Ophthalmology Times
CUTTING-EDGE ADVANCEMENTS

XFRACTION℠
Optical Path Diagnostix

Exceptional Technology for Excellent Vision

J.C. NOREIKA, M.D., M.B.A.MEDINA, OH

INTRODUCTION:

This article is not about refraction. It is about time, money, productivity and exceptional patient care. It is about the Marco XFRACTION℠ Process. This technologically advanced process gives vision care professionals tools to provide the most precise vision that a patient's anatomy allows. By combining data from wavefront aberrometry and automated refraction, it redefines the professional's understanding of the visual system. It is transformative technology: faster, more accurate, less labor intensive and, ultimately, more cost effective than the standard phoropter refraction. The ensuing clinical vignettes will demonstrate why the Xfraction process sets the refractive and diagnostic standard.

THE REFRACTION:

Refraction is often an afterthought in ophthalmology practices that concentrates on diagnosing and treating pathology. Relegated to the practice's technical staff, it seldom contributes actionable information that aids ophthalmologists in the care of their patients. Xfraction is different; it provides an assortment of customizable diagnostic and therapeutic datasets in flexible, easily interpreted formats. Delivered to the specialist in real time at the point of care, this information renders a comprehensive overview of what, why, and how a patient sees.

WHY XFRACTION℠?:

An ophthalmology practice serves three subsets of patients: those with healthy eyes desiring them to remain so; those affected by vision disorders that can be managed, treated and improved; and, those affected by ocular diseases that current science can only support. Now envision these subsets in a Venn diagram (Figure 2). At its center, the Marco OPD-Scan III assists the ophthalmologist in quickly and accurately consigning a patient to each proper subset. The result enhances delivery of appropriate intervention resulting in efficient, high quality care that exceeds the expectations of even the most challenging patient.

Figure 1: OPD-Scan III as configured on EPIC workstation

Eye specialists take justifiable pride in their clinical acumen and surgical abilities. But, the patient is primarily interested in seeing well. In many general practices, this starts and ends with the refraction. Evaluating key parameters of the visual system, the OPD-Scan III defines the patient's visual capability precisely. "The Xfraction process is highly customizable; systems can be configured to any practice's specifications and **budget** (in an existing office space or in the EPIC workstation)." The flagship Epic workstation is an all-in-one unit that saves time (the physician's most precious commodity), staff labor (a practice's most important cost center), and enhances patient convenience.

The following five common clinical situations are presented to show the functionality and diagnostic capability of this game-changing technology.

CLINICAL VIGNETTE #1: THE MYOPIC ADOLESCENT

The starting point of the Xfraction is the Viewing Software's map. In less than a minute, four separate auto-refractions, a corneal keratometric exam, and a

wave-front analysis of the visual system are performed. This map includes the Root Mean Square (RMS) value. Applying the physics of wave-front aberrometry, this calculation defines the patient's visual potential by evaluating the presence or absence of "aberration" due to tear film, corneal, lenticular and vitreal anomalies. The higher the RMS value, the less likely the patient's eyes will achieve excellent vision, *the refractionist's most diligent and sustained effort notwithstanding.*

Scanning the patient's eyes from tear film to the retina, OPD-Scan III can assess visual potential before the slit-lamp is positioned. If the readings indicate that the wave-front refraction was "sent", the patient's visual system is "very clean", i.e., technically, there are no significant sight-impairing abnormalities involving the aforementioned anatomical structures. "Wave-Front Sent" means there is high correlation between the four auto-refraction measurements and the wave-front analysis. Technically, the software's nomogram has found a low RMS value and differences of less than 0.50 diopters in sphere or cylinder or 10 degrees axis between the 2.6 mm pupil's auto-refractions and the 4 mm wave-front refraction in both eyes.

When the 'wave-front' (WF), refraction is sent, statistical probability indicates that the refraction is accurate; one can confidently predict that little or no additional technical effort is needed to refine it. Alternatively, if the Xfraction process indicates that the 'auto-refraction' (AR), has been chosen and sent, a formal refraction is required to achieve best visual acuity. Utilizing decision-tree methodology, the system guides the refractionist to the most efficient method of correcting the patient's vision.

When a comprehensive refraction is required, the flexibility built into the Epic 5100 and TRS-5100's software enhances speed, ease and accuracy by permitting patients to better judge differences detected by traditional "is one better or two better?" methodology. Because the patient's ability to accurately discern differences is increased, the refractionist's task is simplified. Why is this important? Young, healthy patients often present for services paid through vision care plans. Because reimbursement levels are low and decreasing, a refractionist's speed, accuracy, and efficiency is critical if an economic return is to be realized.

Please note two additional innovations of the Epic-5100 and/or TRS-5100 Xfraction process. Upon completion of the formal software-guided refraction, the patient can immediately compare and contrast her vision through her current glasses' correction and the new Xfraction prescription in rapid succession by a single button push. Viewing this near-simultaneous comparison, the patient can quickly decide if new glasses are warranted. The patient is thus prequalified for the optician, an advantage impossible by traditional phoropter refraction.

A second tool involves the visual acuity charts of the OPD-Scan III Viewing Software. In the exam lanes, acuity chart images are presented on LCD screens to demonstrate to patients, significant others or parents how the patient views the world without refraction and with the new Xfraction prescription. For younger or more graphically inclined patients, a beach scene can be chosen to model the differences. This is a powerful teaching tool that engages the patient in the exam process.

CLINICAL VIGNETTE #2: THE ASTIGMATIC PATIENT

The OPD-Scan III Viewing Software's "overview" provides three basic images of each eye: the Axial, Internal OPD, and OPD maps. The OPD map represents the aggregation of the Axial and Internal OPD maps and defines the status of the entire eye. Each provides useful information, the sum of which is more powerful than each individual component.

It is not unusual to interview a new patient who reports they have "a lot of astigmatism"; they will then casually

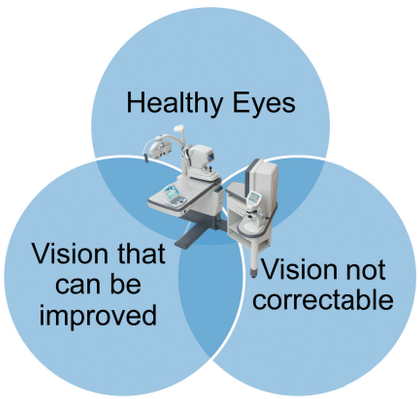

Figure 2: Venn Diagram

ask, "what is astigmatism?" An easy way to get lost in the weeds is to open a discussion on the Conoid of Sturm.

Projecting the Axial map on the exam lane's screen with the Viewing Software, the answer to the patient's query is graphically displayed. The map's colored image illustrates corneal topography and facilitates an explanation in layman's terms. Using the system's Point Spread Function, the actual impact of astigmatism on the patient's vision can be illustrated. The "wow-factor" of this capability should not be underestimated.

The physician can use the three maps to rapidly evaluate the eyes' topography and astigmatic curvatures. The system distinguishes astigmatism at the pinhole automated refraction 2.6 mm, 3 mm and 5 mm zones as well as the mesopic pupil size. Astigmatism that diminishes toward the cornea's periphery has little impact on the quality of the patient's vision. Astigmatism that is seen to increase from the pinhole to 3 mm and 5 mm zones should be addressed; this will be discussed in Clinical Vignette #4.

The OPD-Scan III can identify internal astigmatism, i.e., total astigmatism found behind the anterior corneal surface. This is especially critical when an ophthalmologist advises a prospective cataract surgery patient to consider a premium toric intraocular lens. Unrecognized, internal astigmatism can lead to less than optimal surgical results, patient dissatisfaction and surgeon frustration. It is defined by the Internal OPD

map. An additional tool, the "Subtract Prism" button of the Viewing Software, helps identify the lens as a source of internal astigmatism.

CLINICAL VIGNETTE #3: WHY CAN'T I SEE 20/20?

The science of high order aberrations has shed light on this all-too-common question. OPD – Optical Path Difference – technology can distinguish in seconds if the ophthalmologist is encountering a "clean" eye, i.e., one whose tear film, cornea, lens and vitreous are anatomically normal.

The OPD-Scan III provides several options to elucidate the cause of poorer than expected vision. To evaluate the tear film, increasingly recognized as a necessity for good sight, the system's 33 ring Placido disc is evaluated. Critiquing the quality and symmetry of the rings, a specialist can detect ocular surface abnormalities. More importantly, the images provided by the Viewing Software allow patients to better understand the source of their difficulty. This enhances compliance with proffered therapy.

One of the system's three basic images, the OPD map suggests potential problems at a glance. Color-coded, an OPD image of soft blue, green and yellow tones offers reassurance that the refractive apparatus of the eye is in good condition. "Hot" images showing bright yellows, oranges and reds alert the clinician to look closer to explain the patient's symptoms. The process starts with evaluation of the RMS values at the 3 and 5 mm zones; these data points are found on the OPD and Axial maps and the refraction readout. (Fig. 4 – The OPD Map Graphic)

The RMS values identify those eyes with high order aberrations and transmission defects. Internal high order aberrations cannot be corrected with spherical and cylindric lenses no matter the time and effort expended. If the RMS value is less than 0.4 at the 3 mm zone and less than 0.6 at the 5 mm zone, the patient's best corrected vision will be 20/20 or better (assuming the posterior visual system including the retina, optic nerve, and cortical centers are healthy). RMS values above 0.4 and 0.6 respectively indicate that 20/20 vision is unlikely with spectacle correction. And therein lies the answer to the dreaded question posed above. Identifying high order aberration, the OPD-Scan III allows the specialist to educate the patient why 20/20 vision remains elusive.

Figure 3: The OPD-Scan III Refraction Viewing Screen

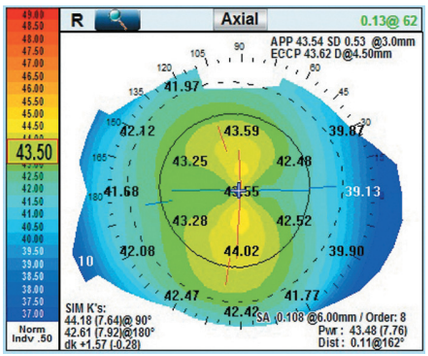

Figure 3a: The Corneal Topographic Map w/ classic bow-tie pattern

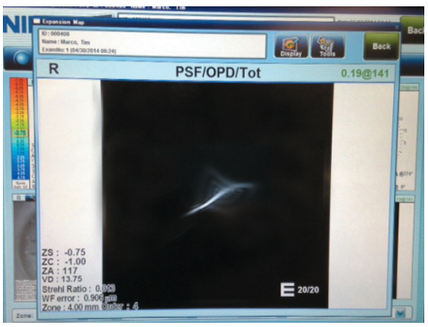

Figure 3b: with an image of the point-spread display of an astigmatic patient as it deviates from pin-point

CLINICAL VIGNETTE #4: THE PATIENT WITH A BAGFUL OF GLASSES

You introduce yourself to the patient. You ask what brings him to your office. Without speaking, he points to the pile of glasses on the desk and, with a sigh, states he can't see with any of them. Did I mention it is a late Friday afternoon?

Often, the complaint involves driving at night. Fortunately, the OPD-Scan III excels in this scenario because it provides a most important clue, specifically, does the patient's prescription differ under photopic and scotopic conditions? Looking at the maps, it can be seen that there is a solid-line circle centrally and a dashed-line circle peripherally. These represent the photopic and mesopic pupils. If the astigmatism power bleeds into the periphery, the patient's prescription will change under photopic and scotopic conditions. (As the pupil dilates, more of the peripheral cornea's refractive power comes into play. This fact also applies to patients wearing sunglasses and transition lenses.) By clicking the Day-Night Refraction button, any significant differences are highlighted in red. Best correction may require a second prescription to maximize vision and comfort. The Axial and OPD maps and the Point Spread Function of the Viewing Software graphically depicts this. The OPD-Scan III can formulate the patient's correction to a pupillary diameter of up to 9.5 mm and provide a customized night-driving solution.

But patients are sometimes examined whose anatomy is normal but whose eyes cannot be corrected to 20/20 vision. The RMS value answers the "why" and the Point Spread Function shows the "what". As noted above, the higher the RMS values, the greater the impact of high order aberrations

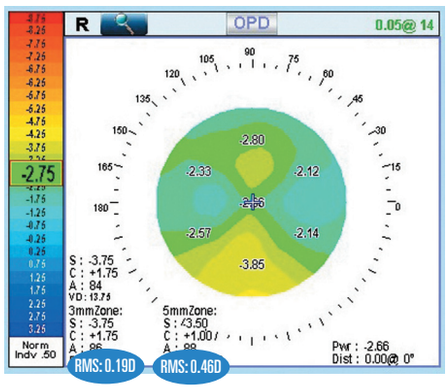

Figure 4 : The OPD Map Graphic

on the quality and quantity of vision. By differentiating corneal surface from internal high order aberrations, the OPD-Scan III can identify those that may be ameliorated by rigid contact lenses. A useful strategy is to identify the problem, determine the refraction providing the best vision and then use Point Spread Function images on the Viewing Software to educate the patient as to what realistically can be achieved. The Point Spread Function compared before and after best correction can reinforce the point. The OPD-Scan III can disassemble the corneal and lenticular components of the Point Spread Function to delineate the effects of nuclear sclerosis, cortical cataracts and tilted or malpositioned intraocular lenses.

The result? Another expensive pair of glasses will not join its bag-encumbered colleagues. Pin-point vision? Not possible. High order aberrations are the reason; the specialist knows this because she has checked the RMS values. The OPD-Scan III Viewing Software helps instruct the patient. And, it is likely that this explanation has never been offered to the patient in the past.

CLINICAL VIGNETTE #5: THE DIAGNOSTIC SURPRISE?

It doesn't happen often. An unsuspecting patient presents for a "routine" eye examination and the ophthalmologist intuits a problem: the patient's symptoms? The level of vision? The many eye doctors consulted in the past? Making or missing the diagnosis can

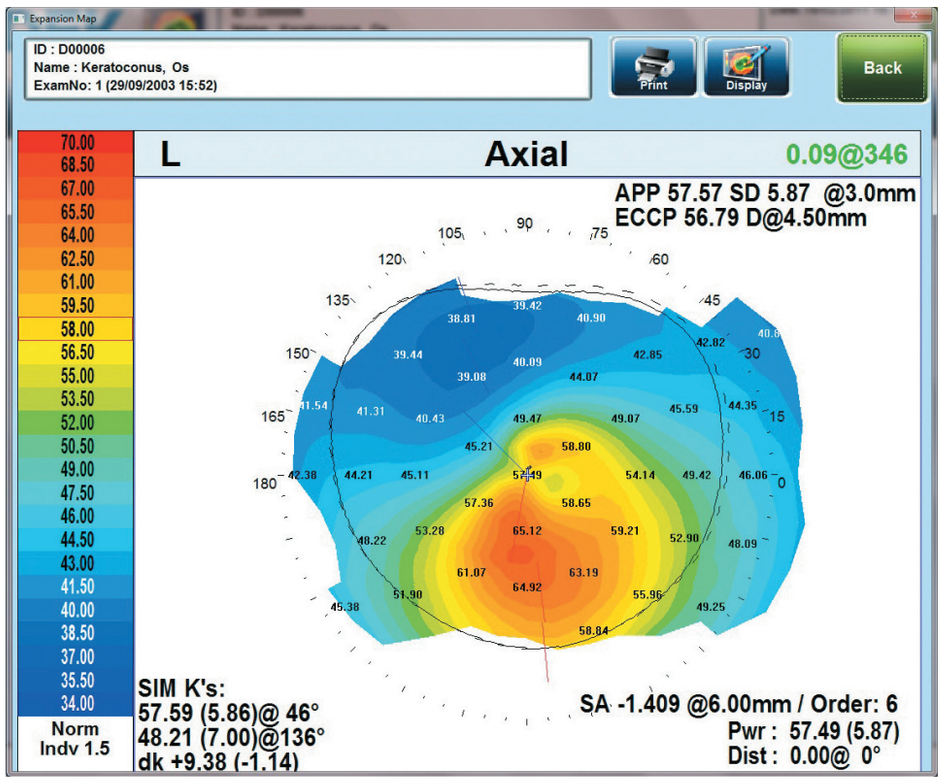

Figure 5: Axial Map with Keratoconus

lie in the doctor's access to information. The OPD-Scan III technology is like the iconic Swiss Army knife; it offers multiple advanced modalities designed into one small, efficient, time-saving footprint of wave-front aberrometry and automated refraction.

Entering the exam lane, a glance at the Viewing Software on the LCD monitor provides the doctor an invaluable first impression. Customization of the Viewing Software permits each physician to choose what appears on the screen. The three basic maps – Axial, Internal, and OPD – are color-coded. Yellow, green, blue? All good. But this patient has an inferior hot spot burning red and orange on the axial map. (Figure 5: Axial Map with Keratoconus) Keratoconus? Forme-fruste? Pellucid degeneration? All this is noted before the doctor sits down. Clicking on the "Subtract Prism" button confirms the problem involves the anterior cornea.

"Cool" colors? Good. But the patient experiences fluctuating vision. Call up the Placido disc. Magnify it on the screen. The mires look warped, irregular. The patient may be relieved to learn that their tear-film instability is not the harbinger of more serious eye disease. The quality of vision and comfort may be enhanced with proper treatment.

SUMMARY:

The XFRACTION℠ Process, with the OPD-Scan III as its crown jewel, is all about diagnostic acumen and clinical outcomes, patient convenience and satisfaction, and practice process efficiency. This technology is impressive, a fact not lost on the patient who has been subjected to traditional phoropter refractions during other encounters.

Yet, as noteworthy as its benefit in the context of the general ophthalmic practice, the OPD-Scan III truly excels in the brave new world of refractive cataract surgery. Beyond the scope of this article, the importance of the OPD-Scan III (in delivering wavefront optimized refractions) to modern premium lens surgery will be addressed in Part II of this series.