% of patients who underwent LASIK surgery improve their symptoms and reduce the average score in dry eye questionnaires.^{7,9} In the present study, 73% of patients reported symptom improvements, while the average score of the questionnaire varied from 34 to 28 points. After IPL, 55% of patients reduced the frequency of use of artificial tears and the average visual discomfort associated to screens, dry environments or reading also diminished.

The limitations of the present study include its retrospective nature, clinic assessments conducted by a single professional, the variety of treatments utilized by patients, those who maintained their treatments throughout the study, the absence of pre- and post-IPL aberration measurements and the lack of long-term follow-up.

Results suggest that IPL could improve symptoms and diminish the use of artificial tears in patients who underwent LASIK surgery and exhibited chronic EDS. More studies with more patients and longer follow-up periods are needed.

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Conflict of interests

The authors declare the absence of any conflict of interests regarding the property or marketing of the products mentioned in this study.

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