# APPLICATIONS OF INTRA CORNEAL RINGS IN OPHTHALMOLOGY

*Essay*

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*BY*


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# LIST OF ABBREVIATIONS

| | |
|---|---|
| BCVA | **Best corrected visual acuity** |
| CH | **Corneal hysteresis** |
| CQ | **Clinical Quality** |
| CRF | **Corneal resistance factor** |
| CXL | **Collagen crosslinking** |
| D | **Diopter** |
| FDA | **Food and Drug Administration** |
| HDA | **Humanitarian Device Approval** |
| ICR | **Intrastromal corneal ring** |
| ICRS | **Intrastroma corneal ring segments** |
| INTACs | **Intracorneal Ring Segments** |
| IOLs | **Intraocular lens** |
| K | **keratometry** |
| LASIK | **laser-assisted in situ keratomileusis** |
| LKP | **Lamellar Keratoplasty** |
| ORA | **Ocular Response Analyzer** |
| PKP | **Penetrating Keratoplasty** |
| PMD | **Pellucid marginal degeneration** |
| PMMA | **Polymethylmethacrylate** |
| PRK | **photorefractive keratectomy** |
| RK | **Refractive keratotomy** |
| SE | **Spherical equivalent** |
| UCVA | **Uncorrected visual acuity** |
| UV | **Ultraviolet** |
| VCG | **Vacuum Centering Guide** |

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# INTRODUCTION

# AND

# AIM OF THE WORK

# Introduction

Options for visual rehabilitation include spectacle correction, contact lens fitting, refractive keratotomy (RK), photorefractive keratectomy (PRK), laser-assisted in situ keratomileusis (LASIK), and intracorneal rings or Intacs. Currently, nonsurgical approaches are still the least expensive and safest. For the subset of patients who desire freedom from glasses and lenses, refractive surgery is an option. The ideal refractive surgery procedure is the one that is effective, predictable, safe, and potentially reversible ***(Shetty et al, 2008).***

The intrastromal corneal ring (ICR) is a device designed to correct mild-to-moderate myopia by flattening the anterior corneal curvature without encroaching on the visual axis. The device is an open-ended PMMA transparent ring with an outer diameter (R1) of 8.1 mm and an inner diameter (R2) of 6.8 mm, and the curvature conforms to that of the cornea. It is inserted through a peripheral radial incision made with a diamond knife at two-thirds corneal depth in to a 360° peripheral intrastromal channel created with specially designed instruments. The anterior corneal curvature is changed by using rings of different thicknesses ***( Ertan et al, 2007).***

Intrastromal corneal ring segments (Intacsmicrothin prescription inserts), or ICRS, are a more recent design modification of the ICR. The ring segments split the ring into two 150° arcs. The use of ring segments simplifies the implantation procedure ***(Shabayek & Alio JL, 2007).***

Another type of Intrastromal corneal ring segments (ICRS) are the Ferrara rings introduced by Pablo Ferrara in 1986. It had proved to be effective in correcting keratoconus as it implanted at 5 mm diameter . The closer the implantation to the visual axis the more effective the segment in correcting Keratoconus ***(Ertan et al, 2007).***

Several benefits of using Intacsmicrothin inserts exist. It is a minimally invasive outpatient procedure. Since the surgery is completed in the peripheral cornea, the central optical zone is not disturbed. Results are rapid and predictable. There is a reduced risk of visual adverse effects and a long-term convenient refractive correction. It is removable and exchangeable ***(Fontana et al, 2009).***

INTACS are intended for the reduction or elimination of mild myopia (-1.00 to -3.00 D spherical equivalent at the spectacle plane) in patients who are aged 21 years or older, in patients with documented stability of refraction as demonstrated by a change of less than or equal to 0.50 D for at least 12 months prior to the preoperative examination, and in patients where the astigmatic component is 1.00 D or less ***(Alio Jl et al, 2005).***

In 2004, INTACS was given humanitarian device approval by the FDA for use in patients with keratoconus who are no longer able to achieve adequate vision using contact lenses or glasses and for whom corneal transplantation is the only remaining option **(Aylin&Joseph,2007).**

INTACS are contraindicated in high degrees of myopia, hyperopia, or astigmatism, Patients with existing collagen vascular, autoimmune, or immunodeficiency disease, Pregnancy, Patients with previous anterior segment trauma, In the presence of existing ocular conditions, such as recurrent corneal erosion syndrome, corneal dystrophy, or other corneal pathology that may predispose the patient to future complications ***(Alio Jl et al, 2005).***

# AIM OF THE WORK

To review literature about the role of Intra Corneal Rings in correction of myopia and its role in ectatic corneal disorders.

# HISTORY OF

# INTRA CORNEAL RINGS

# History of Intracorneal Rings

Near sighted people have thought ways to get rid of their glasses for centuries. Tradition says that ancient Chinese slept with sandbags on their eyes to flatten their corneas. It's certain Purkinje tried the same thing in 1820s with only temporary improvement of his 5D of myopia. In the mid 1800s, a Dr. J. Ball advertised a small mallet mounted on a spring in an eye cup that struck the cornea through the closed eyelid, pounding it flat. "It restores your eyesight and renders spectacles useless," he claimed. Professor Charles Tyrell claimed a similar effect from the use of his ideal SightRestorer at the turn of the same century ***(Ferry AP, 1986).***

Intracorneal implants started in the 1950s when Barraquer proposed the use of implants for a refractive purpose. Polymethylmethacrylate (PMMA) biocompatibility was confirmed and reasonable predictability of these implants was reported***(Barraquer, 1966).***

In 1978, **Reynolds** hypothesized that a ring-shaped implant could be introduced through a single peripheral radial incision in the cornea. **Reynolds** reasoned that this implant would alter the anterior corneal curvature through expansion or constriction in the diameter of the device as needed to correct myopia or hyperopa **(Khann et al, 2000).**.

**Reynolds** began looking at the possibility of actually implanting a 360-degree ring into the cornea to alter its shape. By the mid-1980s, after many early prototype refinements, the first animal studies began looking at the feasibility and biocompatability of implanting a plastic ring into physiologically active tissue **(Fleming et al,1987).**

By 1991, the first ICR had been implanted in nonsighted human eyes in Brazil and would be followed that same year by the initiation of phase I FDA(Food and Drug Administration) studies in the United States. In this phase, ten nonsighted human eyes received the early 360-degree prototype, with a variety of ring thicknesses. These initial studies were undertaken to demonstrate the safety of both the insertion and removal of the rings and that their effect was intended to flatten the central corneal curvature. Using streak retinoscopy and keratometry **(Assil et al,1995).**

**Nose´** found that a 0.30 mm ring thickness produced approximately 2.5 D of central flattening in corneal curvature. As part of the FDA protocol, the rings were removed at the 1-year mark in 5 of the 10 eyes. Surprisingly, these eyes demonstrated a prompt and nearly complete return to their normal preoperative curvatures, suggesting that ring removal may provide a return to a preoperative state **(Nose´ et al 1996).**

In 1993, phase II FDA trials began using the 360-degree ring in sighted human eyes. Coincidentally, a group of researchers in Brazil began altering the ring circumference to small (40- and 60-degree) arcs in an attempt simultaneously to correct astigmatism. Interestingly, these researchers found that altering the original 360-degree design into two equal 180-degree segments resulted in little overall change in the refractive effect **(Krueger&Burris,1996).**

Based on the idea that intrastromal corneal rings can flatten the cornea, providing a potential new method of keratorefractive surgery, the effect of implanting various ring sizes of a given thickness in intrastromal channels dissected in human eye bank corneas was investigated. They concluded that new ring designs should take ring thickness into