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# Management of refractive surgery in refractive abnormalities



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## ABSTRACT

Refractive error is one of the most common cause of avoidable blindness in the world. The prevalence of refractive error occurs in the worldwide were increasing every years, including in the Asian regions. This condition influenced by many risk factors, which are both modifiable and non-modifiable risk factors. There are three types of refractive errors: myopia, hypermetropia, and astigmatism

with low vision condition as the impact of the untreated refractive disorder. Two types of refractive disorder therapies was surgical and non-surgical therapy. Non-surgical therapy including spectacles, contact lenses, and optical low vision devices. The proper management of the refractive error can improving patient's quality of life.

**Keywords:** Refractive surgery, emmetropia, refractive error

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## INTRODUCTION

The innovation of refractive surgical techniques grows with time, new tools, and techniques developed to enhance or maintain the patient's vision. Refractive surgeons are able to treat refractive abnormalities by using various surgical techniques in accordance with eye anatomy. Three variables play an important role in refraction; those are cornea, lens, and length of an eyeball. Refractive strength can be changed by modifying these three variables.<sup>1,2</sup> Currently available refractive surgical procedures or techniques include: refractive keratotomy, astigmatic keratotomy, photorefractive keratectomy (PRK), laser epithelial keratectomy (LASEK), laser in situ keratomileusis (LASIK), intracorneal ring segment (ICRS), laser epithelial keratectomy (LASEK), laser in situ keratomileusis (LASIK), intracorneal ring segment (ICRS), corneal inlay lenses (CIL), phakic intraocular lenses (phakic IOL), clear lens extraction (CLE), presbyopia surgery.<sup>1</sup>

Refractive surgery was first performed by Lendeer Jans Lans, an ophthalmologist in the Netherlands. In 1896, he published a theory of penetrating corneal cuts as management of astigmatism. Later on, in 1960, a doctor named Fryodorov introduced a radial keratotomy technique, which is a technique of making incisions at 90% thickness of the cornea, then adjustment of correction can be made by lengthening or shortening incision site. In 1963, Ignacio Barraquer introduced a surgical technique

for keratomileusis refraction (derived from Greek, kerato: cornea and Mileusis: cutting), which means reshaping the cornea. Keratomileusis can correct the state of myopia and hyperopia. Over time, keratomileusis technique is combined with laser light and is known as laser-assisted in-situ keratomileusis or LASIK.<sup>3</sup>

Refractive abnormalities can also be corrected by replacing the eye lenses with artificial intraocular lenses. Cataract surgery using phacoemulsification and foldable intraocular lenses is an option, smaller incisions and multifocal lenses are expected to provide refraction abnormalities. Multifocal lenses can also be used to correct ametropia and presbyopia.<sup>1</sup>

## MANAGEMENT OF REFRACTIVE SURGERY

Refractive surgery can be performed to correct myopia, hyperopia, astigmatic refractive disorders, and even presbyopia to achieve emmetropia by modifying the optic system of the eye. In this article, we divided refractive surgery into two categories, which are corneal refraction surgery (Keratorefractive) and lenticular or sclera refraction surgery. Keratorefractive surgery techniques are used to change the strength of the corneal refraction without change eye anatomy, and this surgery is the most common technique done recently. Surgical techniques for lenticular or sclera refraction is usually done by adding a secondary lens to the eye

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or relaxing the sclera.<sup>4</sup>

The radial keratotomy procedure was first performed in the United States in 1978 and was used to treat corneal astigmatism before or after the cataract surgery.<sup>1</sup> The optical zone determines some effect of refraction, the number of incisions, and the depth of the incision. For example, patients with myopia can have a corneal stromal incision in the paracentral and peripheral areas to give a flat effect on the central part of the region. Radial keratotomy gives the best results in patients with mild-moderate refractive abnormalities, whereas in patients with high refraction abnormalities give very varied results. The patient's age also plays a role in determining the correction limit. The National Eye Institute (NEI) reports the results of a multicenter study, about 70% leaving a refractive abnormality of 1.0 Dioptri. Refraction after keratotomy is also still inadequate, and the procedure has begun to be replaced by a keratorefractive procedure using an excimer laser. Astigmatic keratotomy is a procedure of making a straight line or arcuate (curvilinear), which is perpendicular to the steep astigmatic meridian. Generally, 1.5 Dioptri astigmatic is a candidate for keratotomy. More in-depth and longer cuts will have a more significant effect.

LASEK is a combination of PRK and LASIK surgery techniques. It is safer surgical techniques, has faster corneal epithelial healing process, and minimal postoperative pain. This procedure is performed in patients over the age of 21 years old, with stable refractive abnormalities, sufficient thickness of the central cornea for correction of myopia -3.00 Dioptri to -6.00 Dioptri, hyperopia + 4.00 Dioptri and astigmatic 4.00 Dioptri. Contra indications for LASEK procedure include keratoconus, herpes infections of the cornea, corneal dystrophy, amblyopia, corneal melting, and unstable refractive abnormalities. Postoperative patients will have periodic examinations on the first day, first week, sixth week, and sixth month to assess visual acuity and complications.<sup>1</sup>

LASIK is a refractive surgery on the corneal stromal lining by using an excimer laser to correct refractive abnormalities. It was first done by Pallikaris et al. in 1990 to correct myopia, hyperopia, and astigmatism. It has generally been indicated to patients with stable refractive abnormalities and over 21 years of age. LASIK contraindications are keratoconus, central corneal thickness <410  $\mu$ m, history of infection, corneal dystrophy, or systemic diseases related to corneal melt. Postoperative examination of patients undergoing LASIK is almost the same as post-LASEK patients. They must be given topical antibiotics and corticosteroid therapy for first-week post-surgery.<sup>1,2</sup>

The Intracorneal ring segments (ICRS) correcting refractive abnormalities by inserting the ring into the peripheral part of the cornea to make the cornea even flatter or reduce the corneal curvature. The diamond blade is used to make a 2 mm incision at the steepest part of the cornea with a depth of 70% corneal thickness, then the ring is inserted, and the incision is sewn using nylon.<sup>1</sup> This procedure is indicated for patients with myopia < 4.5 Dioptri and keratoconus. Keratoconus patient preparation not only based on refractive abnormalities but also based on corneal topography. The advantages of ICRS include: corneal shape are not disrupted, reversible processes, safe surgical techniques, and minimal external predictable outcome.<sup>5,6</sup>

Thermokeratoplasty procedure includes radial keratoplasty, Holmium laser keratoplasty, or conduction thermokeratoplasty. Thermokeratoplasty lasers use infra-red light and can be used to correct hyperopia.<sup>1</sup> Thermal energy will shrink the peripheral or paracentral corneas, thereby increasing the power of the central cornea. This treatment option can be done with hyperopia less than 4.0 Dioptri and astigmatism less than 0.75 Dioptri.

The phakic intraocular lens is a surgical procedure of adding an artificial lens (intraocular lens/IOL) into the eyeball. This therapeutic choice is usually made in patients with high refractive abnormalities, which cannot be corrected using corneal surgery.<sup>5</sup> IOL can be positioned in front of or behind the iris, and then peripheral iridectomy is performed. This therapeutic procedure can maintain accommodation and correct high refractive abnormalities. Possible complications include astigmatism, secondary glaucoma, chronic inflammation, pigmental dispersion, uveitis, endothelial cell damage, cataracts, endophthalmitis, glare, and poor vision at night when pupils are wide.<sup>1,7</sup>

Various therapies for refractive disorder patients such as glasses and contact lenses, the higher the refractive disorders, the risk of therapy is not maximum. Over the past two decades, refractive surgery has grown in popularity and has given good progressivity. This refractive surgery procedure is similar to cataract surgery, but the lens that is removed is not cloudy. This surgical procedure is indicated in patients with myopia > - 6.00 D and hyperopia. Complications found are almost the same with post-cataract surgery patients; this includes astigmatism, posterior capsular opacity, endothelial cell damage, uveitis, endophthalmitis, and glare.<sup>1,5,8</sup>

Accommodation is a mechanism where the lens surface becomes more convex than usual, and

this condition will deteriorate with age. Presbyopia surgery can be done on cornea, lens, or intraocular. The most common surgical procedure is intraocular surgery. This procedure was first performed in 1997 and is referred to as presbyopic lens exchange (PRELEX). An IOL (Intra Ocular Lens) is used to restore accommodation capabilities. There are two types of lenses used, single-power and multifocal. Complications in presbyopia surgeries include lens dislocation, prolonged refractive stability, lens capsule fibrosis, glare, and postoperative refractive abnormalities.<sup>1,5</sup>

Schachar then found that ciliary body contractions can increase zonular tension and, at the same time, reducing the tension of the anterior capsule so that the lens has increased diameter and accommodation. With age increasing, expansion of lens posteriorly during accommodation will also become more and more lessened. Scleral relaxation is a method of operation used to restore accommodation power by increasing the distance between lens equator and ciliary body. Anterior ciliary sclerotomy may be performed in the conjunctiva or sclera and can be modified using silicon sclera plug.<sup>4</sup>

## CONCLUSION

Refractive surgery has developed over time, becoming more and more popular, and nowadays become the therapeutic choice for patients with refractive disorders. The refractive surgery is grouped into corneal refractive surgery and lenticular/sclera refractive surgery. The corneal refractive surgical procedure or keratorefractive is the most popular therapy and is often used nowadays,

especially LASIK. Lenticular/scleral refractive surgeries are more widely used for correcting ametropia and presbyopia. Each procedure has different indications and contraindications. Finally, the operator has an independency to select which preoperative preparation used and determine which operation technique to be used.

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