The objective of this study was to describe our initial experience with the newest refractive platform, the Wavelight Refractive Suite.

A total of 50 myopic eyes (28 patients) were included in this study. Uncorrected distance visual acuity, manifest refraction, and keratometry readings were taken preoperatively and 3 months postoperatively. Emmetropia was targeted with an optical zone of 6.5 mm, and flap dimensions were of 130-μm thickness and 9-mm diameter with a superior hinge in all eyes. Flap thickness was measured with optical coherence tomography postoperatively.

Results: At 3 months postoperatively, 82% (41/50) of eyes achieved uncorrected distance visual acuity of 6/6 or better, 98% (49/50) achieved 6/9 or better, and all eyes achieved 6/12 or better. Eighty-four percent of eyes were within 0.5 diopter (D) of target of emmetropia, and 98% of eyes were within 1 D. Mean postoperative flap thickness was 124 ± 7.8 μm.

Conclusions: The Wavelight Refractive Suite consisting of the femtosecond laser FS200 and Excimer laser EX500 is the newest integrated refractive surgical platform available and can offer good refractive predictability as shown by the results in our initial 50 myopic eyes.

Key Words: Wavelight Refractive Suite, myopic laser in situ keratomileusis, wavefront optimized, femtosecond FS200, EX500

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The Wavelight Refractive Suite (Supplemental Digital Content; http://links.lww.com/APJO/A17) is the most recent addition to the refractive surgery technology market, and it boasts a state of the art refractive surgery solution consisting of a femtosecond laser (FS200) and Excimer laser (EX500), which are fully integrated with one another as well as the diagnostic devices, which include the Oculyzer (Scheimpflug tomographer), the Analyzer (wavefront aberrometer), and Topolyzer (topographer). This integrated network known as the Wavenet offers unprecedented communicative capabilities between these machines and allows for improved safety with regard to data entry and treatment planning.

WAVELIGHT FS200

This is the latest entrant into the femtosecond arena and is a 200-KHz laser. It differentiates itself from the other femto-

second lasers in the market with several features, some of which are the following:

1. It is the fastest femtosecond laser in the market and is able to cut a 9-mm diameter, 130-μm flap in 6 seconds.
2. It allows full customization of size, shape, location, and depth of corneal cuts.
3. There is a 2-part suction process that allows the adjustment of flap centration even after suction has applied.
4. It can make large-diameter applanations, which minimize the incidence of opaque bubble layer as the flap creation process begins with the creation of a canal that extends upward toward the corneal surface near the flap hinge. This allows the cavitation gas bubbles to escape (Fig. 1).
5. It has several important safety features; the laser runs a beam control check before each use, which compensates for deviations in depth of field and the z axis. It also does a self-calibration for the correct focal point each time it is switched on.

WAVELIGHT EX500

This is the latest version of the Wavelight lasers, which are renowned for their speed; the first 200-Hz laser was introduced in 1999 followed by the 400-Hz Eye-Q in 2004 and now the EX500. This 500-Hz, 0.68-mm flying spot laser has a treatment range from −14.0 diopter (D) to +6.0 D and up to +6.0 D of mixed astigmatism.

The 500-Hz repetition rate translates to a treatment speed of 1.4 seconds per diopter of ablation and is currently the fastest in the market. With this level of speed, it can deliver extremely consistent outcomes and reduces the potential for corneal dehydration and patients’ loss of fixation. The Gaussian beam can deliver pulses at high frequency, and the laser’s Perfect-Pulse technology controls the delivery of the beam and overlaps every fifth spot to minimize thermal effect on the cornea.

The EX500 also has a unique optokinetic video-based 1050-Hz multidimensional eye tracker, which can track pupillary diameters of 1.5 to 8 mm with a latency time of 2 milliseconds. In addition to this, it has a Neurotrack feature, which helps compensate for cyclotorsion.

The EX500 features a variety of ablation profiles, and the standard one is the wavefront optimized profile, which is a prolate (aspheric) ablation profile, which compensates for energy loss in the periphery and reduces the amount of induced spherical aberration. The goal of a wavefront-optimized treatment is to maintain the prolate shape of the cornea, which translates to an equal dioptric change in corneal radius of curvature both centrally and in the midperiphery within the optical zone. In this treatment, loss of ablation energy in the periphery is compensated for by increasing pulse energy in these peripheral zones. The patient’s manifest refraction is entered into a global software database (nomogram), and the recommended laser entry value is used.

If customized treatments are required, a decision tree can be followed to choose among the other ablation profiles (Fig. 2). Wavefront-guided (A-CAT) treatment for patients
with higher order aberrations is possible with wavefront aberrometry from the Allegro Analyzer. Topography guided (T-CAT) treatment for patients with irregular corneas can be calculated with the Allegro Topolyzer or Oculyzer and Custom Q (F-CAT) treatments, which is an asphericity-guided treatment to increase depth of field for correction of presbyopia.

It is the objective of the authors to describe our initial clinical experience with this suite using the wavefront-optimized profile for myopic patients.

MATERIALS AND METHODS

This was a retrospective study of patients who underwent laser in situ keratomileusis using the wavefront-optimized ablation profile with the Wavelight Refractive Suite at Lee Eye Centre, Ipoh, Malaysia. We have no financial interests in the products used in this study.

A total of 50 eyes (28 patients) were included in this study. All were myopic eyes that underwent surgery using the wavefront-optimized ablation profile, and surgery was performed by 1 surgeon (M.W.L.). All eyes were targeted for emmetropia, and a 6.5-mm optical zone was used. Flap thickness was targeted at 130 μm with a flap diameter of 9 mm and side cut of 70 degrees. The flap hinge was positioned at 90 degrees, with length of 3.8 mm, angle of 50 degrees, and width of 0.4 mm. Laser energy used for the bed cut and side cut was 0.9 μJ. For the bed cut, laser spot separation and line separation were both 8.0 μm, whereas for the side cut, spot separation was 5.0 μm, and line separation was 3.0 μm.

Uncorrected distance visual acuity (UDVA), best corrected distance visual acuity, manifest refraction, and automated keratometry readings were recorded preoperatively and postoperatively at 3 months. Eyes were further categorized into low myopia (less than −3 D), moderate myopia (−3 D to less than −6 D), and high myopia (greater than −6 D) based on preoperative manifest refraction.

Postoperative flap thickness was also measured with anterior segment optical coherence tomography (AS-OCT), and this was carried out at 1 week and 1 month after surgery. Nine different measurements were taken, and the mean thickness recorded for each eye (Fig. 3).

RESULTS

In this cohort of eyes, 15 (53.6%) were female patients, and 13 (46.4%) were male patients. Mean patient age was 32.4 years (range, 18–45 years). There were 9 eyes in the low myopia group [mean preoperative spherical equivalent (preop-SE), −2.33 D),
28 eyes in the moderate myopia group (mean preop-SE, −4.36 D), and 13 eyes in the high myopia group (mean preop-SE, −7.86 D). The mean preop-SE (all eyes) was −4.91 D (range, −1 to −11.88 D).

At 3 months postoperatively, 82% (41/50) of eyes achieved UDVA of 6/6 or better, 98% (49/50) achieved 6/9 or better, and all eyes achieved 6/12 or better (Fig. 4). Manifest refraction showed that 84% of eyes were within 0.5 D of target of emmetropia, and 98% of eyes were within 1 D (Fig. 5).

For the low myopia group, 88.9% (8/9) eyes had UDVA of 6/6 or better, and all eyes had UDVA of 6/9 or better. All 9 eyes were within 0.5 D of emmetropia.

In the moderate myopia group, 82.1% eyes (23/28) had UDVA of 6/6 or better, and 96.4% (27/28) had UDVA of 6/9 or better; 78% of eyes were within 0.5 D of emmetropia, and 96.4% were within 1 D.

In the high myopia group, 76.9% (10/13) of eyes had UDVA of 6/6 or better, and all eyes had UDVA of 6/9 or better; 84.6% of eyes were within 0.5 D of emmetropia, and all eyes were within 1 D (Fig. 6).

The mean postoperative flap thickness was 124 ± 7.8 μm. There were no intraoperative complications or opaque bubble layer, and we had no incidences of infection, diffuse lamellar keratitis, or epithelial ingrowth. There were 2 cases of flap striae (different patients), which required flap lift and repositioning, and 1 eye achieved final UDVA of 6/6, whereas the other had UDVA of 6/12. Patient satisfaction was high, and none of the eyes required enhancement.

**DISCUSSION**

Our center is a private ophthalmic group practice that has only recently started its refractive surgery services. This is our initial experience with refractive surgery, and it is important to note that this group of patients also represents our first experience with the Wavelight Refractive Suite platform. These cases were performed with a standard nomogram (as recommended by the vendor), and it is expected that this nomogram will be modified accordingly as more clinical experience is gained with this platform.

We have started our surgery conservatively and have performed surgery only on myopic eyes (which are the predominant refractive error in our Asian population). Besides laser in situ keratomileusis, surface ablation procedures were also performed, but as the number of eyes that underwent surface ablation was too few, the results have not been included for analysis.

Fifty-six percent of eyes treated had moderate myopia (−3 to less than −6 D), 18% with low myopia (less than −3 D), and 26% had high myopia (−6 D or greater). From our results, postoperative UDVA at 3 months was good in all groups. For all eyes, 82% of eyes achieved UDVA of 6/6 or better; 84% of
eyes were within 0.5 D of the target (of emmetropia), and 98% were within 1 D. Of particular interest is how well our highly myopic eyes did as all 13 eyes achieved UDVA of 6/9 or better and were within 1 D of emmetropia.

The Wavelight Refractive Suite is the newest refractive surgical platform available and can offer good refractive predictability as shown by the results in our initial 50 myopic eyes. The FS200 shows good predictability with an SD of 7.8 μm for flap thickness, and its speed allows for short “suction on to suction off” time of ~30 seconds. The ergonomic design of the suite with the swiveling patient bed allows for very smooth work and patient flow. The availability of network connection between the lasers and the diagnostic equipment allows seamless data transfer and minimizes potential data entry errors. Treatment planning can also be done before the start of surgery using a portable laptop and transmitted to the lasers when surgery is performed.

The limitations of our study are its retrospective nature and the relatively small number of eyes analyzed. To some extent, expectations from this new refractive surgical platform can be extrapolated from our initial experience. The versatility of the FS200 in terms of the customization of the flap and the variety of ablation profiles available with the EX500 are some of the features we look forward to exploring as our experience with the Wavelight Refractive Suite increases.

REFERENCES


“As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality.”

Albert Einstein (1879–1955)