

# From RK to LASIK

Applying the lessons of refractive surgery to the development of a refractive excimer laser.

BY FREDERIC B. KREMER, MD

It is interesting for me to reflect on the key events in the history of refractive surgery that ignited my desire to help people see without glasses. In the late 1970s, I was a resident in ophthalmology at Thomas Jefferson University and Wills Eye Hospital in Philadelphia. As a resident, I first preferred performing cataract surgery, then retinal, then corneal, and then refractive surgery. There was no such thing as refractive surgery in the curriculum, however; in fact, the concept, for all practical purposes, did not exist. I began considering surgical methods to replace glasses, an idea that was perceived by almost everyone as rather “crazy.” But was it?

## FYODOROV AND RK

I had heard that Svyatoslov N. Fyodorov, MD, of Moscow was performing a procedure called *radial keratotomy* (RK). The procedure created purposeful radial incisions in the cornea in order to flatten and reshape it, thus decreasing refractive error. Almost simultaneously, I made plans to visit Dr. Fyodorov and created the first ultrasound pachymeter to measure corneal thickness, a device that was more accurate than pachymeters using light beams viewed through a slit lamp. This pachymeter made it possible to measure the cornea at the time of surgery, in the exact location of the incisions prior to setting the length of the blades. In Russia, I spoke with Dr. Fyodorov and his staff, who had first performed the RK procedure in patients 5 years earlier. After I examined one patient who had undergone the corneal incisional refractive procedure in 1974, I became an instant believer! By the time I

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began performing RK in patients, only nine other doctors had performed the surgery in the US.

In those days, it was challenging to believe in something that more senior ophthalmologists did not, so I decided to stay in Philadelphia where colleagues knew that I would approach ophthalmology carefully and rationally. I performed my initial RK cases under a protocol, and another independent ophthalmologist examined my initial patients prior to the surgery. The RK procedure was a great advance. It enabled many patients to see without glasses or contact lenses. It is difficult to understand in this day of elevated patient expectations, but, at that time, most patients were extremely happy with any visual improvement after surgery, even if they still required glasses for some tasks. As time passed, many other surgeons and I made advances in surgical techniques (eg, multizone approaches, different numbers of incisions, ways to grasp the eye, refinement of incisional depth, etc). Incidentally, I feel that modern refractive surgery should be performed in absolutely sterile ORs with sealed walls and floors and separate air-handling systems. It amazes me that this idea has not yet caught on.

### KERATOMILEUSIS

In 1985, I began performing keratomileusis using the cryolathe developed by Professor José I. Barraquer, MD, of Bogotá, Columbia, on patients who had more than 10.00 D of myopia. This procedure was quite interesting because the surgeon had to concentrate on multiple parameters simultaneously without making a mistake. The parameters included (1) the placement of the microkeratome, (2) the timing of tissue removal, (3) the timing of the freezing of tissue, and (4) the timing of the lathing. Eventually, I performed keratomileusis on refractions as low as 6.00 D of myopia as well as on some cases of hyperopia. We performed approximately 1,000 of these procedures. When using the cryolathe, it took patients' vision between 1 and 2 weeks to perform well, and, of course, it continued to improve more over time.

Luis Ruiz, MD, of Bogotá, Columbia, attempted to eliminate the cryolathe by performing multiple passes over the cornea with the microkeratome in a procedure known as anterior lamellar keratoplasty. This procedure resulted in a much more rapid recovery time, but it was not as accurate as the cryolathe in terms of the final refraction.

### EXCIMER LASER

The development of the excimer laser enabled surgeons to perform keratomileusis without freezing the corneal tissue. At the time, I tried to convince one of the first laser manufacturers (Summit Technologies) that surgery should be performed this way. They had asked me to lead their study of PRK, and I said that I would consent if we could use what is now called *LASIK* (at that time, I called it *Laser-K*; the "K" was for keratomileusis, performed with a laser). They refused, and I literally had to build a laser to test my hypothesis. Fortunately, it was correct, and my excimer laser, the Kremer Excimer Laser System was actually the first one approved by the FDA for LASIK on July 30, 1998.<sup>1</sup>

The next issue is correcting presbyopia! This will be very exciting! ■

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1. US Food and Drug Administration, Center for Devices and Radiological Health. PMA final decisions rendered for July 1998. Available at: <http://www.fda.gov/cdrh/pma/pmajul98.html>. Accessed March 9, 2004.