

THERAPEUTIC CONTACT LENS: A RECENT REVIEW***Dadarwal Poonam¹, Asija Rajesh¹, Patel Chirag J¹, Prof. Satyanand Tyagi², Mohit³, Bhupender Kumar Nimbiwal⁴**¹Department of Pharmaceutics, Maharishi Arvind Institute of Pharmacy, Mansarovar, Jaipur, Rajasthan, India-302020.²President & Founder, Tyagi Pharmacy Association (TPA) & Scientific Writer (Pharmacy), Chattarpur, New Delhi, India-110074.³Department of Pharmaceutics, Mahatma Gandhi College of Pharmaceutical Sciences, Sitapura, Tonk Road, Jaipur, Rajasthan, India-302022.⁴Department of Quality Assurance, Seth G. L. Bihani S. D. College of Technical Education, Gagan Path, Sri Ganganagar, Rajasthan, India- 335001.**ABSTRACT**

Therapeutic contact lenses (TCLs) have proved to be an effective tool in the management of a wide variety of ophthalmic disorders. Conditions recalcitrant to other treatment modalities may heal readily with the use of a TCL. With proper patient selection, observation and management, TCLs provide an extremely effective therapeutic adjunct. Drug delivery through therapeutic contact lenses enhances the bioavailability of drug by controlled and extended release on the eye surface and enhances the residence time of drug in eye cavity. The contact lenses prevent the drug from being lost to tear drainage by releasing the drug into tear layer on the contact lens, where it ultimately diffuses into the eye. In this review focus has been made on developing drug eluting contact lens using three techniques like nanoparticle encapsulated therapeutic contact lens, molecularly imprinted therapeutic contact lens and Particle-laden soft contact lenses.

KEY WORDS: Contact lenses, Visual, Ocular**INTRODUCTION:**

The term "therapeutic" is derived from the Greek word "therapeuein" meaning to take care of, or to heal. The term "therapeutic" is often used as if it applied to a specific type of contact lens, when in reality, nearly every lens type can be used in a therapeutic capacity. Therapeutic use of contact lenses is an essential element in ophthalmic care. Materials currently in use include polymethyl methacrylate (PMMA), cellulose acetate

butyrate, siloxane-containing polymethacrylates, silicones, and hydrogels^{1,2}.

Basically several approaches have been used to incorporate drugs into contact lenses like "loading drugs into preformed lenses", "manufacturing the lens with the drugs entrapped inside", "dissolving drug in the monomer solution and followed polymerization", "nanoparticles encapsulated contact lens", "ion exchange reaction with hydrogel functional groups" etc^{3,4}.



Figure 1: Therapeutic contact lenses (TCLs) the aims of therapeutic contact lens wear:

The aims of therapeutic contact lens (TCL) wear are diverse and there are often several options available to achieve a specific therapeutic goal. The use of such lenses for visual improvement is not included in this guide although this can be a secondary benefit from TCLs.

The five main aims of therapeutic contact lenses are summarized as:

1. Relief of ocular pain;
2. Promotion of corneal healing;
3. Mechanical protection and support;
4. Maintenance of corneal epithelial hydration;
5. Drug delivery.

Of these the first three are probably the most common aims of use in the UK. Often, the aims of therapeutic lens wear are a combination of the above³.

CLASSIFICATION OF TCL TYPES:

The different types of therapeutic lenses presently available are summarized below:

1. Hard (PMMA) and gas permeable scleral lenses;
2. Hard scleral rings;
3. Low water content hydrogel soft lens (38%-45%);
4. Mid-water content hydrogel soft lens (45%-55%);
5. High water content hydrogel soft lens (67%-80%);
6. Silicone rubber and silicone hydrogels (38%);

THE CHOICE OF LENS DEPENDS ON A CONSIDERATION OF:

1. The aims of lens use, which may be a combination of the above;
2. The physiological requirements of a diseased eye can be quite different from that of a normal cornea;
3. More than one option often being available;
4. Progress must be closely monitored;
5. If necessary, the lens design or material should be changed, perhaps several times, to obtain the clinical effect best suited to the corneal condition concerned³.

METHODS^{1, 6, 7}:

1. NANOPARTICLE ENCAPSULATION:

Encapsulation of the drug in Nanometric particles or vesicles is made by drug dispersed in the solution of the monomers which make up the lenses so that, when the polymerization occurs, said particles remain trapped in the structure. Colloidal particles are in charge of regulating the release of the drug. If the dimensions of the colloidal structures are adequate and are included in moderate proportions, the lenses will maintain optical transparency. This idea has been substantiated with the inclusion in acrylic hydrogel of micro emulsions and liposomes carrying hydrophobic drugs such as lidocaine. The resulting systems

release about 25% of the dosage within 24 hours and control the release of the remaining fraction for over one week in an efficient manner. However, this interesting approach has a couple of drawbacks:

- a. A low degree of stability of colloidal structures during sterilization, and
- b. Premature release of a significant portion of the dosage in the lens conservation liquid, which requires their storage in a medium which does not allow, said release.

2. MOLECULAR IMPRINTING:

The utilization of the molecular imprinting technique is an important progress in this work. The procedure consists in synthesizing the contact lens in the presence of the drug molecules which act as a mould causing monomers to arrange themselves according to their affinity. The spatial arrangement of monomers becomes permanent when the polymerization process is completed. In this way, specific receptors are created in the structure of the lens having the most adequate size and chemical groups for capturing the drug with the highest affinity. The limited number of functional monomers available and the reduced physical stability of the receptors (derived from the flexibility of the lenses) are important for the application of this technique. However, with a careful optimization of the composition and the synthesis procedures, it has been possible to develop contact lenses with improved bearing capacity and controlled delivery which provide levels of norfloxacin exceeding the MIC of numerous bacteria or which enhance considerably the ocular bioavailability of timololol in animal models. Ease of use and low cost of manufacturing processes have made soft contact lenses very attractive as controlled release systems for ocular drugs. Although more research is required, particularly in vivo trials, before we see medicated contact lenses in the market, said recent developments allow us to forecast that in a not too distant future they will become a very useful instrument for prolonging the permanence of drugs in the pre-corneal area, reducing their systemic absorption and improving compliance of dosage regimes.

3. PARTICLE-LADEN SOFT CONTACT LENSES:

Particle-laden hydrogels are promising approach for ocular drug delivery and are expected to deliver the drugs at therapeutic levels for a period of time. It involves liposomes-laden, surfactant laden, biomimetic hydrogels and drug polymer films coated with hydrogels. It may be possible to use this system for both therapeutic drug delivery to eyes and the provision of lubricants to eye problems prevalent in extended lens wear. Typically, they

are transparent and provide controlled drug delivery. Gulsen and Chauhan encapsulated the ophthalmic drug formulations in nanoparticles and dispersed these drug-laden particles in the lens material, such as p-HEMA hydrogels. This drug-laden p-HEMA hydrogels were synthesized by free radical solution polymerization of the monomers in presence of nanoparticles and were found to control the drug release for few days. Similarly, to reduce drug loss and side effects, it is proposed to encapsulate the ophthalmic drug formulations in liposomes and disperse the drug-laden liposomes in the lens material. Upon insertion into eye, the liposome-laden lens is likely to release the drug between air and lens and/or between cornea and lens thus provides drug delivery for extended periods of time. In another study, dimyristoyl phosphatidylcholine liposomes are dispersed in p-HEMA hydrogel contact lenses and the results indicate the prepared lenses are transparent and exhibited controlled release (~8 days). Further, the delivery rates can be

modified by controlling particle size and drug loading. Alternatively, drug delivery from contact lenses can be controlled by formulating microencapsulation. Gulsen embedded micro emulsion drops in p-HEMA hydrogels, stabilized with a silica shell, which were found to be transparent and provided controlled release for >8 days. Kapoor and Chauhan have developed surfactant-laden p-HEMA contact lenses of cyclosporine A for the controlled release using various Brij surfactants and evaluated the influence of chain length and unsaturated groups on drug release. The results indicate that surfactant-laden p-HEMA gels are potential for extended release of cyclosporine A, and possess suitable mechanical and optical properties for contact lens applications. All these studies points to the fact that particle-laden hydrogels could be considered as one of the most promising approaches for the successful delivery of ODDS.

APPLICATIONS^{8,9}:

Table 1: Applications of therapeutic lenses

Increased comfort	Pain relief from exposed nerve endings that can occur in conditions such as band keratopathy, corneal abrasions, and bullous keratopathy
Mechanical protection	Protecting the cornea in cicatrizing ocular surface diseases, and from mechanical injury in conditions such as trichiasis (inverted eyelashes abrading the anterior eye)
Wound healing	Assists healing of epithelial defects by protecting migrated and/or newly formed cells from the blinking action of the eyelids
Vehicle for drug delivery	Allows prolonged drug delivery, albeit at a lower dosage rate, for better permeation and absorption because the drug remains in the eye longer
Maintain ocular surface hydration	Prevents tear evaporation or provides a moisture reservoir for the ocular surface in cases of severe dry eye
Vision enhancement	Use of plano or powered contact lenses to smooth an irregular corneal surface; counteract under or over-correction after refractive surgery.

COMPLICATIONS ASSOCIATED WITH THERAPEUTIC CONTACT LENSES (TCLS)³:

The complications of extended wear TCLs are similar to those of cosmetic extended wear lenses. The compromised nature of the eye needing therapeutic application of lenses does not seem to significantly alter the incidence of lens complications as a whole. The use of prophylactic antibiotics with TCLs may be beneficial in the short term, although this remains highly controversial. Microbial keratitis is the most serious complication of contact lens wear and ulcers induced by TCL wear pose a serious problem.

CONCLUSION:

Different techniques have been used for increasing the drug load and controlled release. Various lens materials and their requirement for ophthalmic use, also have effect

on the drug loading. The type of the contact lenses and the technique of drug loading are found to affect the residence time of the drug. In comparison with topical alternatives, contact lenses provide an increased residence time at the surface of the eye for efficacious therapy.

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