
Corneal & Refractive Surgery

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Excimer lasers and high technology instrumentation have ushered in a new era of vision improvement surgery in Hawaii, replacing the more traditional forms of refractive surgery: cataract surgery, corneal transplant surgery, and radial keratotomy. Corneal surgery has been enhanced by new techniques of microsurgery and a more effective tissue procurement system for donor corneal tissue. Several laser centers provide the latest in FDA-approved excimer laser procedures including PRK and PTK. Mild to moderate myopia and astigmatism may now be corrected. Off-label use of LASIK, too, may soon be realized.

Corneal Surgery

As on the mainland, corneal surgery in the Islands has provided excellent visual results for patients with opacification and diseases of the cornea. Among the most common causes of corneal disease in Hawaii are corneal damage from previous eye surgery (cataract operations), misshapen corneas (keratoconus), corneal injury and scarring, and corneal dystrophies (granular corneal dystrophy, and Fuchs' endothelial corneal dystrophy).

The most common of the corneal operations done locally is the corneal transplant — which replaces the opacified cornea with a clear donor cornea. Besides the expertise of an experienced corneal surgeon, successful transplant surgery also requires the assistance of a local organ donor bank in procuring suitable tissue that is properly screened and processed. Patients with corneal disease are carefully evaluated by the cornea specialist, and then are placed on waiting lists maintained by the local eye bank. As soon as the donor tissue becomes available, the surgeon is notified, and the patient is brought to the hospital for outpatient surgery. Most corneal transplants can be done under local anesthesia (few still requiring hospitalization) with operating times just under one hour. Many of the hospital centers are well equipped with the latest operating microscopes, experienced assistants, trephines, viscoelastics, and fine sutures to insure precise removal of the central 7-8 mm of the recipient, replacing it with a donor cornea.

Recovery after the corneal transplant surgery along with the ensuing visual rehabilitation process requires a long time. Often a "triple procedure" can be done in which the transplant surgery is coupled with removal of a cataract, and implantation of an intraocular lens implant. Intraocular lens implant exchanges can also be performed with techniques of suturing lens implants into the sclera when there is no support in the posterior chamber. These combined procedures require skillful management to determine the proper power of the lens implant to closely match the resultant eye power after the cornea operation.

Adjustment of corneal sutures and wounds postoperatively has become one of the greatest challenges for corneal surgeons. Another advanced technology in Hawaii is videokeratography and corneal

topographic analysis which have helped the surgeon with this problem of corneal shape management postoperatively.

The success in restoring good vision after corneal surgery depends on many factors. The surgical manipulation is critical, but so is the effective management of potential complications such as graft failures, secondary glaucoma, and corneal rejection reactions. Although most corneal surgeons have successful results in over 80% of their grafts, adverse outcomes may warrant repeat transplants in 10-15% of cases despite the precautions of using topical antibiotics, steroid eye drops, and immunosuppressive agents.

Eye Banking in Hawaii - Hawaii Lions Eyebank and Makana Foundation

The Hawaii Lions Eyebank & Makana Foundation has been in operation since 1980, when the late Dr Kent Bennett of Straub Hospital & Clinic, and I obtained the support and commitment from the Hawaii Lions of District 50 to adopt the Makana Foundation as one of its major projects. The Eyebank and its major supporters have served our community well by procuring, processing, and distributing donor eye tissue, and promoting organ and tissue donations. It has provided our patients with eye tissue for nearly 1,700 surgical procedures, a majority of which were used for corneal transplantation. The HLEB & NIF has a full-time executive director, a medical director, and a full-time technical director. It is accredited by the national eye bank organization, Eye Bank Association of America, and is part of a network of cornea banks working together to facilitate tissue procurement and distribution nationwide. There is a close working relationship between the Hawaii Lions Eyebank & Makana Foundation and the Organ Donor Center of Hawaii, which handles recovery and processing of the other transplantable organs. The Eyebank processes donor corneas and stores them in special tissue culture media prolonging their viability, and also examines and tests the tissue for transmittable diseases such as hepatitis and AIDS.

It has been estimated that our needs in Hawaii range from 120 to 140 corneas annually, of which three-quarters are obtained here. There are 16 ophthalmologists here and on neighboring Guam and the Philippines, who use the HLEB & NIF for cornea and scleral tissue. Patients are placed on the transplant list in the order in which they are registered by their eye surgeons. The wait for donor tissue averages three to six weeks. Through the dedicated effort of the Lions of District 50 and the Eyebank directors, local donations have tripled during the past 3 years despite the diversity of ethnic and religious preferences here in the Islands. There are approximately 38,000 organ and tissue donors registered here in Hawaii.

Refractive Surgery in Hawaii

Cataract and corneal surgery are the traditional forms of refractive surgery that are performed on eyes with sight-threatening disorders. Hundreds of these procedures are done in Hawaii each month and many Island ophthalmologists are well versed in the indications, techniques, and complications (see cataract surgery segment of this monograph). However, radial keratotomy and the newer forms of excimer laser refractive surgery that are currently available are significantly different in that they are:

- a) considered elective procedures,
- b) surgeries done on structurally normal eyes - increasing risk/benefit ratio,
- c) not reimbursed by health insurance, encouraging a "consumer" attitude,
- d) technically more challenging, require expensive accessories, computerized lasers, and
- e) associated with advertising, media coverage, co-management with para-ophthalmic practitioners.

Radial keratotomy (RK) has been performed on hundreds of island residents since the late 1980s, with excellent results for those who had low to moderate nearsightedness and astigmatism. Although few are performed today, the procedure was relatively simple, requiring diamond-blade knives, steady hands, a microscope, and pachymeter. Four, eight, and sixteen-cut incisions of varying lengths were capable of flattening the corneal shape to provide 20/40 or better vision to 90% of patients. Despite comfort during the procedure with topical anesthesia there were several days of pain and discomfort after the surgery. Fortunately, there were few complications, but the worst were overcorrections, induced astigmatism, and persistent glare in highly myopic patients. RK may still have some usefulness in patients who require visual enhancement surgery for low corrective and mild astigmatic refractive errors after cataract surgery. For many refractive corneal surgeons, the RK diamond blades can now be **useful** for making sharp, clean incisions for no-stitch cataract surgery.

Photorefractive keratectomy (PRK) has now replaced radial keratotomy as the treatment of choice for patients with mild to moderate nearsightedness and astigmatism. It is an outpatient excimer laser procedure that can reshape the cornea by (ablating) removing small amounts of tissue in the central visual axis, instead of making radial incisions into the peripheral cornea as in radial keratotomy surgery. PRK has resulted in patients not requiring glasses or contacts, with as many as 95% having been made to see 20/40 or better — well enough to pass their driver's licensing eye exam. There are three laser centers in Hawaii — one using the Summit Apex laser and two using the VISX Star laser to perform refractive keratectomies, requiring only topical anesthesia and a few minutes under the laser beam. The physician and skilled technicians operate the excimer lasers using integrated computers and pre-programmed laser cards designed to deliver precise cuts according to the patient's refractive errors.

Phototherapeutic keratotomy (PTK) uses the excimer laser to ablate superficial scars from the corneal surface. Successful removal of granular corneal dystrophy scars has been performed

locally. Other applications may prove useful in patients with recurrent corneal erosion syndrome. Although not intended to be a refractive procedure, PTK, effecting the removal of tissue from the cornea, may cause eccentric corneal thinning and induce refractive changes. Moreover, corneal opacities from dystrophic conditions could return after several years.

Automated Lamellar Keratoplasty (ALK)

ALK is used to reduce high levels of nearsightedness, and can also be used for farsightedness. The procedure requires a microkeratome which slices across the superficial cornea creating a thin flap. The second part requires another slice across the corneal stroma, removing a thin disk of tissue. The flap is replaced without sutures. For farsighted eyes, only the thin flap is made, and no stromal disk is removed. Over- and undercorrections are significant with ALK results, with irregular astigmatism also causing decrease in best-correctable vision. ALK had a place in refractive surgery during pre-excimer days, but it is all but being replaced by a more precise and predictable LASIK procedure.

Laser-assisted In-Situ Keratomilcusion (LASIK)

LASIK is a procedure which also corrects the moderate to high degrees of nearsightedness. LASIK is the combination of ALK and PRK, in which the surgeon uses a keratome to shave a thin layer of tissue off the center of the cornea as a flap, and completes the process with excimer laser to remove a thin layer of tissue from the corneal stroma. The flap is replaced without sutures. LASIK is now being done regularly at many laser refractive centers in Canada, Europe, and South America, however, in the United States, it is still considered an "off-label" procedure, similar to use of certain approved medications for non-approved circumstances. Many Hawaii residents have already had this procedure in Colombia or Canada with good results. More investigational studies are required by the FDA before LASIK can gain approval for general use in the U.S. Reports so far have been very encouraging in determining its safety and long-term predictability. Many who have had the procedure claim that there is very little discomfort after the procedure. Since LASIK relies on precise shaving of the corneal cap, surgeons performing this operation must be adept with both highly technical tools — the microkeratome and the excimer laser.

Current Status of PRK, PTK, RK, AILK, and LASIK

Radial keratotomy is a relatively simple procedure. It has the longest record of scrutiny by researchers and the FDA, and can claim results of 90% of patients seeing 20/40 or better in those lower degrees of myopia. There has also been a large accumulation of literature worldwide, covering every facet of RK complications and what to do about them. Radial keratotomy surgery does require touch-up surgery in 30-50% of cases, but everything is done using inexpensive equipment in an outpatient office setting. On the other hand, laser refractive surgery is still in its infancy. Fewer than 500 patients have had PRK in Hawaii since laser centers opened 1-2 years ago. Setup expenses are high for refractive laser surgeons who must increase their malpractice liability, invest in specialized equipment (laser center access fees, videokeratometers, and microkeratomes), and gain certification for PRK by taking

mainland workshops and performing one procedure under supervision at a laser center. The length of the learning curve varies for each surgeon especially for the more technically-challenging microkeratome/excimer laser combination procedures of ALK and LASIK. Lasers need constant maintenance for precise energy output and beam quality, and can be fallible during power failures, and computer glitches. In all procedures patients must be carefully screened by an ophthalmologist since there is a growing list of eye problems that are contraindications to laser refractive surgery. Refractive surgery is not a casual procedure that anyone can do and do well. An experienced LASIK surgeon advised that in order to keep up with the procedure, that at least one procedure per week be done. There are risks (2-3%) which may leave a patient losing 2-3 lines of best-corrected vision after refractive surgery! And, just as I would have strong reservations about allowing optometrists to perform laser surgery, I personally would also have a problem sharing a patient with a nonmedical eye care practitioner in a co-management arrangement.

Interest for the surgery has increased rather slowly in our community perhaps due to high out-of-pocket costs for the procedure and the unstable economy. But more so, I believe this may be due to the cautious attitude of conservative island residents who demonstrate

aversion to risk. For most patients the mild-moderate discomfort for a few days are tolerable in return for good vision without need for glasses. However, in a small number of cases there may be annoying fluctuating vision, and a hazy quality of vision that may persist for weeks after surgery. In cases where undercorrections or induced astigmatism are obtained, additional enhancements can be done but are sometimes more difficult with PRK. Overcorrections must be corrected with either glasses or contact lenses, too often with some difficulty. Central corneal haze can be treated with manual debridement or topical steroid drops and should disappear. Other problems such as secondary glaucoma from use of steroid drops, corneal infections and scarring occur rarely.

Wound healing in refractive surgery plays an important role in determining results. Age and sex are significant factors with young females more apt to have varying visual results from hormonal influences. It is important to stress to patients preoperatively that refractive surgery has risks as well as promise of vision improvement without contact lenses and glasses. Remember that PRK patients in the U.S. have only had a 3 year follow-up period. There still may be those unexpected problems associated with a thinner cornea that could affect such things as inaccuracy measuring intraocular pressures in unexpected glaucoma patients, and vision loss affecting high altitude mountain climbers.

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