

## Keratorefractive Surgery

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The concept of keratorefractive corneal surgery is not new, yet it has remained at a low level of activity within ophthalmology for a number of years.

The term keratorefractive corneal surgery (refractive keratoplasty), dates back to 1949 when Jose Barraquer described it as "The modification of the refractive error of the eye by plastic surgical intervention in the cornea"<sup>1</sup>.

In general principles, to understand refractive corneal surgery we must know that the cornea is a plastic and elastic medium, which maintains its curvature (power) or takes a different one as it is modified surgically. Surgical modification of corneal power is possible since it possesses about two-thirds of the total power of aphakic eye (cataract removed eye)<sup>1</sup>. Currently there is a great deal of interest in this modality.

The history goes back to 1898 when Lans first published his observation that a partial thickness radial incision in the cornea flattens the corneal curvatures in the meridian of the incision<sup>2</sup>. However, the actual procedure was originally described by Sato in Japan<sup>3</sup>, by describing anterior and posterior radial keratotomies as a technique of correcting myopia. Twenty years later Fyodorov and Durven in Russia, modified the procedure and published their extensive experience in 1979<sup>4,5</sup>. In the United States, radial keratotomy was first introduced by Bores in the fall of 1978<sup>6</sup>. Since then more than 200,000 cases of radial keratotomies (RK) have been performed in the U.S. alone.

The technique of RK is only one of several different modalities but it is the most frequently practised refractive surgery performed on the cornea. Other techniques are listed below :

1. Radial keratotomy for moderate myopic cases.
2. Myopic keratomileusis for high myopic cases.
3. Hyperopic keratomileusis for high hypermetropic cases.
4. Onlay lamellar graft for aphakic, myopic and keratoconus (another term used is epikeratophakia).
5. Intrastromal corneal hydrogel implants for aphakia and myopia<sup>7</sup>.
6. Wedge resection for astigmatism for high astigmatic cases<sup>1</sup>.

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In radial keratotomies, ophthalmic surgeons will make a radial corneal incision of partial thickness in order to flatten the cornea. Sato<sup>3</sup> described his technique by making 40 to 64 incisions from both anterior and posterior surfaces of the cornea. However, after several modifications, the procedure was then performed by making only 8 to 16 anterior radial corneal incisions and should be effective to correct between one to six dioptres of myopia.

When the procedure was introduced in the United States by Bores it aroused great interest among the public under the slogan "Throw away your glasses". The procedure is performed more frequently in the U.S. and has established itself with definite indications and fairly predictable results<sup>8</sup>. A number of investigators in the U.S. have reported thousands of documented cases showing the reasonable safety and efficiency of RK, one or two years after surgery<sup>9</sup>.

However, although RK is an excellent way of correcting myopia, not all cases make good candidates. Motivation and enthusiasm are the main reasons why patients chose to undergo RK. Essentially their reasons are either cosmetic (to improve their appearance by discontinuing the need for corrective eye glasses or contact lenses) or professional (enabling work or other activities requiring near perfect or perfect uncorrected vision).

During the procedure, a series of four to sixteen microfine radial incisions are placed in the mid periphery on an anterior portion of the cornea.

The ideal candidate for RK is the myopic patient between one to six dioptres, in the age group 21 – 50, as these have an excellent chance that RK will free them from the need for glasses or contact lenses. However, in less successful cases, patients will have a good chance that after RK they will benefit from a significant decrease in myopia and astigmatism, although they may still need to wear contact lenses or eye glasses.

Myopic keratomileusis is a less common keratorefractive surgery. It was first reported by Jose Barraquer in 1964<sup>1</sup>. The purpose of the surgery is to flatten the optical zone of the cornea very precisely. To do this the ophthalmic surgeon will resect a corneal disc about 75 mm in diameter and 0.32 mm in thickness of parallel faces. This corneal disc is then frozen and lathe-cut like a contact lens with certain power, then it is defrosted and replaced in the corneal bed. Donor tissue is not needed. For correcting myopia, the cut cornea lens is shaped as minus lens. The procedure is extremely beneficial in correcting a high degree of unilateral myopia. The procedure is not favoured because of the complicated procedure, expensive machinery and a certain degree of unpredictability, as in myopia keratomileusis, one is operating on a normal cornea thus the risk benefit ratio should be low if the surgery is to be accepted<sup>10</sup>.

Onlay lamellar graft or epikeratophakia is a keratorefractive surgery by using a corneal lenticule preground from donor tissue to alter anterior corneal curvature<sup>10</sup>. Kaufman developed epikeratophakia for the correction of unocular adult aphakia and it has since been adopted for myopia aphakia in infants<sup>11</sup> with congenital or traumatic cataract and for treatment of keratoconus as these types of cases are very difficult to treat with conventional corrective devices. The procedure to date can correct up to 25 dioptres of myopia. The procedure is also useful for pterygium and corneal perforations.

In Bahrain the department of ophthalmology at Salmaniya Medical Centre (SMC) is set to start RK procedures in the near future, however we have been cautious enough not to start too soon. The American Academy of Ophthalmology states that the RK procedure continues to develop as a surgical technique for modifying myopia, but that it is too early to completely evaluate the incidence of postoperative complications or to draw conclusions regarding the effects of the procedure. The RK procedure may reduce or eliminate the need for eye glasses or contact lenses, but at least until more long term data is available, this benefit must be weighed against the possibility of future impairment of sight or less significant complications.

At this time, although tens of thousands of RK procedures are done, it is still considered to be an investigational procedure. It should be conducted with adequate review mechanisms and with the appropriate informed consent which recognises the special nature and the present ramifications of the procedure.

There is no doubt that RK has gained wide popularity and acceptance in Russia and the U.S. and it has been practiced in Europe. It has shown great predictability and improved results especially with the improvement of instrumentation and ultrasonic corneal thickness measuring devices. The future is for RK, as it will replace the conventional mode of therapy for millions of patients and may turn eye glasses and contact lenses into obsolete optical aid devices.

In conclusion, the field of refractive corneal surgery is new and exciting. It is constantly evolving and promises to be one of the major fields of ophthalmic care in the coming years. The procedures are presently undergoing significant evolution and improvement and the optical complications are constantly decreasing.

As we develop a better understanding of the biology of the cornea, improve our surgical techniques and further our understanding of corneal wound healing, the results and the predictability of the procedure should improve so that keratorefractive surgery is performed on millions of error of refraction cases.

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