Visante OCT comparison of the uniformity of Intralase vs. microkeratome flaps

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Dr. Dishler specializes in refractive surgery, practices in Denver Colorado, and has personally completed almost 40,000 LASIK procedures over the last 10 years. He has helped in the original development of excimer lasers through FDA trials and the femtosecond lasers since their inception. Currently he consults for several companies on improved products for the refractive surgery industry. He holds several patents related to this expertise.

As one of the ZEISS study sites, Dr. Dishler has helped verify the accuracy of the Visante OCT for measurement of corneal thickness as compared to other modalities. In his presentation he also demonstrated accurate and reproducible flap thickness measurements. According to Dr. Dishler, such measurements are important clinically in his practice. The feature Dr. Dishler highlighted as being most useful is the pachymetry mapping capability of Visante OCT, which he found to correlate with excimer laser ablation patterns.

Visante OCT – A Valuable Diagnostic Tool For Refractive Surgeons

As one of the three U.S. study sites for the Visante OCT, we became familiar with this instrument's capabilities for measuring corneal thickness and flap thickness related to LASIK refractive surgery. It has proven to be more accurate and reproducible than existing technologies such as ultrasound or slit illumination methods. This is due to the inherent accuracy of interferometry, the powerful optical principle at the heart of the ZEISS instrument. The OCT optical engine is packaged in an instrument that is extremely easy to use by the physician and well tolerated by the patient. The user interface and ergonomics are typical of the high quality we have seen in other ZEISS instruments.

New Applications

In the Visante OCT image in Fig. 1, we see a typical pre-op pachymetry map. The color coding demonstrates the pattern of corneal thickness, shown more exactly with the numeric scale to the right. The + sign represents the visual axis of the eye. Note that there is some asymmetry of shape that is acceptable as normal.

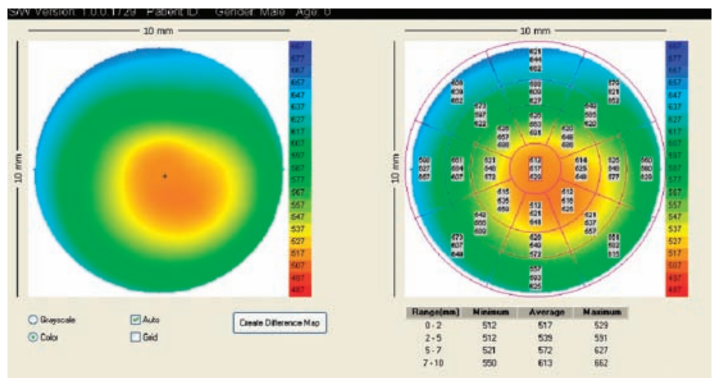

Fig. 1: Typical pre-op pachymetry map

Abnormal Pachymetry Maps

The high resolution of Visante OCT allows us to appreciate fine detail in corneal structure, previously not recognized. For instance, in the case shown in Fig. 2, where the cornea is slightly thin, we can also appreciate a multicentric pattern of thinning. There is an irregularity to the shape suggestive of forme fruste keratoconus, which suggests a possible increased risk to performing laser corrective surgery. Note on the left that the yellow central color is irregular. This is a good example of the usefulness of Visante OCT in preoperative patient evaluations.

Dr. Dishler article continued

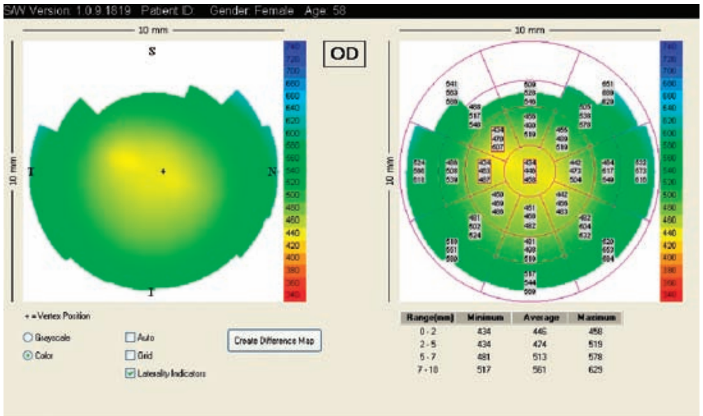

Fig. 2: Abnormal pre-op pachymetry map

Pachymetry Difference Maps

Perhaps the most valuable capability of Visante OCT related to refractive surgery is the pachymetry difference map. In figures 3 and 4, a pre-surgery and post-surgery map are compared and the mathematical difference is computed and displayed. In this example, we can appreciate the shape of the laser ablation, and correlate the ablation depth calculated by the excimer laser to the measured ablation depth. For this eye, there is good agreement and an excellent visual outcome. The measured ablation depth was 87 microns, and the calculated ablation depth was 92 microns. We can compare this to the fellow eye of the same patient, where the ablation depth was measured at only 74 microns, but was expected to be 104 microns. This variation is due to swelling of the cornea and is reflected in a reduced vision of 20/40 in the left eye, as compared to 20/20 vision in the right eye.

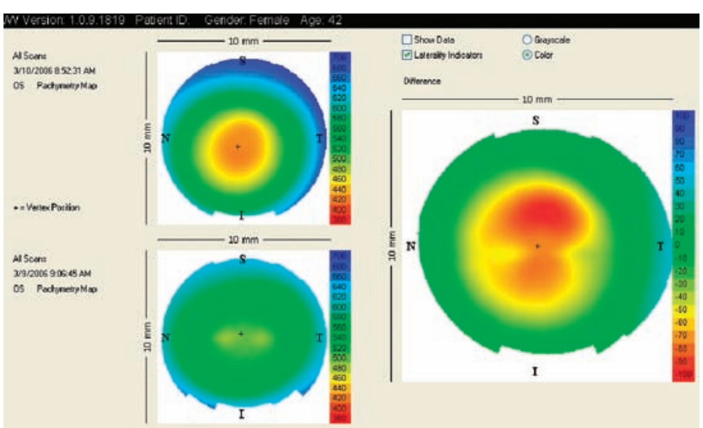

Fig. 3: Right eye – normal ablation difference map

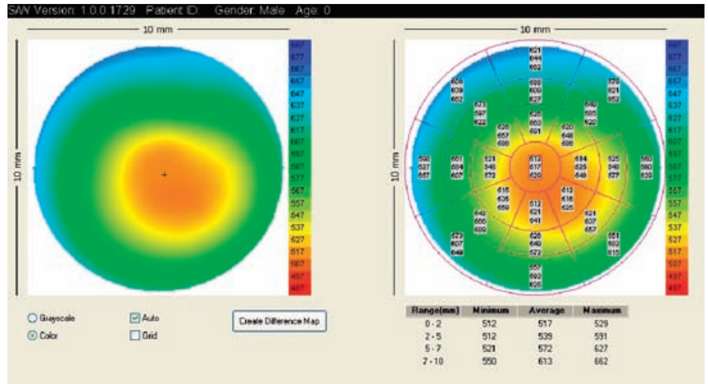

Fig. 4: Left eye – post-operative swelling reduces apparent ablation depth

Other Examples

The pachymetry map in Fig. 5 shows the interesting pattern of a large astigmatic correction. Note that the cornea starts with a symmetric shape (lower left), and the laser ablation is "imprinted" in the cornea in the post-operative pachymetry map (upper left). In the difference map (right) we can see that there are about 100 microns of early post-operative swelling. We can follow this with sequential maps over time to monitor the patient's improvement. The apparent increase in thickness shown in the difference map, despite tissue being removed by the laser, clearly implies swelling.

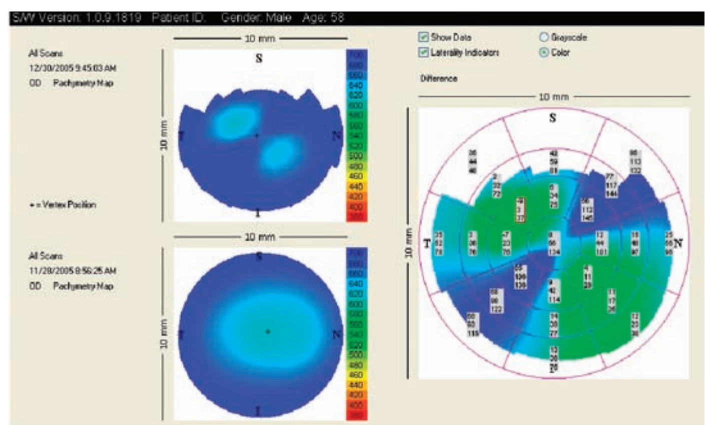

Fig. 5: Pachymetry difference map for astigmatic correction

High Resolution Corneal Maps

Another very valuable capability of the Visante OCT is the display of corneal cross sections, which enables visualization of finer structures, including the actual flap created as part of the LASIK procedure. We can quantify measurements of flap thickness, the entire thickness of the cornea, and most importantly the so-called residual corneal bed. This is the amount of untouched cornea, which is vital for maintaining structural integrity. For instance, many believe that a minimum thickness of residual bed should be at least 250 microns. In Fig. 6, we can see a flap made with an Intralase femtosecond laser, measured close to the programmed 120 microns flap thickness. Also, we can appreciate that there are approximately 350 microns of residual bed, providing a comfortable margin.

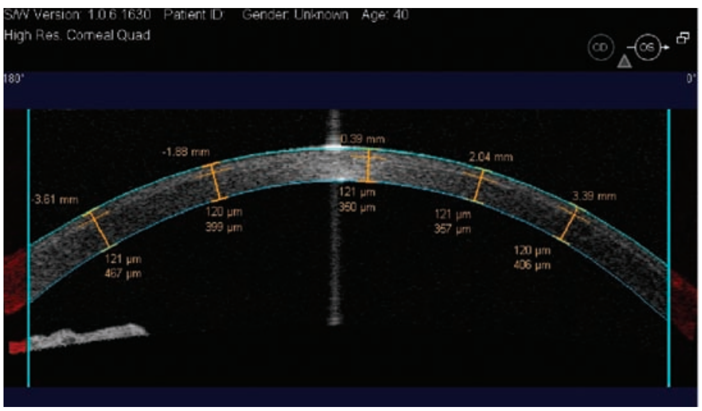

Fig. 6: Intralase flap at 120 micron programmed depth

This contrasts with the image in Fig. 7, showing a microkeratome created flap with a residual bed of only 228 microns. This patient would be advised not to have additional laser refractive surgery.

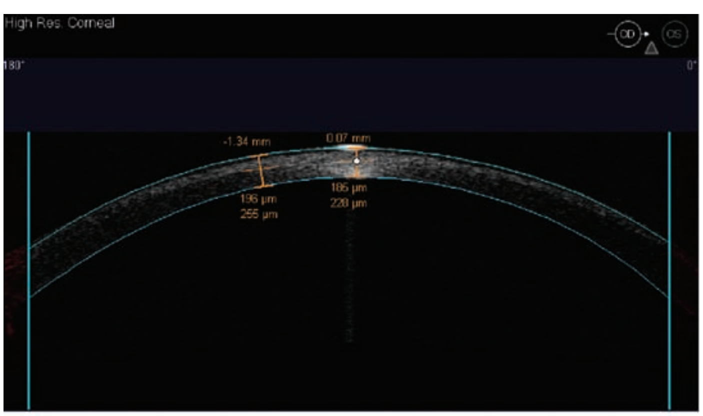

Fig. 7: Microkeratome case with thick flap (190 microns) and thin residual bed (228 microns)

Other Applications

There are many applications of Visante OCT beyond those mentioned in this article. They include measurements of critical anterior segment dimensions related to intraocular lens implants, and several glaucoma diagnostic applications, including screening for narrow angle glaucoma. One of the more interesting images we have seen is of a Revision Optics intracorneal hyperopia correcting lens (Fig. 8), essentially a contact lens placed within the cornea. Note the dark band within the cornea, which is the intracorneal implant. The lens steepens the shape of the front of the cornea, resulting in correction of farsightedness. We can measure this implant for critical dimensions as well as evaluate the depth and centration of placement. This is one example of the continuing stream of new applications found for the Visante OCT.

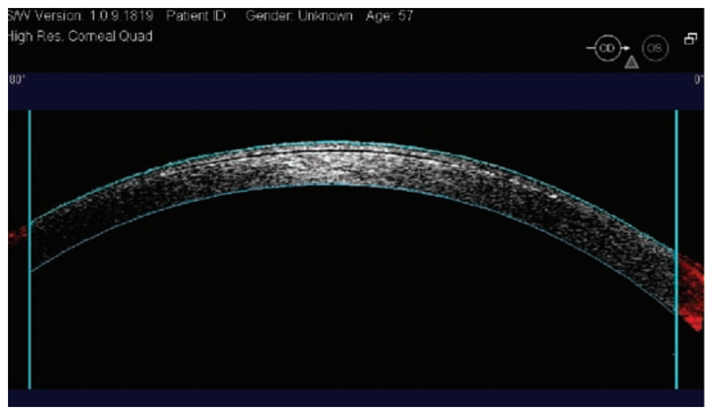

Fig. 8: Revision Optics intracorneal hyperopia correcting lens