

Case report of a unocular topography guided laser-assisted *in situ* keratomileusis enhancement following an incorrectly treated astigmatic axis

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A 23-year-old male presented to us wanting spectacle removal for cosmetic purposes. He underwent bilateral wavefront optimized (WFO) laser-assisted *in situ* keratomileusis (LASIK) on the Alcon Wavelight®EX-500 excimer laser with an incorrectly treated astigmatism axis for left eye due to a manual data entry error in the laser. WFO LASIK treats the sphere and cylinder only. LASIK enhancement with topographic-guided

ablation resulted in the elimination of all refractive errors and gave excellent results. Wavelight® topographic-guided treatment can perform two separate layers of correction in the same ablation: The first is to treat the corneal irregularities for the higher order aberration (HOA) removal, the second one meant to treat the sphere and cylinder if indicated.

Key words: Enhancement, LASIK, topographic-guided ablation

Wavefront-optimized ablations apply a spherical aberration treatment to produce an aspherical ablation profile.^[1] WaveLight® topographic-guided ablation (WaveLight, Germany) is a relatively new concept and performs two separate layers of correction: the first is the higher order aberration (HOA) removal layer to remove the natural aberrations found in the cornea.^[2] Second layer is to correct the sphere and cylinder.

Ophthalmologists have a choice whether to use the manifest refraction or the topographer (Topolyzer, Wavelight, Germany) measured astigmatic correction (the astigmatism/axis that the topographer calculates) for topographic-guided LASIK. The topographer measured astigmatism correction is derived by systematic analysis of the cornea with a WaveLight® proprietary algorithm and may be sometimes markedly different from the manifest refraction, resulting in a dilemma for surgeons. This confusion is now being addressed by experts advocating the use of Contoura Vision correction with the LYRA (Layer Yolke

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Reduction of Astigmatism) protocol,^[3] and other methods like the Phorides Analytical Engine^[4] or Topography Modified Refraction.^[5]

Case Report

A 23-year-old male wanted LASIK for cosmetic purposes, with a history of using glasses since past 6 years with no other ocular complaints.

Manifest refraction RE: -0.25 D -1.0D × 105 (6/6, N6 @ 33 cm) LE: -0.25 D -1.50 D × 80 (6/6, N6 @ 33 cm) Pentacam

screening (Oculus, Germany) data showed both eyes fit for LASIK [Fig. 1 for LE]. For LE, calculated residual stromal bed was of 372 microns with 130 micron Flap. From the Topolyzer, keratometric values 43.5, 44.5 D with a flat axis at 80.3 degrees [Fig. 2] corroborated with the manifest refraction. He underwent bilateral WFO LASIK, with an incorrectly modified (treated) astigmatism axis for LE. This was due to a manual data entry error in the excimer.

LE: Manifest refraction: -0.25 D -1.50 D × 80 deg 6/6 N6 @33 cm. Target refraction: plano. Modified (treated) refraction: -0.50D -1.50 D × 150 deg (manual data entry error in

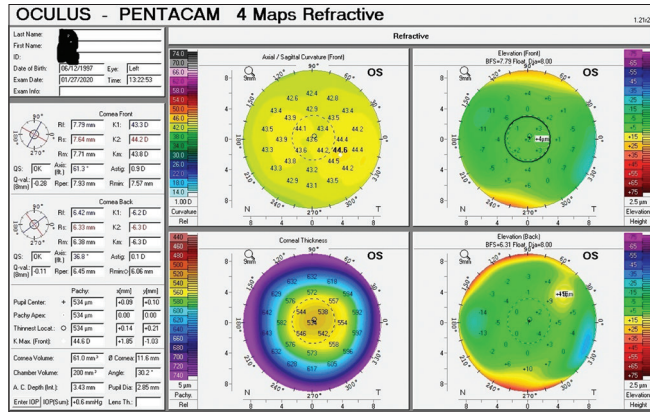


Figure 1: Preoperative Pentacam tomography view for left eye

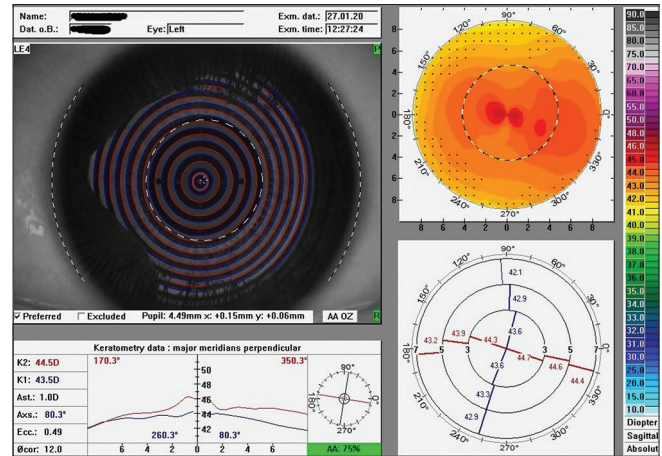


Figure 2: Preoperative Topolyzer topography overview for left eye

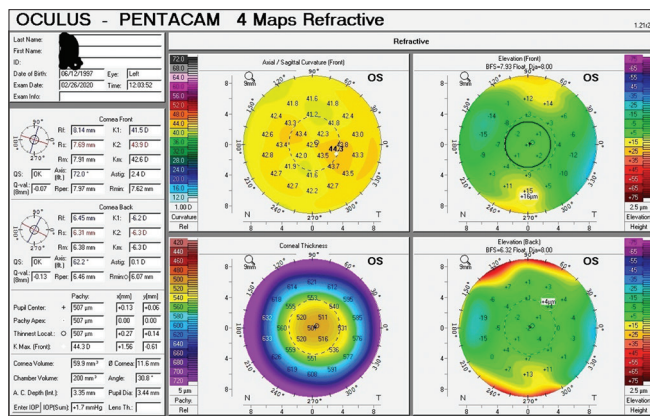


Figure 3: Post primary LASIK corneal tomography for left eye using Pentacam

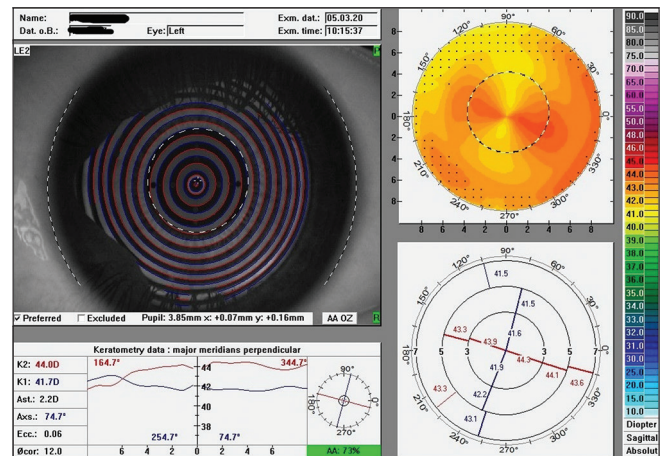


Figure 4: Post primary LASIK Topolyzer topography overview for left eye

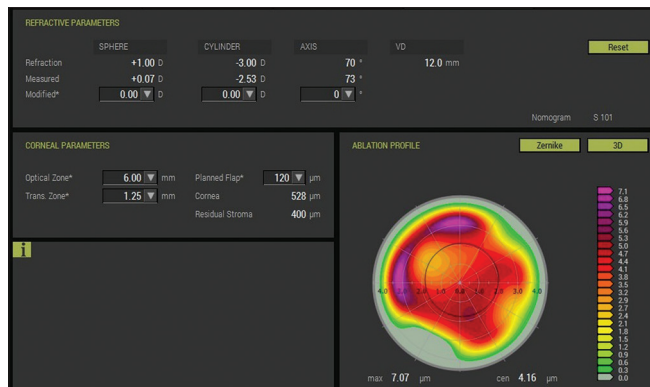


Figure 4a: Ablation profile for only the Irregularities which induce HOAs

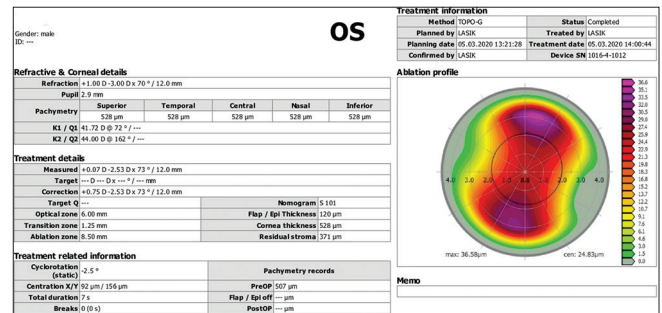


Figure 5: Treatment details of the enhancement

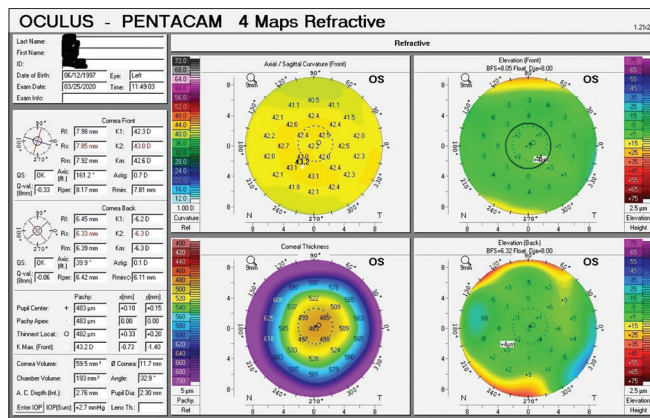


Figure 6: Pentacam tomography of left eye post enhancement

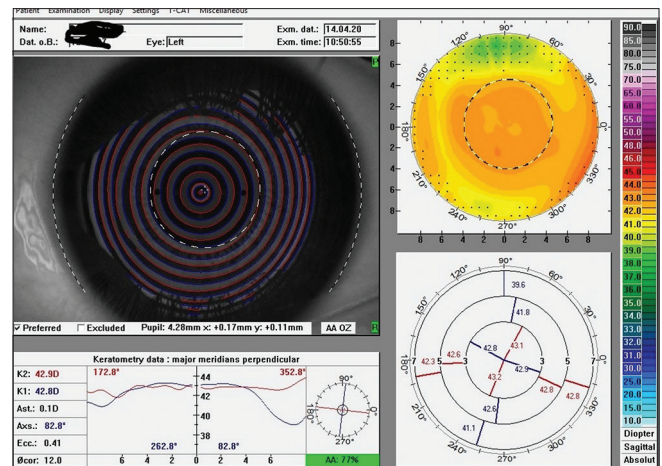


Figure 7: Post enhancement Topolyzer topography maps

excimer laser). Here -0.25D was added to the manifest sphere as a nomogram adjustment.

RE: Was treated correctly with postoperative vision 6/6 the next day. Nothing else remarkable about the LASIK done.

This LE had a cylinder correction done at a different axis - 150 instead of 80 degrees. Postoperative refraction was done on day 3 and repeated after a month.

The refraction over this period was stable. He ended up with a new astigmatism on 70 Degrees with a change in sphere also.

His UDVA was 6/36, postoperative day 3 refraction was +1.00 D -3.00 D x 70 deg 6/6p. Cycloplegic fraction postoperative day 3 was +2.00 D Sph - 3.25 D Cyl x 80 (6/6) and cycloplegic refraction on 1 month was +1.75 D Sph -3.00 D Cyl x 80° (6/6).

The post primary LASIK topography [Figs. 3 and 4] shows this astigmatism at the 74.7 degree axis; this astigmatism here once again corroborated with the manifest refraction. Hence the cylinder has resulted at a different axis (70 degrees) from the treated axis and the original manifest cylinder axis.

This eye was subsequently planned for an enhancement with topographic-guided ablation after one month of primary LASIK.

Manifest refraction +1.00 D - 3.00 D x 70 deg (SE -0.50 D).

Target refraction: plano.

Topolyzer cylinder : - 2.53 x 73 deg.

Modified (Treatment) Refraction : +0.75 -2.53 D x 73 deg (SE -0.51 D).

Here the manifest and topolyzer cylinders did not exactly match. This difference could be due to the HOAs [see Fig. 4a] which are adding to the real topographic cylinder. Only treating the manifest cylinder with the topo-guided ablation Topolyzer could over-correct the cylinder. Hence the cylinder was treated with the topographic cylinder and axis. An adjustment in sphere was done to ensure the same SE was treated. The same flap was lifted and the LASIK was completed uneventfully. All the refractions and treatments were done by the same surgeon (HA) in the same setup using the same diagnostic instruments on the same excimer.

Fig. 4a above shows the ablation profile for only the Irregularities which induce HOAs. To demonstrate this, here

the modified refraction is set to 0. Note that about 7 microns of tissue are being ablated for the purpose of treating these irregularities around 36 microns are ablated for the entire enhancement. Post-enhancement [Fig. 5], after a month UDVA was 6/6 with no acceptance. The refraction on retinoscopy was +0.50 D Cyl x 80.

Topography [Figs. 6 and 7] showed the cornea was very much regularized with an insignificant cylinder (0.1 D).

Discussion

The reason for enhancements could be due to wrongly done manifest refraction, incorrect techniques, regression, index myopia^[6] and operating room factors like temperature and humidity, and of course excimer laser performance issues.

One important reason is that of a data transcription error. The data is incorrectly fed into the excimer. Other reasons are - wrong patient treated, wrong eye treated and wrong entry of the numerical value and '+' and '-' sign. These errors could likely have been under reported for obvious reasons.

It has been documented that correction of an incorrect manifest refraction astigmatic axis induces an entirely new abnormal astigmatism on a different axis. Manifest refraction is less accurate and can lead to abnormal astigmatism when laser ablation is performed.^[3] Hence a topo-guided treatment was planned and it gave excellent results. Topo-guided ablation also been successfully used to treat post-keratoplasty cornea,^[7] to enlarge optical zones,^[8] keratoconus, and ectasia following LASIK.^[9]

Conclusion

LASIK enhancement with topographic-guided ablation results in excellent outcome in a patient with a prior incorrectly treated astigmatic axis.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

Employed by Alcon Wavelight as Clinical Application Consultant.

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