Unintentional excimer laser calibration effected during photoablation treatment with LASIK. A case report

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Abstract: We present a case of unintentional excimer laser calibration delivered as corneal stromal photoablation during LASIK. A 21-year old female with refraction of -3.25 -0.75 ×100 and -2.75 -1.25 ×70 was scheduled for LASIK. Due to an incomplete pre-operative laser calibration, an intrastromal laser calibration was applied in the right eye by human error. Follow-up at day 1 determined a refraction of -2.00 -1.25 ×120 and -2.75 -1.25 ×70. A secondary laser procedure performed 3 months later derived in decreased myopic refraction, a slight shift of the astigmatic axis and a 2 diopter (D) decrease in keratometry. Laser correction of the residual refraction resulted in a post-operative refraction of +0.25 -0.25 ×180 and -0.50 ×180 and patient satisfaction. To our knowledge, no previous studies have reported laser calibration in the corneal stroma. Although its occurrence is unlikely, our case emphasizes the importance of making ophthalmologists aware of this very rare complication and a great learning point.

Key words: Excimer laser, LASIK, corneal photoablation.

Introduction

LASIK has been an ophthalmic procedure of choice for more than two decades because of its safety and effectiveness. The accuracy, repeatability, and consistency of surgical results mean that patients can usually expect excellent postoperative results.[1] Despite the overall generally good results, several trans-operative complications can arise, such as flap creation complications, flap epithelial ingrowth, diffuse lamellar keratitis, halos, dry-eye syndrome, residual refractive errors, postoperative ectasia, and marginal sterile corneal infiltrates.[2,3] Continuous efforts have been made to reduce short and long-term incidents, giving greater emphasis to screening criteria in order to reduce risk of postoperative ectasia.[4] Nevertheless, other complications arising from technology and the use of lasers should be acknowledged.

Typically, the details of surgical incidents, are not usually published. However, the importance of learning from the achievements of others does not outweigh learning about the potential hazards that every surgeon might face. Here, we present a case report of laser calibration in the corneal stroma as a complication arising due to human error and failure of the laser equipment to notice the presence of a patient instead of the calibration cards.

Case report

A 21-year old otherwise healthy female nurse presented for refractive surgery evaluation, with a three-year stable refraction. She used to wear soft contact lenses. She had a manifest refraction of -3.25 -0.75 x 100 and -2.75 -1.25 x 70 and a corrected distance visual acuity (CDVA) of 20/20. Her keratometry readings were 45.23/46.10 x 176 and 45.01/45.86 x 44, with a pachymetric reading of 543 µm and 541 µm by Optovue optical coherence tomography. Her slit-lamp and fundus examinations were normal and her pre-operative topography was unremarkable. LASIK treatment was scheduled with a flap setting of 130µm using the MEL 90 excimer laser platform (Carl Zeiss Meditec AG, Jena, Germany). Equipment calibration was conducted prior to surgery. Flap creation using the Moria M2 microkeratome (Antony, France) was uneventful and a superior corneal flap hinge was created in the right eye. Laser calibration was unintentionally delivered as the myopic photoablation correction in the right eye, and consequently, the surgeon noticed three unusual events. The ablation time was less than expected, the noise emitted by the equipment was louder (sounding like the one emitted during a calibration procedure), and the stromal appearance after the laser treatment suggested the presence of a central pinhole **(Figure 1A, Video 1)** (*Video available at the online version of this article*).

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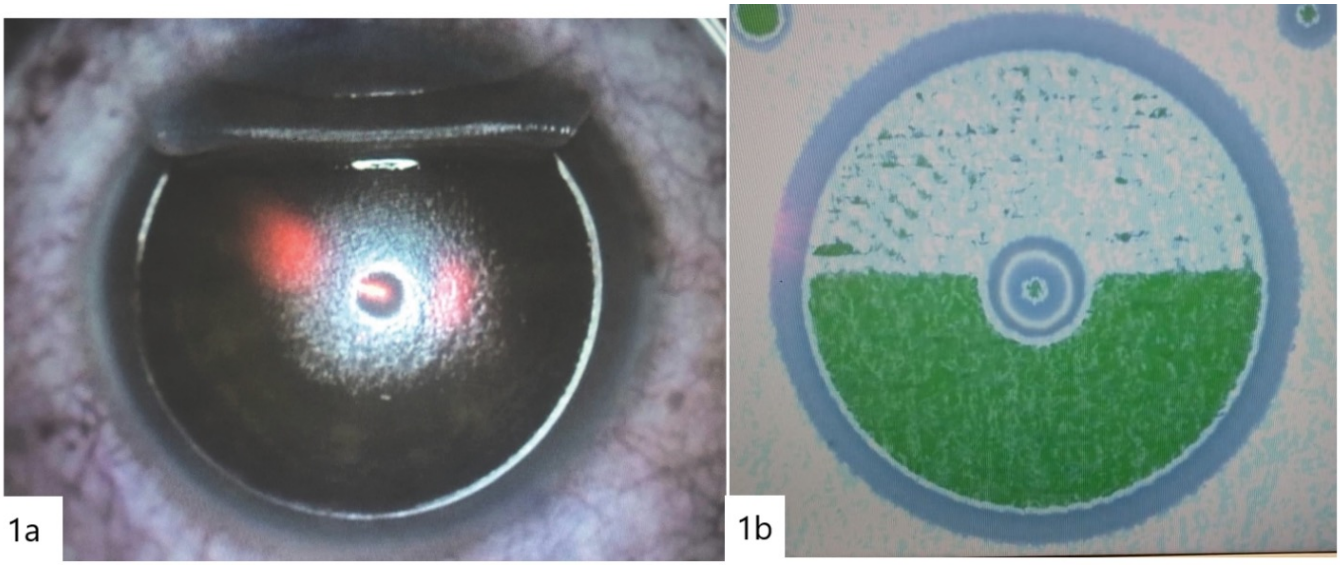

Figure 1. A. Intrastromal Calibration. B. Stromal Corneal Pin-hole and Mel-90 Calibration pattern.

The corneal flap was repositioned and the surgical procedure was thus suspended, so the left eye remained untreated. Using the excimer laser database, it was confirmed by video that laser calibration had been performed in the right eye stroma. Pentacam topography depicted a keratometric reading of 43.7/44.2 ×178 and pachymetry of 560 µm (**Figure 2)**. No change was observed in pachymetric values, but a clear 2D diminished difference was depicted in keratometry. No corneal edema was evident and the cornea had a regular surface. Reporting a refraction of -2.00 -1.25 x 120 and -2.75 -1.25 x 70 respectively, CDVA of 20/20 for both eyes.

A decrease in the myopic value and a slight shift of the astigmatic axis was noted, probably due to the central ablation as a result of the use of the calibration settings. After a close 3-month follow-up, the refraction was stable and control topography demonstrated no change in the keratometric and pachymetric readings. A secondary LASIK procedure

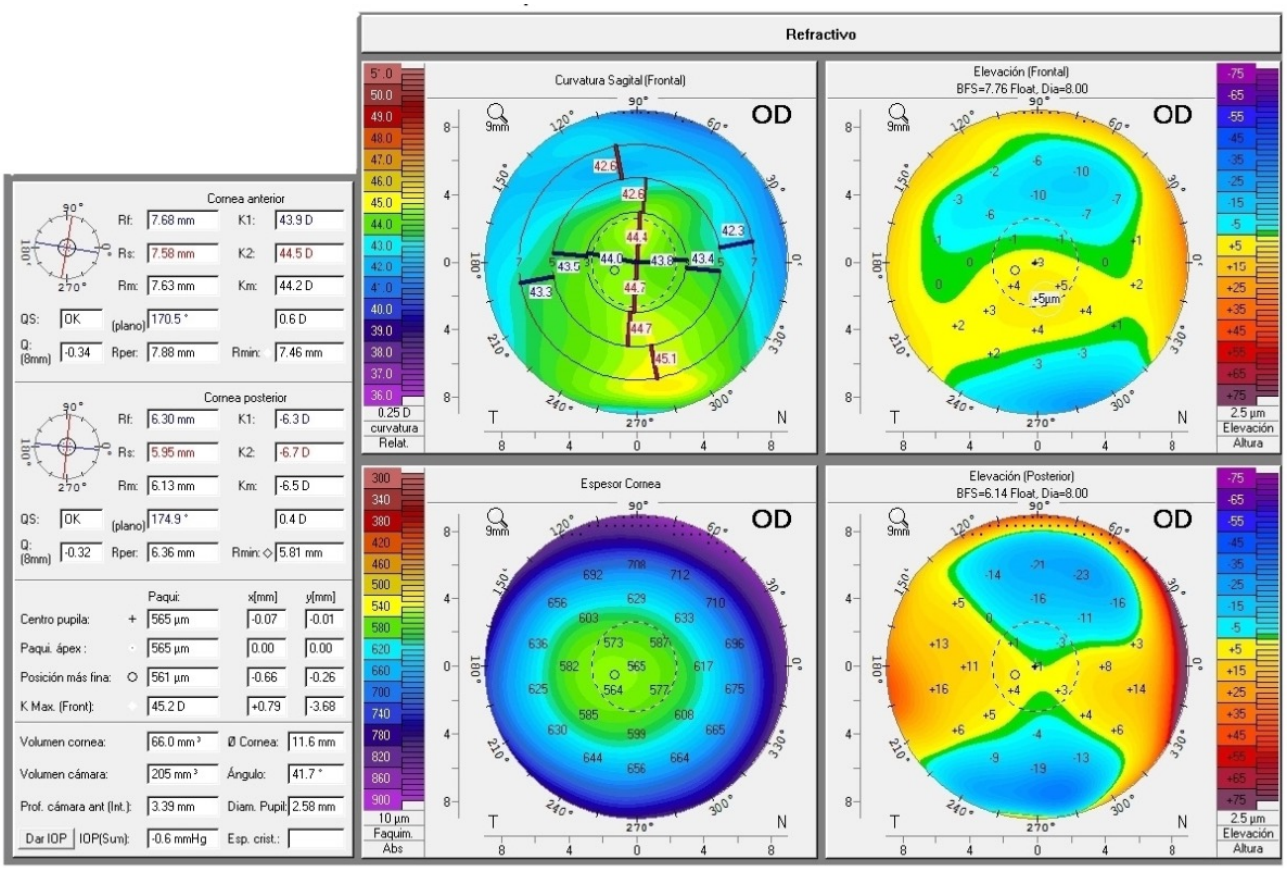

Figure 2. Corneal Topography with slight inferior steepening.

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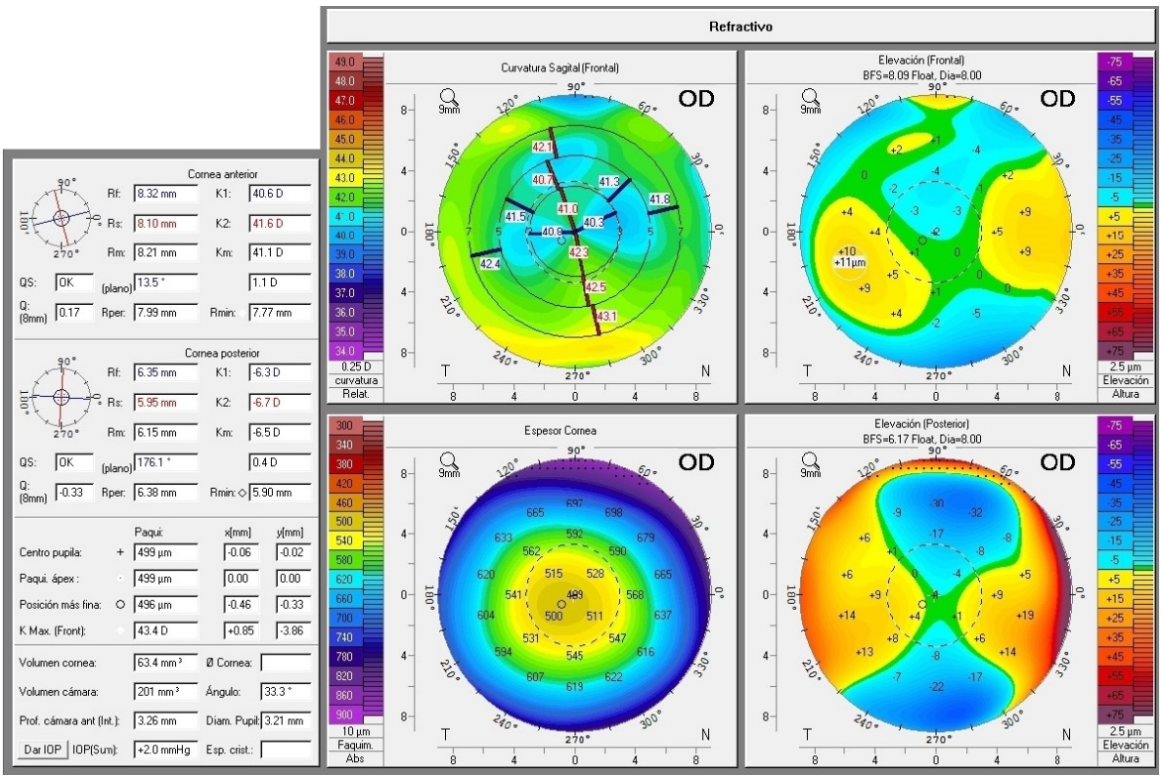

Figure 3. Twelve-month follow up corneal topography with symmetric bow-tie pattern.

was performed (with re-lifting of the previous flap created in the right eye). The surgical procedure was uneventful in both eyes. The patient achieved post-operative refraction of +0.25 -0.25 ×180 and -0.50 ×180. Control topography showed stable keratometric readings. After a twelve-month follow-up, the residual refractive error was +0.50 -0.25 ×70 and -0.25 -0.25 ×145 and a control topography was obtained (**Figure 3**).

Discussion

Many types of lasers are available, ranging from dye lasers and solid-state lasers to fiber lasers and the increasingly ubiquitous diode laser.[5] The excimer lasers used in ophthalmology use a pulsed emitted beam with a radiation that penetrates the cornea, leading to photoablation of tissue. To enhance its safety, the equipment has a stable beam path and counts with an eye-tracking system to center the procedure; this tracking system cannot be controlled by the operator.[6] This platform performs a phototherapeutic keratectomy-like (PTK-like) ablation profile as a calibration system.[7] Calibration of the equipment is an important 20-second process that is conducted prior to surgery. When performed at regular intervals, it promotes the adjustment of the laser system to achieve a constant ablation depth.[8] This process can be viewed as two semicircles of ablation patterns (**Figure 1B**).

The calibration procedure provides a general picture of how the laser will ablate the cornea. Arba-Mosquera et al.[7] determined that the aspects needed to take into account for a better calibration system were the spot roundness; scanner symmetry; scanning amplitude; scanner relative and absolute orientation; spot size and shape; calibration of centration; rotational orientation and perpendicular orientation. Shen et al.[9] demonstrated that the ratio of ablation efficiency between the human cornea and calibration material is critical for a successful refractive procedure.

In our patient case, a review of the equipment's database revealed an aberrant and/or incomplete preoperative calibration. The equipment did not register that it was calibrating on the corneal stroma instead of the calibration cards. After our experience, and to avoid these scenarios, we suggest adding a sensor to the patient bed that would sense weight.

Having an activated sensor would allow the equipment to receive an alert and not to perform the calibration. It would also advertise when two continuous calibration processes were being ordered.

Conclusion

Some recommendations can be made from the present case report experience. Technology aids us daily, but surgeons should not take for granted that there is no room for failure in handling equipment and technology. Calibration of the equipment is an important step, but in order to enhance the accuracy of the procedure, calibration should be conducted under optimal conditions (such as adequate temperature, airflow, and humidity) and the equipment should be

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handled by qualified personnel. All equipment should be calibrated at regular intervals. Familiarization with new equipment and training personnel continuously will improve outcomes in general.

Conflicts of interests

The authors have no financial disclosures and no commercial or proprietary interest in any materials discussed in this report.

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