A Look at Refractive Surgeries

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Refractive surgery has been a hot debate over the past seventeen years, since radial keratotomy (RK) was brought to this country by Bores in 1977 [1]. As a growing number of ophthalmologists offer this service it becomes imperative that optometrists stay informed of the new techniques, outcomes, and complications of the procedures. Refractive surgery has become "big" business as centers appear in most metropolitan areas. A survey of the nations ophthalmologists, conducted by the American Society of Cataract and Refractive Surgery examined the methods of practice with respect to refractive surgery. Refractive surgery attempts to eliminate refractive error, such as myopia, hyperopia or astigmatism, by manipulating the cornea with surgical blades or lasers. The survey estimates that the percentage of surgeons performing RK has increased from 31% to 45% from 1992 to 1993/94 [1]. A similar increase is expected with astigmatic keratotomy (AK) as surgeries become perfected. As the numbers above indicate the procedure has become a major component to the future of eye care. Patients require information regarding refractive surgery to make informed decisions. An article in the May '94 issue of Contact Lens Spectrum points out, primary eye care practitioners, including optometrists, have become more open to refractive surgery than previously believed. Nearly every practitioner questioned has had at least one interested patient, within a three month period, in the prospect of refractive surgery and 40% of the practitioners report that 42% of their patients have inquired about refractive surgery [2]. It is obvious that refractive surgery is a treatment option for refractive error and ignoring it is a disservice to the patient. The following paper is an overview of a number of common refractive surgeries, with outcomes and complications.

The first and currently the most prevalent refractive surgery is Radial Keratotomy (RK). RK, as indicated in the previous paragraph, was brought to this country in 1977. It is a series of deep radial incisions in the cornea, which are designed to flatten the central cornea, leading to decreased myopia. The procedure is indicated in cases of stable myopia, between two and eight diopters, with patients generally being between 21 and 49 years old. Kanski describes the surgery as marking a central optical zone and visual axis with a 4mm circle. The corneal thickness is then measured with an ultrasonic pachometer to determine incision depth. Up to sixteen radial incisions are made from the clear optic zone, stopping short of the limbus, to avoid any blood vessels. Specially calibrated diamond knives are used for the incisions [3]. As with any surgical procedure there are variations. J. Charles Casebeer, M.D. indicates that as few as four incisions may be required in his seminar, A System of Precise, Predictable keratorefractive Surgery - A Surgical Approach to Emmetropia. The number of incisions, their depth and placement are all variables of RK surgery. They are altered according to the patients refractive error. Casebeer presents a refractive surgery that follows a nomogram. The nomogram was produced based on thousands of RK cases. The nomogram allows the surgeon the advantage of using a technique which has been proven to work [4]. A survey of the American Society of Cataract and Refractive Surgery (ASCRS) indicates that 48% of the respondents were trained by Casebeer and that 75% of surgeons use a nomogram as the surgical plan for RK. Casebeer points out that contemporary refractive surgery benefits appear to far outweigh the potential risks. The ASCRS survey also indicate that, in general, US RK surgeons tend to be cautious in their surgical strategy. Surgeons tend to

use four and at times eight radial incisions, with a fairly high enhancement rate. This would indicate that the surgeon would prefer to under correct the patient, with the possibility of further enhancing the procedure at a later time [1]. Kanski indicates that the main post-operative problems and complications are as follows:

1. Loss of 1 to 2 Snellen lines of best corrected VA in 10% of patients.
2. Diurnal fluctuation in visual acuity.
3. Difficulties with driving at night due to glare.
4. Intrastromal epithelial inclusion cysts.

The patient needs to understand that this is a surgical procedure, there are risks involved and that the outcome of the surgery is permanent. It is also important to inform the patient of the need for protective eye ware to prevent any unnecessary strain on the eye. While this is significant pre-operatively, it takes on added concern when the eye has been manipulated, impairing its overall strength. A second area of concern is indicated in the above list. While results appear satisfactory and patients are happy with the results at this time, it should be a concern that in the future, any scarring which may have occurred to the cornea may have an additive effect to decrease vision as the patient ages. Increased glare due to corneal scarring and opacities within the lens may have a large impact on the patients functional vision.

The results of RK have been studied by the Prospective Evaluation of Radial Keratotomy Study (PERK Study) supported by the National Eye Institute over the past six years. In March 1994 the group released their findings on the spectacle and contact lens wearing habits of their participants. The article Spectacle and Contact Lens Wearing Six Years after Radial Keratotomy in the prospective Evaluation of Radial Keratotomy

Study authored by Borque, et al., was designed to reveal if the RK procedure had met the needs of the participants. The objective of the PERK Study was to look at the affects of RK on a population of subjects who wished to "see without dependence on corrective lenses." The criteria is a visual acuity of 20/20 or better in at least one eye, with a residual refractive error within plus or minus 0.50D. The following results were compiled by the study as to the lens wearing habits of the participants. Overall, 52% of the subjects wore no lens (170), 18% wore a distance correction (59), 16% wore distance and near correction (51) and 15% wore only near correction (48). The participants were then divided into prepresbyopic and presbyopic categories, by age. As would be expected, the group less than 40 years old had a significantly higher percentage of no correction versus those over 40 years old. The following table illustrates the results:

	under 40 years old	over 40 years old
No Lens	64%	40%
Distance Only	19%	17%
Near Only	4%	26%
Both	14%	17%

The results obviously show the change in the study population toward presbyopia with the corresponding increase in the need for a near correction. While the percentage of corrective lenses in the Distance and Both categories remained similar. The main corrective lens in this study was spectacles. The use of contact lenses was discouraged by the investigators to avoid effecting the natural course of the RK postsurgically. Seven (2%) of the subjects reported wearing only contact lenses as a means to correct their vision. The study did not indicate the type of lenses used by the participants [5].

The unplanned occurrence of anisometropia greater than or equal to 3.00D in twelve subjects brought up the topic of monovision. The participants appeared to adjust well to the difference in refractive error between the eyes. The "worst" consequence of the surgery for these subjects was the need for reading glasses, visual acuity not being 20/20, visual acuity being worse, trouble focusing, glare or light sensitivity, glare at night, "star" images, and a few reported no one "worse" thing. A number of these complaints are also found in the general RK population, which would indicate that future studies of monovision by RK may be a feasible alternative to near correction [5].

The PERK Study supports the use of RK as an alternative to corrective lenses. Overall, the subjects felt their goals were met by the procedure and they would have RK repeated. Complications of the procedure were not discussed in the article.

A refractive procedure which would allow higher degrees of myopia to be corrected is Epikeratophakia. The surgery requires a lenticule of donor cornea, which is used to increase or decrease the refractive power of the cornea. It is indicated in cases of greater than 4D and up to 27D of myopia, as well as, in cases of aphakia. It may be used in children and adults who have been dissatisfied with spectacles and/or contact lenses. Depending on the refractive error to be corrected a plus or minus lenticule of donor cornea is used. Epikeratophakia may also be performed in cases of keratoconus with a plano lenticule. As Kanski states the donor cornea is kept freeze-dried until it is required in surgery. The visual axis is marked and a circular cut is made about 8mm in diameter and 0.3mm deep. An annular keratectomy is then made to be placed in the before mentioned cut and sutured into place. Early indications are that this procedure is a viable

refractive surgery and that a high proportion of patients gain a satisfactory level of acuity. The major complications of this procedure are epithelial defects, which in one study lead to a 6.9% removal of lenticules. As mentioned before this procedure is still under investigation [3].

One of the most current refractive surgeries is Photorefractive Keratectomy or PRK. PRK is currently under conditional approval by the FDA in the United States and is available in Canada [7]. The 193-nm excimer laser ablates corneal tissue to decrease myopia. It destroys Bowman's layer in the ablated areas, which includes the visual axis. Early results from this procedure appear good, although it is not without problems. Haze secondary to the surgery appears in all patients, although it is not a problem in a majority of cases. A second concern is the decentration of the laser. The fixation of the eye and centration of the beam are manual, leaving room for human error [6]. The number of completed PRK cases is continually increasing. More recently the FDA, March 1995, approved the Summit Excimer Laser for use in the US, in phototherapeutic situations. It is expected that photorefractive surgery will be approved in the US by late 1995. Approval by the FDA will increase the number of procedures dramatically and allow a better assessment of the procedure.

Laser Keratoplasty (LK), also known as Flap and Zap or LASIG, is a refractive surgery technique which combines excimer laser and automated lamellar keratoplasty. It involves the use of a automated keratome to make a 7.2mm diameter cut leading to a "flap" of cornea, which is then peeled back. The corneal stroma is then ablated with a laser to adjust the refractive error. The corneal epithelium is set back into place without

sutures. Proponents report that the next day the cornea is intact and refractively clear. Food and Drug Administration Phase III clinical trials began in December of 1994. LK is performed by approximately 300 ophthalmologists in all major markets [7]. LK's position as a refractive modality appears to be in the correction of high myopia, more so than the previously mentioned surgeries. Other benefits of the surgery include:

1. Stromal haze does not appear to be a complication, as found in PRK.
2. Wound healing is eliminated, which may improve accuracy.
3. No removal of epithelium, as with PRK, thus minimal post-operative pain.

The procedures discussed in this paper are by no means exhaustive. Current research is ongoing in numerous areas of refractive surgery. At this point I would be comfortable in recommending RK to suitable patients who are interested. Although, I would have two requirements before referring the patient, one, to have faith in the surgeon and two, to have discussed the risks/benefits completely with the patient. The other procedures will be better analyzed in the future when more long-term data is available. I recommend to any and all eye care practitioners to stay informed to the future of refractive surgery.

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