Target Z-axis Optimized LASIK for 2 Cases with Decentered Ablation

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Purpose: To report target z-axis optimized LASIK treating for two eyes from two patients with decentered ablation.
Methods: The LaserSight AstraPro2.2 Z software is a topography-guided custom ellipsoid ablation platform. LASIK with target z-axis optimization was performed to restore pre-operative visual axis using a LaserSight SLX excimer laser (version 5.3, 300 Hz).
Results: During preoperative examination, the uncorrected visual acuity (UCVA) was 0.5 in both eyes, and the best spectacle-corrected visual acuity (BSCVA) was 1.0 and 0.8. The decentered ablation zones were diagnosed with LaserSight AstraMax topography. Following target z-axis microtranslation, fifteen and eight μm of central corneal tissues were preserved in the two eyes respectively, the UCVA was 1.2 in both eyes, and secondary ablation zones were both centered on the visual axis. Topography maps and UCVA were stable in both eyes at the time of final follow-up.
Conclusions: Using target z-axis optimized LASIK with the LaserSight AstraPro Planner 2.2 Z customized ablation software was an effective method to modify decentered ablation and restore the visual axis. ***Eye Science 2010*; *25*:*78-81*.**

Key words: Topography-guided LASIK; Corneal topography; LASIK retreatment; Ablation

Laser Sight AstraPro Planner 2.2 Z software is based on corneal topography/elevation data. Its customized ablation model is ellipsoid. The Z-axis via corneal vertex can be microtranslated to achieve an ablation zone centered around visual axis [1]. We report 2 cases with decentered ablation after excimer laser refractive surgery, retreated by LaserSight excimer LSX laser (LaserSight Technologies, Inc.) and AstraPro Planner 2.2 Z software.

Materials and Methods

Case 1

A 32-year-old woman experienced an uneventful bilateral photorefractive keratectomy (PRK) for approximately −8.00 diopters of myopia in 1995. The type of laser used was unknown. After 12 years, she complained of gradual blurred vision in her right eye. Preoperatively, the uncorrected visual acuity (UCVA) was 0.5, and the best spectacle-corrected visual acuity (BSCVA) was 1.0 with a manifest refrac-

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tion of −2.75 −0.25×95. The central corneal thickness was 541 μm. Slitlamp biomicroscopy examination showed that the cornea was clear and without haze. An average of three similar preoperative corneal topography maps was obtained using LaserSight AstraMax (LaserSight Technologies, Inc.). An ablation profile (Fig 1–3) was determined on the AstraPro2.2Z platform and transferred to the laser system via a 3.5-inch floppy disk. During the operation, the patient maintained focus with both eyes on a blinking red light. The corneal reflex of the red light in the center of the white ring in LaserSight laser system, indicating the corneal vertex was maintained in the center of the pupil, and the offset was not adjusted. Following a Moria 2 90 microkeratome cut, a topography-guided ellipsoid ablation, assisted by an active pupil tracking system, was performed. The flap was repositioned after the stromal bed had been irrigated with balanced salt solution (Alcon). Postoperatively, 0.1% fluo rometholone eye drops (Allergan Inc.) were used 4 times a day, and gradually tapered over 4 weeks. Tobramycin 0.3% (Alcon) was applied 4 times a day for one week. Artificial tear was given 4 to 6 times a day for 2 months. At one month, the UCVA was 1.2, and the residual refractive error was +1.37−0.25×115. The central corneal thickness was 448 μm. At 13 months, the UCVA was also 1.2 with a residual refractive error of +0.5+0.5×16, and the central corneal thickness was 453 μm. Corneal topography was per formed (Fig 4). The patient was satisfied with this vision, and didn't complain of night-time glare.

Case 2

A 36-year-old woman experienced an uneventful bilateral laser in situ keratomileusis

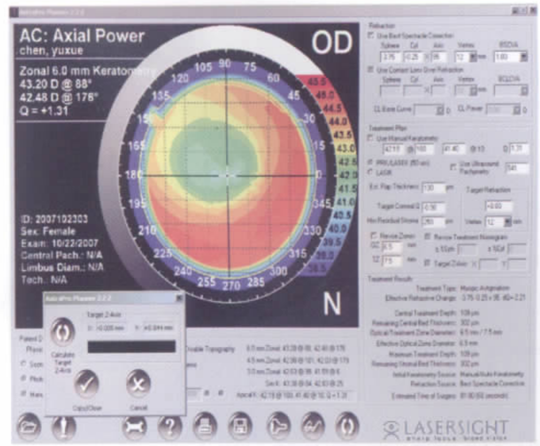

Fig.1 The average map revealed superior and temporal decentered of the treatment zone on the AstraPro2.2 Z platform. The pane (lower left) showed that target z-axis was calculated with the software. Before copying the calculated target z-axis, central treatment depth was 109 μm and equal to maximum treatment depth.

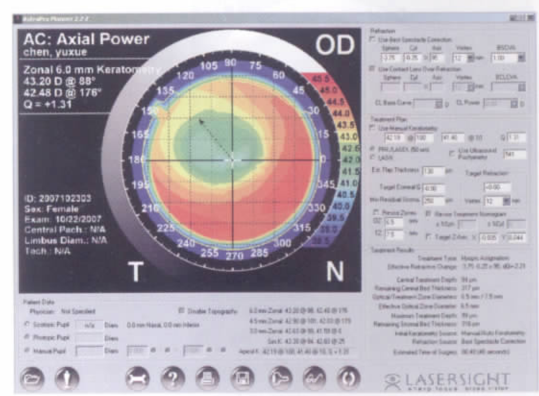

Fig.2 The arrow pointsed to the microtranslation of postoperative z-axis which laid in the point (−0.035, 0.044) on the AstraPro 2.2 Z customized ablation planner interface.

Fig.3 The treatment results (upper left) showed central treatment with depth of 94 μm and maximum treatment with depth of 99 μm. Fifteen μm central corneal tissue was saved compared with unadjusted ablation plan. Planned axial ablation profile (upper right) also showed ablation zone translating to the nasal and inferior.

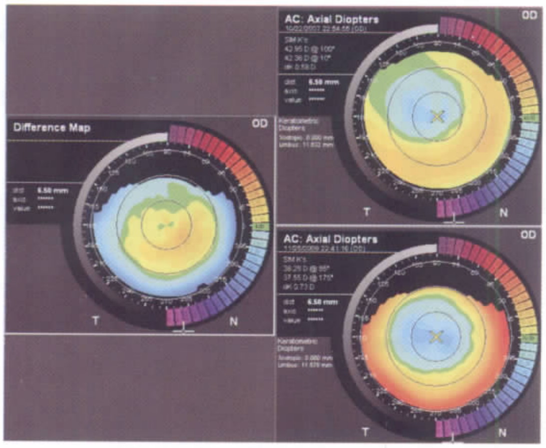

Fig.4　The difference maps between preoperative corneal topography and the postoperative ones at the interval of 13 months. The real different map (left) was almost same to the simulation (upper right) in the Figure 3.

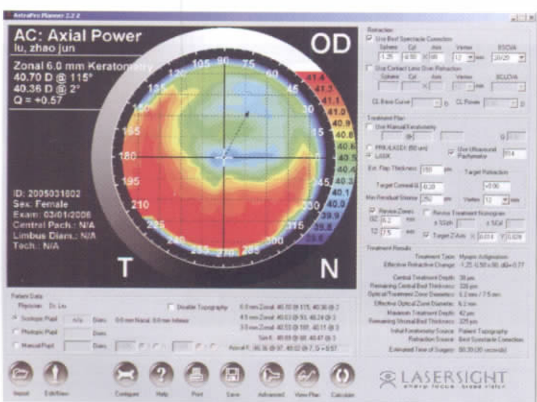

Fig.5　The AstraPro planner2.2 Z platform showed that primary ablation zone decentered to the nasal and superior. Postoperative z-axis (corneal vertex) was shifted to (0.014 mm, 0.028 mm), a very small shift from the origin along the arrow direction as indicated. Even though the Z-axis shift was minute, the central treatment depth reduce significantly from 46 μm to 38 μm; and the maximum treatment depth was only 42 μm, compared to 46 μm without the AstraPro Z tissue saving algorithm.

(LASIK) with Moria 2 110 microkeratome and LaserSight excimer laser in our center on March 28, 2005. During laser scanning, the pupil based eye tracker was out of order, and fixation of patient was not properly maintained. Six months later, the UCVA in the right eye regressed to 0.5, and the BSCVA was 0.8 with a correction −1.50−0.5×80. The central corneal thickness was 514 μm. The patient complained of severe glare and poor quality of vision in the right eye, especially at night. An enhancement procedure was performed in the right eye using the AstraPro2.2 Z software (Fig 5). The original flap was lifted, and the corneal bed thickness was measured by ultrasonic pachymetry (SP−2000, Tomey) to avoid residual stromal bed thickness less than 280 μm following laser application. The pupil offset was 0.1 mm temporally and inferiorly. Excimer laser ablation was performed with the usual tracking system engaged. The flap was repositioned after being irrigated with BSS. A bandage contact lens was applied and remained in place for 2 days. Routine postoperative topical steroids and antibiotics were administered. One month later, the patient reported better night vision when driving. The UCVA was 1.2 with a residual refractive error, and an increase of 2 lines compared to the preoperative value in BSCVA. The central corneal thickness was 476 μm. At 7 months, the UCVA was 1.2 with a residual refractive error of +0.12/−0.25×126, and the corneal topography revealed that the decentered ablation had been completely resolved (Fig 6).

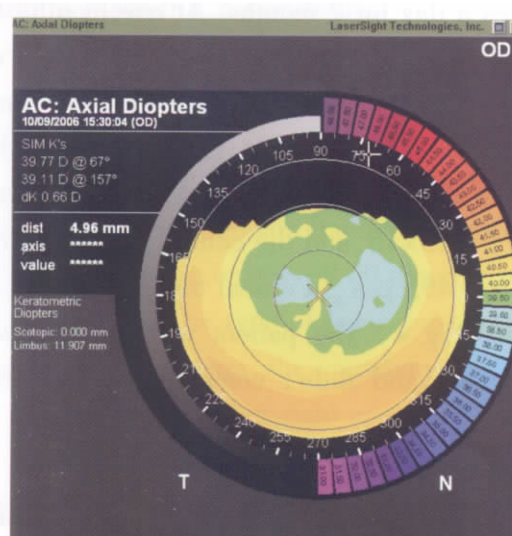

Fig. 6　The stable topography map at 7 months.

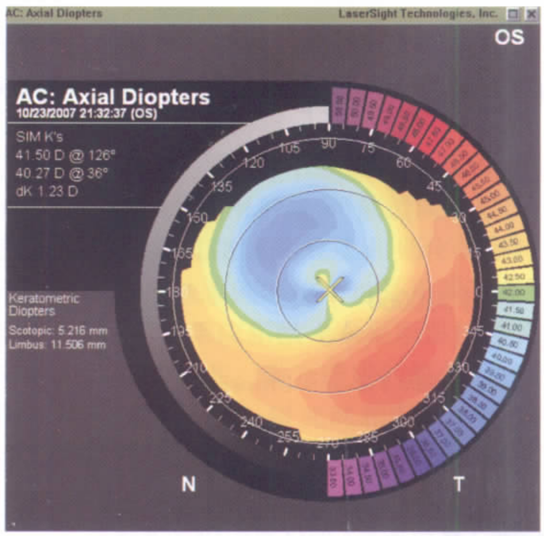

Fig.7　The decentered laser ablation in left eye of case 1.

Discussion

Some corneal refractive surgeons have reported on methods to retreat decentered excimer laser ablation [2-8]. We used LaserSight AstraPro Planner2.2 Z software, and a topography-guided customized ellipsoid ablation platform, to successfully modify a decentered optical center by z-axis optimization in two eyes. Central corneal tissue was preserved, and the corneal surface was regularized. The subjective quality of vision and UCVA were significantly increased postoperatively. Our clinical experiences are as follows. First, the ablation zone should be as large as possible, and care should be taken to maintain the thickness of the residual stromal bed at 280 μm or greater. Postoperative refractive status and vision quality are better and more stable with larger optical and treatment zones. Second, adjustment of the offset is very important in topography-guided laser ablation. Laser scanning should be performed along the visual axis. As the patient's pupil is changing size continually during the operation, the background illumination during measurement of the offset should be the same as that during laser treatment. The offset should be determined repeatedly and kept minimum value in minimum pupil to avoid over-shifting.

It is interesting that an obvious decentered ablation was also seen in the topography map of the left eye (Fig 7) of case 1. But the patient denied visual complaints. The UCVA was 1.0, while the refractive error was −2.75 −0.5 ×78 without cycloplegia, indicating excessive accommodation. This may be due to right eye dominance.

LaserSight AstraPro Planner2.2 Z topography-based customized ellipsoid ablation software was applied to retreat 2 cases with decentered excimer laser ablation. By z-axis micro-translation, corneal tissue was preserved, the visual axis restored, UCVA and BSCVA increased, and the quality of vision improved. This platform is a safe and efficacious tool to improve decentered ablation.

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（收稿日期：2010-08-05；编辑：林燕薇）

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(*Receiving date*: *2010-05-01*; *Editor*: *Jianhua Liu*)