

AHEAD OF HIS TIME ON LASIK

In 1985 Gholam Peyman filed a patent on stromal ablation under a flap using an excimer laser, anticipating much of the procedure’s future development

by Howard Larkin in Chicago

Gholam A Peyman MD is perhaps best known for his pioneering work in vitreo-retinal surgery, including intravitreal drug delivery, endoresection, development of the operating microscope with stereoscopic assistant head, the endolaser and the first 23-gauge vitrectomy system. While he limits his clinical practice to retinal diseases, he has developed techniques and instruments for treating a wide range of ophthalmic conditions, for which he has been granted 116 US patents. “I felt that I could contribute in management of the diseases affecting other parts of the eye” he says. One such concept was modifying the curvature of the cornea for refractive purposes using an excimer laser to sculpt the corneal stroma or on the back surface of a corneal cap or flap – the procedure that would become known as LASIK. Dr Peyman first filed a patent on the concept in July 1985 (US patent 4,840,175) (see figure). After two revisions of the application, the patent was finally granted in June 1989, about six months before Ioannis Pallikaris MD, PhD performed the first LASIK procedure on a human eye.

Avoiding scars and pain Dr Peyman’s interest in laser refractive surgery dates back to 1977. Then a faculty member at the University of Illinois in Chicago, his investigations of the effects of lasers on eye tissues led him to experiment with CO2 lasers to modify corneal refraction in rabbits. The laser was applied to the cornea in different patterns, but all caused significant scarring. “My conclusions at that time were: 1) We have to wait for the development of an ablative laser and 2) We should not ablate the surface of the cornea but, instead, the ablation should take place under a flap in order to prevent scarring and other undesirable sequelae,” Dr Peyman says. He published the first paper on the topic in *Ophthalmic Surgery* in 1980.¹

Dr Peyman’s interest was piqued again in 1982, when reading an article, in the journal *Laser Focus* from Bell Laboratories, describing the photo-ablative properties of the excimer laser on organic materials. “When I read about the excimer laser, I thought it would revolutionise corneal laser surgery. My mind was ready for it,” he recalls. The next year Stephen Trokel MD, PhD published his landmark study of excimer incisions on enucleated cow’s eyes, also conducted at Bell.

In 1985, Dr Trokel and his group published a paper that described using an excimer laser for radial keratotomy (RK) on an enucleated human eye. However, RK incisions failed to heal apparently due to removal of a thin layer of tissue between the sides of the cut, so most investigations shifted to surface ablation.

Dr Peyman took another route. “Because of my previous experience with the CO2 laser, I wanted to avoid surface ablation thereby preventing the potential corneal scarring

and the pain associated with the removal of the corneal epithelium that exposes the nerves after surface ablation. I applied for a patent in June 1985 describing the method of modifying corneal refractive errors using laser ablation under a corneal flap.” The filing anticipated several methods for directing a refractive laser, including “use of a variable diaphragm, a rotating orifice of variable size, and a scanning mirror which directs the laser beam towards the exposed internal stromal surface or the underside of the corneal flap.”

Dr Peyman tried to get an excimer laser for research from a firm in Finland, but the device was just too expensive. However, he was able to evaluate the effects of various excimer lasers in conjunction with the Physics Department of the University of Helsinki (1985).

He had also purchased an infrared Erbium-Yag laser to evaluate stromal ablation under a hinged corneal flap² in vivo in rabbit and primate eyes. He presented the research at the Association for Research in Vision and Ophthalmology in 1988, and published it in *Ophthalmology* in 1989. By this time he also had moved to Louisiana State University, where Marguerite McDonald MD and colleagues were developing PRK. However, as a retinal specialist, he was restricted and not involved in the project.

Surface ablation continued as the dominant procedure for some time, and Dr Peyman had little success getting manufacturers interested in laser ablation under a flap. In 1990, he sold the patent to Chiron. “They purchased it for a very little amount of money and that was the end of it,” Dr Peyman says. “However, I was happy that at least someone liked the concept and paid for my development costs.”

Mitigating LASIK side effects Dr Peyman still conducts LASIK research, primarily to address some shortcomings. “I have always been very aware of the potential limitations of my invention, and have devoted considerable time and effort over the years to find ways to ameliorate them,” he says. Among these have been ablative and non-ablative inlays inserted under the corneal flap to allow a greater range of refractive correction (*J Cataract Refract Surg.* 2005)³, and the use of topical cyclosporine to enhance the recovery of corneal sensation after LASIK (*J Refract Surg.* 2008 Apr;24(4):337-43)⁴.

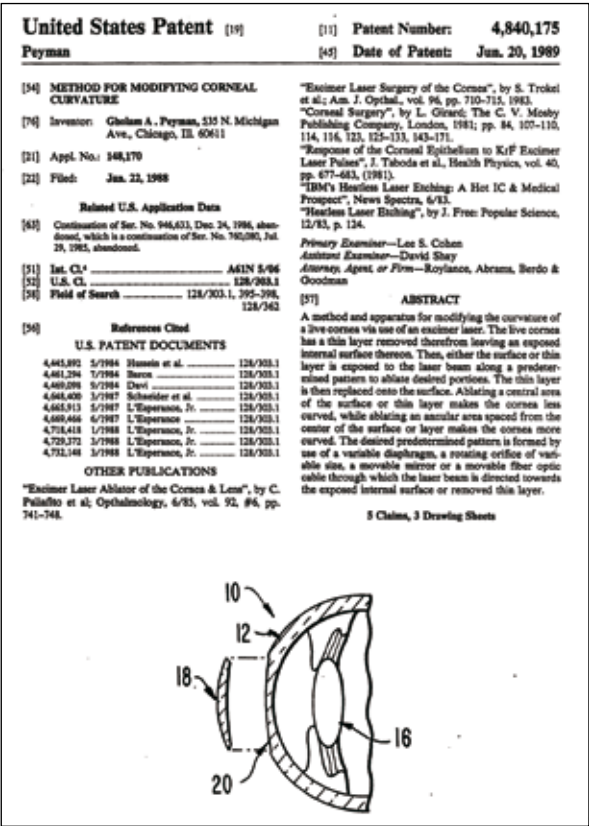
Now as professor of basic medical sciences at the University of Arizona in Phoenix, Dr Peyman continues his research in other areas. He is currently developing a tonometer that can measure IOP and outflow through the eyelid for patients to use at home, and a pressure jet injector in which no needle enters the eye for non-invasive subconjunctival and intraocular injections. Why has he been involved in so many different projects? “I enjoy research,” he said.

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First page of Dr Peyman's patent for LASIK

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3- Peyman GA, Beyer CF, Bezerra Y, Vincent JM, Arosemena A, Friedlander MH, Hoffmann L, Kangelor J, Roussau D. Intracorneal inlay Photoablative inlay laser-assisted in situ keratophakia (PAI-LASIK) in the rabbit model. *J Cataract Refract Surg.* 2005 Feb;31(2):389-97.
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