

# Management Approaches in Corneal Keratoconus

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**Abstract:-** Corneal Keratoconus is a disease characterised by gradual thinning of central and peripheral stroma resulting in protrusion and reduced visual activity. The aetiology of keratoconus is an underlying genetic predisposition coupled with environmental factors, including eye rubbing and atopy. Spectacles, contact lens and Intrastromal Corneal Ring Segments (ICRS) remain fundamental to optic management of keratoconus. These contact lens and ICRS do not treat underlying disease process. Keratoplasty – Penetrating Keratoplasty (PK), deep anterior lamellar keratoplasty (DALK) treatment of choice for advance form of keratoconus. Therefore, current approach is corneal collagen cross-linking (CXL). CXL aims at stiffing the cornea using a combination of UV-A light and chromophore (Vit-B12, riboflavin) and proposed in various indications, from progressive ecstastic disease to corneal infection.

**Keywords:-** Best Corrected Visual Acuity (BCVA), Spectacles and Contact Lens (SCL), Intrastromal Corneal Ring Segment (ICRS), Conservative, Intermediate and Advanced Treatment, Keratoplasty -PK, DALK, Corneal Collagen Cross Linking (CXL).

## I. INTRODUCTION

Keratoconus is a Greek word [kerato-core; konos-cone] meaning cone-shaped protrusion of the cornea [1]. Keratoconus is a non-inflammatory, progressive thinning of the cornea that is usually bilateral and involves the central two-thirds of the cornea [1]. It causes due to eye allergies, excessive eye rubbing [2], connective tissue disorders like Marfan syndrome and Ehlers-Danlos syndrome [3]. It affects both men and women, usually at a young age, with prevalence of 5% of the population in middle east [4]. Signs and symptoms include blurred vision, disorted vision, astigmatism, double vision, inability to see in dim light, near-sightedness, sensitivity to light, or vision loss [5]. Diagnosis can be made by slit-lamp examination and observation of central or inferior corneal thinning and Computerized video keratography is useful in detecting

early stage of keratoconus [6]. The management of corneal keratoconus involve different methods. The early stage of keratoconus is treated spectacles and contact lens, and disease progression is treated with following surgical methods ICRS, PK, DALK, CXL [7].

## II. CURRENT MANAGEMENT FOR KERATOCONUS

### ➤ Spectacles and Contact Lens (BCVA)

For best vision. Spectacles are used in early ketaronic cases. It is difficult to achieve patient satisfaction spectacle vision because of various disease factors, such as high irregular astigmatism and significant anisometropia [8]. Contact lens offer satisfactory vision by addressing refractive errors and anterior corneal irregularities in keratoconus patients. The type and use of contact lenses depends on stage of keratoconus, where as **soft contact lens** used in early stage of disease [8,9]. As the disease progress, **Rigid-Gas-Permeable (RGP)** lenses [8,9] or **scleral lenses** [8,10], may be used. RGP lenses usually rest on the apex of the cone. In early or mild keratoconus traditional RGP lenses are used to fit, but it is difficult to get an ideal fit and patient have to accept compromised fit, and it not cause ocular damage [9]. The next type of lens is Scleral lens used for advanced cases and provide good visual performance and comfort [8]. These scleral lenses are placed on sclera not on cornea to improve vision in patient with high astigmatism conditions like keratoconus [10].

### ➤ Intrastromal Corneal Ring Segment (ICRS)

ICRS are medical device made of synthetic material designed to alter morphology and refractive power of cornea [8]. It is safe and reversible technique and originally accepted that ICRS have a key role in treating keratoconus [8,11]. The main aim of ICRS to induce geometric change in central corneal curvature, then reduce refractive error and improve visual acuity [11].

- *Conservative, Intermediate and Advanced Management Options Include:* [12]
- **C-1:** use spectacles, contact lenses & treatment for atopy & eye rubbing.

- **C-2:** Include possibility of CXL (*especially in younger subjects*).
- **I-1:** Progress to CXL.
- **I-2:** CXL + ICRS.
- **I-3:** CXL +/- ICRS +/- Laser keratorefractive surgery (**PRK**).

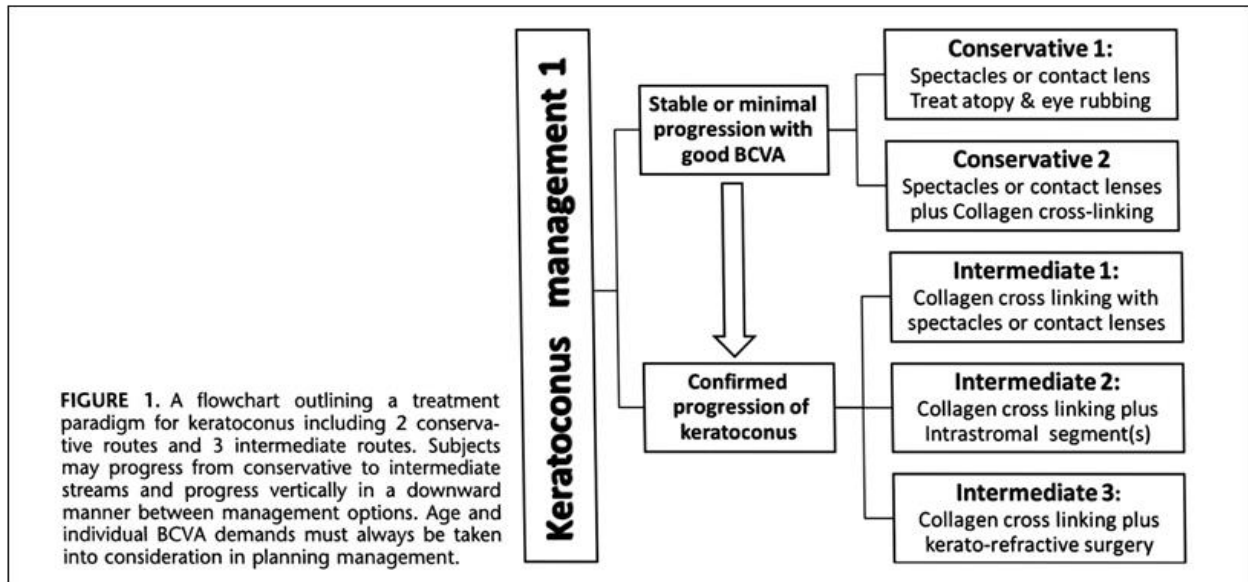


Fig 1 Referred from Reference [12]

➤ *Keratoplasty –Penetrating Keratoplasty (PK) Deep Anterior Lamellar Keratoplasty (DALK)*

Keratoplasty is considered as **corneal transplantation**. Whereas PK is a full thickness transplant, and done for all effected corneal layers [13]. It is well-established technique and succeed in high rate in keratoconus [14]. DALK is most common indication in keratoconus which useful in preserving own endothelial [15]. DALK procedure successfully performed by considering factors like age, ophthalmic co-morbidities, retina and intraocular pressure [16]. Advanced of DALK over classic pk consist of extra-curricular surgery without replacing corneal endothelial, lower rates of graft rejection, no risk for endothelium [17], avoid an open- sky procedure, & shorter period of postoperative instillation of steroid agents, leads to lower incidence of post operative cataract & glaucoma [12]. DALK has fewer intraoperative and postoperative complications including hemorrhage, Anterior synechia, and glaucoma when compared to PK [18]. Limitations of this method include the demanding surgical skills required for performance of DALK technique & fact cannot applied easily in corneas with scars, neovascularization, or previous hydrops [12].

➤ *Surgical Approach in Keratoconus:*

• *Corneal Collagen Cross-Linkage:*

CXL is an invasive technique which strengthen the corneal tissue by using riboflavin and UV-A light [19]. In late 2011, orphan drug status was awarded by the FDA to Avedro’s for its formulation of **riboflavin ophthalmic solution** to be used in conjunction with company’s particular UV-A irradiation system. CXL using riboflavin

and UV received FDA approval on April 18, 2016 [20]. Main components of CXL, Riboflavin is used as the photosensitizer and UVA to increase the formation of intra- and interfibrillar covalent bonds by photosensitized oxidation [21]. It is systemically safe and can be adequately absorbed by corneal stroma topically. It has an absorption peak at 370 nm [20]. Oxygen indicates presence of oxygen is an essential for effective CXL [20].

• *Surgical Technique:*

CXL entails removing the corneal epithelial, using either an epithelial brush, diluted alcohol or manual scraping. “Some clinicians tend to prefer an excimer laser scrape of the epithelium. After epithelium is removed, the corneal is soaked with riboflavin drops placed over a 30 min period. Then; the CXL device is placed over the patient eye, which is usually held open with a lid speculum. Patients was anaesthetized with topical anaesthesia, usually one drop of **Proparacaine or Alacine** replenish every 10-15 min, depending on patient’s tolerance. The device has a timer with an LCD screen to help to evaluate the progress of the procedure. Following the procedures, some clinicians patch the eye, and some use a bandage contact lens. Antibiotic medications and corticosteroids are typically used for one to four weeks, eyes are typically protected from UV light for 2 months. The device should not be placed too close to the cornea, if higher amount of energy delivered it cause scar to cornea [22].

• *CXL Indications:*

To improve patient vision in keratoconus disease and in Pellucid marginal degeneration & Terrien’s marginal degeneration [20].

• *Types of CXL:*

There are two main types include:

✓ *Epi-on CXL-*

The epithelium is left on during the procedure. The epithelium will be loosened by physician with sponge or eye drops before putting B2 drops in eye [23].

✓ *Epi-off CXL-*

The 8.0-9.0mm central epithelium is removed for procedure then eye drops are placed in eyes [24].

➤ *CXL Protocol:*

These guidelines followed from institutions human research ethics committee [25].

• *Conventional (Dresden) Protocol:*

It is a traditional method which involves debridement of central 8-9 mm zone of corneal epithelium after application of topical anaesthesia in sterile setting, then instil solution of 0.1% of riboflavin in 20% dextrose every 2 min for 30 min and UV-A light (370nm) used [26].

• *Accelerated (Anthen's) Protocol:*

Also known as high-fluence protocol. It entails epithelium of 50µm with excimer laser, partial topography-guided stromal ablation to max a depth of 80µm, by high fluency CXL using UV-A 10mW/cm<sup>2</sup> for 10 min [27].

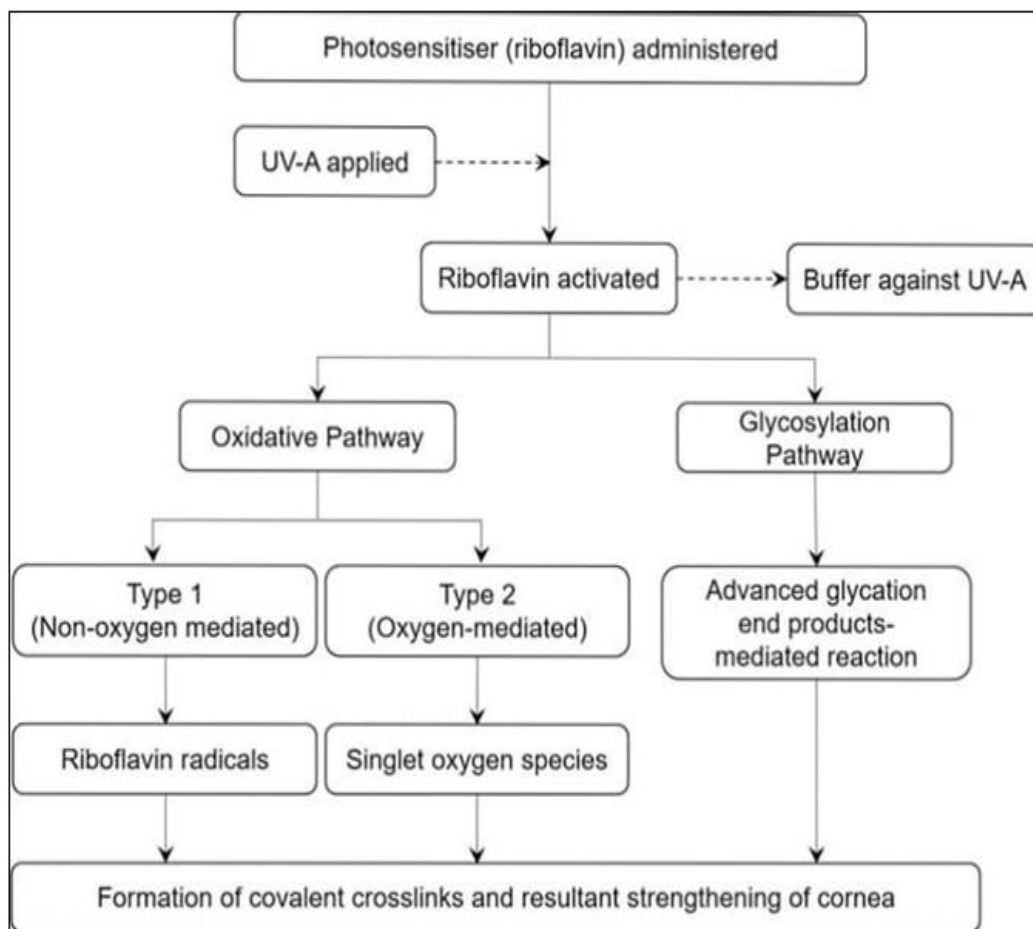


Fig 2 Mechanism of Action of Riboflavin<sup>[28]</sup>

➤ *Complications of CXL:*

Pain, epithelial defects, dry eyes, infectious and non-infectious keratitis, corneal edema and endothelial damage are the complications of CXL that mostly occurred during various clinical trials [29].

➤ *Contraindications of CXL:* [30]

- Corneal thickness of less than 400µm.
- Viral reactivation.
- Several corneal scarring or opacification
- Autoimmune disorders.

➤ *CXL Combined with Laser:*

The combination of CXL and laser refractive surgery in keratoconus patient is emerging and exciting therapeutic modality. Incidence of BCVA is 7 of 26 eyes i.e., 27% [31].

**III. CONCLUSION**

Keratoconus is a degenerative eye disease (corneal dystrophy) which causes cornea to bulge and changes cornea optics and produce blurred & distorted vision. The new management approach is CXL which decreases the rate of corneal transplantation. CXL is an accepted procedure for

progressive keratoconus disease which Improve eye vision. Over 90% of people have good outcomes with arrested progression of keratoconus at one year after procedure. The aim of this article to improve vision by treating with different management approaches in patients suffering with vision- threatening corneal keratoconus disease.

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