“But first, you’ll be a doctor.”

With these words to the teenaged Charles D. Kelman, MD, his father guaranteed that the world would experience phacoemulsification. The story of how it became the accepted cataract surgery technique in the developed world and the aspired-to technique elsewhere is hardly straightforward, however.

BEGINNINGS

Charles D. Kelman, MD—Charlie to all those who knew him—was born in 1930 to Eva and David Kelman. Charlie grew up in a middle-class neighborhood in Queens, New York. His father, a Jewish immigrant from Greece (Figure 1), had been an inventor but never received adequate reimbursement and recognition for his efforts. This affected Charlie, who later as an inventor himself desired recognition for his work—the money was a mere bonus.

Medicine was certainly not Charlie’s first love; that was music. Growing up in the swing era, as a teenager Charlie dreamed of being a musician and playing saxophone with the great dance bands. In high school, he started composing musical scores. Although his grades were not outstanding, he managed to secure a spot at Tufts University in Boston and graduated with a Bachelor of Science in 1950. Years later, while studying medicine at the University of Geneva in Switzerland, Charlie continued to play and compose music and perform at clubs. He also worked at a radio station and published a song, “Le Petit Déjeuner” (Paroles et Musique de François Charpin et Charles Kelman), that was later recorded by Jean Sablon, the popular French singer and actor.

In 1953, while still abroad, Charlie received the bad news that his father was diagnosed with cancer. David Kelman died 2 years later. His death was a major blow to Charlie, and it spurred him to graduate with his medical degree in 1956.

He decided that ophthalmology would be a good career, because he would have plenty of time for music, and persuaded the powers that be at the Wills Eye Hospital in Philadelphia to allow him to join its residency program. Charlie continued to submit original songs to record companies, and his demo tape of “Telephone Numbers” excited interest. He recorded the song under the name Kerry Adams so that his medical colleagues would not know about his musical sideline. When the song became a hit, Charlie thought that his career was made; however, as Charlie tells the story, a dance craze called the twist came along and changed the pop music scene. Charlie’s musical career ended at this point, but this allowed him to turn his attention more fully to ophthalmology. Because he had developed a taste for entertaining and enjoyed the recognition it brought him, he yearned for the same recognition in ophthalmology that he had briefly achieved in music. Therefore, he quickly began brainstorming ideas that would bring this to fruition.

FIRST EFFORTS

Charlie’s first efforts centered on the use of extreme cold in cataract surgery. He had seen the publicity surrounding Irving Cooper, the American neurosurgeon who used a cryoprobe to treat Parkinson disease, and he wondered if the device might be useful in ophthalmology. Charlie managed to inveigle his way into Dr. Cooper’s laboratory and successfully extracted a cataract in its entirety with the cryoprobe. Having realized that Charlie might be onto something, his mentor took over his work,
and Charlie was cut out of credit for the discovery. This rankled Charlie and would color his attitude toward sharing information about his subsequent work in phacoemulsification, especially in the initial phases.

During the days of extracapsular cataract extraction and large incisions, postoperative recovery typically took more than 10 days, with the patient initially immobilized in the hospital and continued slow visual recovery thereafter. Charlie wondered if it might be possible to remove a cataract through a smaller incision, thus avoiding hospitalization. He approached the John A. Hartford Foundation and was given funds for a 3-year study but had no clue how he would achieve his aim. After almost 3 years of wasted ingenuity and extensive animal study, Charlie had spent all the funds trying dozens of devices to extract a cataract through a reduced incision (Figure 2). Although each device could engage the cataract, it would either spin in the eye or did not come out as planned. The damage to delicate ocular tissues was extensive. Thus, the time had come to report his research to the Hartford Foundation and try to apply for more funds.

**A TRIP TO THE DENTIST**

As a result of his obsessive approach to work, Charlie had neglected himself; his hair grew long and his teeth were in need of cleaning. During one appointment, the dentist used a new device to clean his teeth. The Cavitron dental cleaner vibrated at ultrasonic frequencies to remove plaque from teeth (Figure 3).

Charlie rushed from the dentist’s office shouting, “I’ve got, I’ve got it!” He later returned with a newly extracted cataract and made a remarkable observation: The device was able to penetrate into the lens tissue and, because of its rapid oscillation, engrave lines on the cataract without it jumping from his hand. This was a function of the ultrasound probe’s very rapid rate of vibration. Charlie subsequently worked with Cavitron to create the first phacoemulsification machine (Figure 4).

Many of the things we take for granted about phaco technology today were simply unknown at this time. However, by 1967, Charlie felt ready to try his machine on a blind eye. The patient submitted to surgery knowing that the result was purely for the benefit of medical research. The operation was carried out in great secrecy, and the operating room door was locked. It took more than 4 hours to complete the procedure, and the phacoemulsification portion alone lasted 70 minutes. The phaco handpiece was extremely heavy by comparison with those used today, and Charlie’s hand became fatigued frequently during the operation. The original video of the operation demonstrates how often the cornea collapsed onto the phaco tip, due to the inadequate understanding of fluidics at the time (Figure 5).

Two years later, after extensive changes had been made
to the phaco machine, Charlie felt it was time to try again. Phaco procedures in three more eyes helped Charlie undergo a rapid learning curve, with significant improvements to technique and outcomes in each subsequent procedure. He began to think his idea would work and decided that this invention would be his alone, especially after his experience with cryoextraction. He patented his ideas and entered into a contractual arrangement with Cavitron.

**CONTROVERSY**

By 1970, Charlie had started to train other surgeons in his new technique by holding courses in New York (Figure 6). As most surgeons had never before used an operating microscope for cataract surgery, Charlie was meticulous about teaching this early group of phaco users the manual skills necessary to achieve cataract extraction using a variety of devices—something never before done in cataract surgery. Charlie avoided publishing papers in peer-reviewed journals about his new technique; those who attended his early courses largely did so because of word of mouth. These early acolytes were almost exclusively in active private practice and not academia. When the denizens of the great academic ophthalmic institutions became aware of what Charlie was up to, they reacted negatively. Phaco was described as “malpractice” and “ridiculous,” and many warned of potential long-term effects on the cornea. In response to these charges, the National Eye Institute declared that phacoemulsification was experimental. As a result, medical insurance companies withdrew reimbursement for the procedure.

In the early days, few ophthalmologists supported the use of phacoemulsification. In 1973, at the annual Welsh Cataract Symposium, surgeons lined up to convey their bad experiences, and patients with poor results gave testimonials. Unfortunately, most of the commentators were not phaco surgeons themselves.

By 1974, the American Academy of Ophthalmology (AAO) established a committee to compare phacoemulsification with conventional intracapsular cataract surgery.

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**LASIK: Then and Now**

Comments from the father of LASIK.

**BY IOANNIS G. PALLIKARIS, MD, PhD**

The first LASIK procedure worldwide was performed at the University of Crete, Greece, in June 1990. The first LASIK clinical trials took place in the United States in 1994, and US Food and Drug Administration (FDA) approval was obtained in 1999. At this early time in refractive surgery, we used a manual Barraquer microkeratome to create the LASIK flap. The procedure required exceptional skills and was fraught with complications. Improvements to the technology and to the procedure helped us to slowly overcome the drawbacks associated with LASIK, and eventually it gained surgeons’ trust as a safe refractive treatment, even among the most conservative surgeons.

Today, it is a safe assumption that LASIK designated the start of a new era in ophthalmology, and that in the future it will continue to evolve and to be refined as a method for treating refractive errors. In the past few years, for instance, LASIK—and refractive surgery in general—has experienced an upsurge in customized treatments such as wavefront-optimized procedures to minimize induced higher-order aberrations and achieve optimum visual quality postoperatively. The efficacy of customized ablation profiles has been shown to be safe and effective, without the consequence of any particular complications.

Since its inception, LASIK has continually evolved as a refractive procedure in everyday clinical practice. The future of LASIK lies in customized treatments and the use of femtosecond lasers. As technology is constantly improving, the goal of any refractive surgical procedure is not to produce super-vision but to achieve natural vision that meets our patients’ current and future needs.

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and findings were reported at the annual meeting later that year. In order to make sure the assessment was fair and balanced, Charlie organized his own statistical review of results. The AAO study found that phacoemulsification was as good as but not better than conventional surgery, and as a result phaco was not endorsed.

At this stage, Charlie was convinced of the rightness of what he was doing, as were a coterie of those he had taught. He organized teaching courses on phacoemulsification at Mt. Sinai Hospital in New York (Figure 7), and he also decided to do something that had never been done before in medicine—going directly to the public with the merits of his invention. He wanted to flaunt his achievement in front of his doubting colleagues using shock tactics. On February 21, 1975, Charlie appeared on the Tonight Show Starring Johnny Carson, the most prestigious talk show on US television at that time (Figure 8). Not only did Charlie joke with Carson on air, dressed like a media personality, but he played his saxophone. Afterward, Charlie’s practice ballooned overnight, and he was able to thumb his nose at the ophthalmic establishment.

**REcOGnITION**

Despite Charlie’s individual success as a practitioner, it was not until a foldable IOL designed by Thomas R. Mazzocco, MD, became available in the early 1980s that large numbers of surgeons started to transition to phacoemulsification. In 1985, Charlie published his account of the battle to develop phacoemulsification and the trials and tribulations of having it accepted by his peers. The subtitle of “Through My Eyes” was “The story of a surgeon who dared to take on the medical world.” The implication behind his autobiography is that Kelman won—although he felt some of his colleagues might doubt this.

I met Charlie in 1979, when he taught a phaco course at Charing Cross Hospital in London. My mentor and the first surgeon in Europe to perform phacoemulsification, Eric John Arnott, FRCS, had asked me to give a talk on learning how to perform phacoemulsification. Charlie and I quickly became friends, and over the years we organized many meetings together. Over a 10-day period in 1986, Charlie and I taught a European phaco tour in London; Antwerp, Belgium; Munich, Germany; Bologna, Italy; and Athens, Greece, and performed live surgery in each venue, with the exception of Antwerp.

As we made our way across the continent, Charlie treated me—a relative unknown—with extraordinary intellectual generosity. I felt as though we both mattered equally, even though it was he who made the difference. Almost everyone who encountered Charlie would agree that he loved being the center of attention, but he also made others feel important.

As the 1980s progressed, so did phaco techniques and technologies. By the end of the decade, with the availability of trustworthy foldable IOL models and improvements in machine technology, more surgeons converted to small-incision cataract surgery. During the 1990s, Charlie finally received recognition for how phacoemulsification had changed cataract surgery. In 1992, US President George H.W. Bush presented him with the National Medal of Technology (Figure 9).

Despite these honors, Charlie did not feel fulfilled. To some extent, his love of performing music had been met by the performances he delivered at the end of his teaching courses in New York. Yet he still sought other challenges outside of ophthalmology. He learned to fly and subsequently purchased a helicopter to commute from his office in Manhattan to his house on Long Island; he performed his own show at a casino in Atlantic City, New Jersey; and he took up golf, hiring a professional for several months to improve his technique as rapidly as possible.

Over the years, Charlie continually brainstormed new ways to remove a cataract and replace it with an artificial lens. His Binkhorst Medal Lecture at the American Society
of Cataract and Refractive Surgery (ASCRS) in 1989 delighted all who heard it. He described an innovative use of electromagnets to break up the cataract in the eye, a technique that he called the magnetic fly. He also proposed using a patient’s own collagen to create a clear gel that would fill the empty capsular bag after the contents had been removed, restoring accommodation.

The senior members of the AAO had been some of the most outspoken critics of phaco in the 1970s, and it was not until 2003 that Charlie was awarded the AAO’s highest honor, the Laureate Recognition Award. In his acceptance lecture, Charlie retold the early history of phacoemulsification and thanked the AAO for the honor it had bestowed upon him.

LAST WORDS

In 2004, Charlie’s 6-year tussle with metastatic lung cancer ended, and he died on June 1. A glittering array of friends from the worlds of ophthalmology and entertainment attended a memorial event that, in typical Charlie fashion, took place in a Broadway theater. Many who had known him from all spheres of his life paid tribute to Charlie, and I was glad I had made the journey from the United Kingdom to wish him a last farewell.

What was Charlie’s contribution to our specialty of ophthalmology? He demonstrated that when you have an idea in which you truly believe, you must take it forward regardless of opposition. In the end, those in opposition will come to understand how they were wrong. Without the revolution that Charles D. Kelman, MD, started, we might still be languishing in an era of 12-mm cataract incisions held together with multiple stitches and all that implied for our patients.

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