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ANJANA THERAPY AS AN OCULAR DRUG DELIVERY SYSTEM: AN AYURVEDIC–MODERN PERSPECTIVE

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ABSTRACT

Shalakya Tantra, one of the eight branches of *Ashtanga Ayurveda*, deals with diseases occurring in the region above the clavicle, particularly those involving the sensory organs. Among these organs, the eye is considered highly significant because vision plays a crucial role in perception, learning, and daily activities. Classical *Ayurvedic* texts therefore describe several preventive and therapeutic measures aimed at preserving ocular health. Among these approaches, localized therapeutic procedures collectively known as *Netra Kriyakalpa* are regarded as important interventions because they deliver medicines directly to ocular tissues and produce relatively rapid therapeutic effects. *Anjana* is an important procedure among *Netra Kriyakalpa* in which medicated formulations are applied to the inner surface of the eyelid, usually over the lower palpebral conjunctiva or conjunctival sac. From a modern biomedical perspective, this procedure can be considered a specialized form of topical ocular drug delivery. The effectiveness of the therapy depends on several physicochemical factors, including pH, viscosity, tonicity, molecular size, molecular weight, and lipid solubility of the active constituents. Traditionally, *Anjana* is classified into three forms: *Gutika*, *Rasakriya*, and *Churna*. *Rasakriya* preparations resemble ophthalmic solutions, whereas *Gutika* and *Churna* forms may be conceptually correlated with ophthalmic suspensions containing fine particles that remain longer in the conjunctival sac, thereby enhancing drug retention and ocular bioavailability. The present article aims to review the classical concept of *Anjana* and

interpret its probable mechanism using modern perspectives of ocular pharmacokinetics and drug delivery, thereby highlighting its relevance in contemporary ophthalmic practice.

KEYWORDS: *Anjana, Netra Kriyakalpa,* Ocular Drug Delivery System, Tear Film Interaction, Ocular Pharmacokinetics, *Ayurvedic* Ophthalmology.

1. INTRODUCTION

Shalakya Tantra, one of the eight major branches of *Ashtanga Ayurveda*, deals specifically with disorders occurring above the clavicle, particularly those affecting the sensory organs such as the eyes, ears, nose, and oral cavity. Among these, the eye is accorded paramount importance because vision is central to perception, cognition, learning, and social functioning. Classical *Ayurvedic* scholars emphasized that knowledge derived through direct observation (*Pratyaksha Pramana*) depends primarily on visual perception, and even when other sensory faculties are intact, the absence of vision significantly compromises human experience and independence.[1] Consequently, preservation of ocular health was regarded not merely as a therapeutic concern but as a fundamental prerequisite for physical, intellectual, and social well-being.

To achieve this objective, authentic *Ayurvedic* texts prescribe extensive preventive and curative strategies for maintaining ocular integrity. These include internal medications, dietary and lifestyle regulations, surgical and para-surgical interventions, and specialized localized therapies. Among these modalities, local ocular treatments are considered particularly precise and effective because they enable direct interaction of the medicinal substance with the affected tissues. Such procedures are collectively termed *Netra Kriyakalpa*, and their significance in ocular disorders may be compared to the role of *Panchakarma* in systemic diseases.[2,3] The concept reflects an early understanding of targeted therapy, wherein localized application was intended to produce rapid and site-specific therapeutic effects.

Classical literature describes seven principal *Netra Kriyakalpa* procedures: *Akshi Tarpana, Putapaka, Seka, Aschyotana, Anjana, Bidalaka,* and *Pindi*.[2,3] *Akshi Tarpana* involves retention of medicated lipid preparations over the eyes to nourish and strengthen ocular tissues. *Putapaka* follows a similar principle but employs specially processed formulations to enhance potency. *Seka* consists of controlled pouring of medicated liquids over closed eyes and is particularly beneficial in acute inflammatory conditions. *Aschyotana* involves

instillation of medicated liquids into open eyes and is often considered a primary intervention in various ocular disorders. *Bidalaka* and *Pindi* involve external application of medicated pastes around or over the eyelids to reduce inflammation and improve local circulation. Among these procedures, *Anjana* occupies a distinctive place because of its dual preventive and therapeutic applications and its frequent recommendation in daily regimens.

In modern ophthalmology, drug delivery to ocular tissues is achieved through systemic administration, periocular injections, intraocular injections, and topical formulations. Topical delivery systems such as eye drops, ointments, gels, suspensions, ocular inserts, and medicated contact lenses are widely preferred due to their non-invasive nature and ability to provide direct access to ocular structures while minimizing systemic exposure. Interestingly, the conceptual basis of these modern modalities parallels the principles underlying *Netra Kriyakalpa* procedures described in classical Ayurveda, particularly in terms of localized action and tissue targeting.

Anjana is a medicated preparation applied along the inner margin of the eyelid, typically over the lower palpebral conjunctiva or conjunctival sac, using a specialized applicator known as the *Anjana Shalaka*. The term "*Anjana*" is derived from the Sanskrit root *Anj*, meaning "to apply," "to adorn," or "to impart clarity."[7] Classical texts such as *Sushruta Samhita*, *Ashtanga Hridaya*, *Ashtanga Sangraha*, and *Sharangadhara Samhita* provide detailed descriptions of its classification, dosage, indications, contraindications, and procedural methodology.[4,6] These descriptions suggest that *Anjana* was conceptualized not merely as a cosmetic collyrium but as a systematically structured therapeutic intervention.

Historically, collyrium-like preparations were also used in ancient civilizations, including the Indus Valley culture, for both therapeutic and cosmetic purposes. However, *Ayurvedic* literature offers a uniquely detailed and methodologically organized framework for its application, including guidance on dosage regulation, seasonal timing, contraindications, and post-procedural measures. Such comprehensive detailing indicates an early recognition of factors that influence ocular drug effectiveness and safety.

From a contemporary biomedical perspective, *Anjana* may be interpreted as a specialized form of topical ocular drug delivery. The effectiveness of topical ophthalmic preparations is influenced by several physicochemical parameters, including pH, viscosity, tonicity, molecular size, molecular weight, and lipid solubility of active constituents. Traditionally,

Anjana is classified into three pharmaceutical forms—*Gutika, Rasakriya,* and *Churna*—which may be conceptually correlated with modern ophthalmic suspensions and solutions. These structural and functional parallels provide a framework for exploring *Anjana* through the lens of ocular pharmacokinetics and drug absorption science.

Although classical *Ayurvedic* texts provide a detailed procedural framework for *Anjana* therapy, systematic integration with contemporary ocular pharmacokinetics and drug delivery science remains limited. Existing literature primarily describes classical concepts without critically examining physicochemical determinants of drug absorption, bioavailability, and translational standardization. Therefore, a structured reappraisal of *Anjana* through modern ocular drug delivery principles is warranted.

3. MATERIALS AND METHODS

3.1 AIM

To explore the concept of *Anjana* therapy described in *Ayurvedic* literature and interpret its relevance as an ocular drug delivery system from a modern scientific perspective.

3.2 OBJECTIVES

1. To review the classical description of *Anjana* in *Ayurvedic* texts.
2. To understand its types, indications, and method of application.
3. To correlate the concept of *Anjana* with modern principles of ocular drug delivery and pharmacokinetics.

3.3 Study Design

The present study is a literary review based on information obtained from classical *Ayurvedic* texts and contemporary scientific literature.

3.4 Sources of Data

Data related to *Anjana* therapy were collected from authoritative *Ayurvedic* texts such as *Sushruta Samhita, Ashtanga Hridaya, Ashtanga Sangraha, Sharangadhara Samhita,* and *Bhavaprakasha.* Modern concepts related to ocular drug delivery, tear film dynamics, and pharmacokinetics were gathered from standard textbooks, research articles, and scientific databases including PubMed and Google Scholar.

3.5 METHODOLOGY

Relevant information from classical and modern sources was compiled, analyzed, and interpreted to understand the therapeutic role of *Anjana* and its possible mechanism in relation to ocular drug absorption and delivery. The findings were then organized and presented systematically.

4 CONCEPTUAL UNDERSTANDING OF *ANJANA* AS AN OCULAR DRUG DELIVERY SYSTEM

4.1 Types of *Anjana*[8-11]

In *Ayurvedic* ophthalmology, *Anjana* is an important therapeutic procedure used both for preventive and curative purposes in various eye disorders. Classical texts describe different classifications of *Anjana* based on its pharmaceutical form and therapeutic action. These classifications help physicians choose the most appropriate preparation depending on the severity of the disease, the predominance of *Doshas*, and the condition of the patient.

4.1.1 Classification According to Pharmaceutical Form

Traditionally, *Anjana* preparations are grouped into three major forms

a. ***Gutika Anjana***: This form is prepared as a solid stick or pill-like structure. It is usually applied with the help of a special applicator known as *Anjana Shalaka*. Because of its solid consistency, the drug is released gradually and remains in contact with ocular tissues for a longer period.

b. ***Rasakriya Anjana***: *Rasakriya* is a semi-solid or concentrated extract obtained after processing herbal drugs. It dissolves easily when applied to the eye and therefore produces relatively quicker therapeutic effects.

c. ***Churna Anjana***: *Churna* refers to finely powdered formulations. These preparations often possess stronger therapeutic action and are generally used when deeper cleansing or scraping of accumulated *Doshas* is required.

Classical scholars such as *Acharya Sushruta* and *Acharya Vagbhata* mention that the intensity of action increases sequentially from *Gutika* to *Rasakriya* and then to *Churna*. However, some authors including *Acharya Bhavamishra* describe slight variations in this order. In clinical practice, the selection of the form is made according to the severity of the disease and the strength of the patient.

Table 1: Classification of *Anjana* According to Form.

Type of *Anjana*	Physical Nature	General Characteristics
Gutika	Solid preparation	Gradual drug release and moderate action
Rasakriya	Semi-solid extract	Faster dissolution and quicker therapeutic response
Churna	Fine powder	Stronger cleansing effect and deeper action

4.1.2 Classification Based on Therapeutic Action

Apart from physical form, *Anjana* is also categorized according to its therapeutic properties and the type of *Dosha* involved in the disease process.

a. ***Lekhana Anjana***: *Lekhana Anjana* is primarily indicated in conditions associated with excessive accumulation of *Kapha* and other morbid materials. These preparations usually contain substances possessing bitter, astringent, pungent, or alkaline properties. Their action is described as "scraping," meaning they help remove unwanted secretions, deposits, and pathological substances from ocular structures.

b. ***Ropana Anjana:*** *Ropana* type *Anjana* is mainly used for healing and tissue repair. It commonly contains soothing substances combined with ghee or oil that promote regeneration of ocular tissues and improve the quality of vision.

c. ***Prasadana Anjana:*** *Prasadana Anjana* is mild and soothing in nature. It is generally recommended for maintaining ocular comfort, enhancing clarity of vision, and pacifying aggravated *Doshas* affecting the eye. Some classical texts also refer to related types such as *Snehana* or *Drishti-Prasadana*, emphasizing lubrication and visual improvement.

Table 2: Functional Types of Anjana.

Type	Composition	Therapeutic Action
Lekhana	*Tikta, Kashaya, Katu* properties	Removes accumulated *Doshas* and secretions
Ropana	*Kashaya* and *Tikta* with *Ghee* or oil	Promotes healing and improves ocular tissues
Prasadana / Snehana	*Madhura* with *Ghee* or oil	Soothes the eyes and enhances clarity of vision

4.2 Indications of *Anjana*[12-16]

In Ayurvedic ophthalmology, *Anjana* therapy is recommended when the pathological factors (*Doshas*) are primarily confined to the eyes and have reached a stage suitable for elimination or pacification. Classical texts suggest that the procedure should ideally be performed after appropriate purification of the body through *Panchakarma* therapies such as *Nasya*,

Virechana, *Basti*, and *Raktamokshana*, as these help prepare the system for localized ocular treatment.

Different *Ayurvedic* authorities have mentioned several clinical situations where *Anjana* is considered beneficial. These indications mainly relate to conditions where morbid *Doshas* manifest locally in the ocular structures.

Table 3: Indications of *Anjana* in Classical Texts.

Indication	*Sushruta Samhita*	*Ashtanga Hridaya*	*Sharangadhara Samhita*	*Bhavaprakasha*
Manifestation of *Doshas*	✓			
***Doshas* localized in the eyes**	✓	✓		
After systemic purification	✓	✓		
***Doshas* reaching a mature stage (*Pakva*)**	✓	✓	✓	
Mild swelling of the eyes			✓	
Intense itching in the eyes			✓	
Excessive sliminess or stickiness			✓	
Thick ocular discharge			✓	
Disorders involving *Vata*, *Pitta*, *Kapha*, or *Rakta*				✓

4.3 Timing of *Anjana* Therapy[17,18]

Apart from disease indications, *Ayurvedic* scholars also described appropriate seasonal and daily timings for the administration of *Anjana*. These recommendations were intended to enhance therapeutic outcomes and prevent complications.

4.3.1 Seasonal Considerations

Certain texts suggest that the time of application may vary according to seasonal conditions:

Season	Recommended Time
***Hemanta* and *Shishira* (winter)**	Afternoon
***Grishma* (summer)**	Morning
***Sharad* (autumn)**	Evening
***Vasanta* (spring)**	Any suitable time

During the rainy season, the preparation should not be excessively cold or very hot, as extreme temperatures may cause discomfort to the eyes.

4.3.2 Daily Timing According to *Dosha*

Classical *Ayurvedic* authors also emphasized that *Anjana* should generally be applied during morning, evening, **or** night, while avoiding application during the middle of the day. The type of *Anjana* used may vary depending on the predominance of *Dosha*.

Time of Day	Preferred Type	Indication
Morning	*Lekhana Anjana*	*Kapha*-related disorders
Evening	*Snehana Anjana*	*Vata*-related conditions
Night	*Prasadana Anjana*	*Pitta*-related conditions

These recommendations reflect the Ayurvedic understanding of daily Dosha fluctuations and their influence on ocular physiology.

4.3.3 Contraindications of *Anjan*[19-21]

Although *Anjana* therapy is widely described in *Ayurvedic* ophthalmology, classical texts clearly emphasize that it should not be performed under certain conditions. These restrictions are intended to prevent complications and ensure the safety of the patient.

Anjana is generally avoided in individuals experiencing extreme fatigue, disturbed bodily functions such as *Udavarta*, excessive tearing of the eyes, intoxication, intense emotional states such as anger or fear, and during the early stage of fever. Application is also discouraged in persons who suppress natural urges or suffer from disorders affecting the head region, as these conditions may lead to redness, irritation, discomfort, discharge, or impairment of vision after the procedure.

The therapy should also be avoided in situations such as sleep deprivation, strong winds, exposure to dust or smoke, and active ocular discharge**.** Classical descriptions mention that performing *Anjana* in such circumstances may worsen ocular irritation or cause congestion and pain. Similarly, the procedure should not be carried out immediately after cleansing therapies such as *Nasya*, *Vamana*, or *Virechana*, because the body is considered sensitive during this period. Other conditions where *Anjana* is discouraged include headache, immediately after bathing the head, severe cold weather, before sunrise, and during indigestion when bodily channels are believed to be obstructed. These precautions are particularly emphasized in the case of *Lekhana Anjana*, which possesses a stronger action.

In addition to these guidelines, *Acharya Bhavamishra* advises that the therapy should not be administered during extremely hot, cold, or windy environmental conditions. Improper

application under such circumstances may aggravate *Doshas* and lead to complications such as redness, thick discharge, visual disturbance, or discomfort.

4.4 Dosage of *Anjana*[22]

The quantity of *Anjana* to be applied varies according to the type of preparation and the therapeutic objective. Classical *Ayurvedic* texts describe dosage in traditional units such as *Harenu* and *Shalaka*.

Table 4: General Dosage of *Anjana* According to *Acharya Sushruta.*

Type of Anjana	*Lekhana*	*Prasadana*	*Ropana*
Gutika	*1 Harenu*	*1½ Harenu*	*2 Harenu*
Rasakriya	*1 Harenu*	*1½ Harenu*	*2 Harenu*
Churna	*2 Shalaka*	*3 Shalaka*	*4 Shalaka*

The term *Harenu* refers to a traditional measurement associated with a small seed-like quantity.[23]

4.4.1 Dosage According to *Sharangadhara Samhita*[24]

4.4.1.1 Gutika *Anjana*

The dose may vary depending on the potency of the formulation

Potency	Quantity
***Tikshna* (strong)**	1 *Harenu*
***Madhyama* (moderate)**	1½ *Harenu*
***Mridu* (mild)**	2 *Harenu*

4.4.1.2 *Rasakriya Anjana*

Dose Level	Quantity
Uttama Matra	*3 Vidanga*
Madhyama Matra	*2 Vidanga*
Heena Matra	*1 Vidanga*

Vidanga refers to the seed of Embelia ribes, commonly known as false black pepper.

4.4.1.3 *Churna Anjana*

Therapeutic Purpose	Quantity
***Virechana* (eliminating action)**	*2 Shalaka*
***Mridu* (mild action)**	*3 Shalaka*
***Snehana* (unctuous action)**	*4 Shalaka*

These dosage guidelines help ensure that the medicine acts effectively while minimizing irritation or adverse effects on the delicate ocular structures.

4.5 Procedure of *Anjana* Therapy[25,26]

The method of performing *Anjana therapy* is described in detail in classical *Ayurvedic* texts such as those of *Sushruta* and *Vagbhata*. According to these descriptions, the medicated preparation is generally applied along the inner margin of the eyelid, extending from the medial canthus toward the lateral canthus. The application may be performed using a specialized instrument known as an *Anjana Shalaka* or, in certain situations, with the physician's finger.

Although classical texts do not always clearly specify whether the upper or lower eyelid should be used, many practitioners interpret the procedure as being performed on the lower palpebral conjunctiva or the conjunctival sac, as this area provides adequate space for proper application and distribution of the medicine.

During the procedure, the physician gently separates the eyelids using the thumb and index finger of one hand, while holding the *Anjana Shalaka* with the other hand. The medication is applied carefully without causing discomfort to the patient. In some cases, repeated gentle application may be done to ensure uniform distribution and improve drug contact with ocular tissues. Excessive pressure or repeated manipulation should be avoided, as it may lead to irritation.

After the application, the patient is usually instructed to move the eyeballs slowly upward and in circular motions. This movement allows the medicine to spread evenly over the ocular surface. Gentle massage of the eyelids may also assist in improving circulation around the eye and may support better absorption of the medicine. However, actions such as vigorous blinking, squeezing of the eyes, or immediate washing of the eyelids should be avoided until the therapy has produced its desired effect.

Following the main procedure, cleansing of the eyes with appropriate liquids may be performed as a *post-procedural measure* (*Paschat Karma*)**.** This helps remove excess medicine and prevents irritation. In certain situations, additional supportive procedures such as *Dhumpana* (medicated fumigation) or *Pratyanjana* (restorative collyrium) may be used to alleviate discomfort.

For safe and effective results, the preparation used for *Anjana* should be properly formulated. It should neither be excessively strong nor too mild in potency. Similarly, the quantity

applied should be appropriate, and the consistency should not be overly thick, thin, rough, or excessively hot, as such factors may cause ocular irritation.[27]

4.6 Features of Proper and Improper Administration of *Anjana*[28]

Classical *Ayurvedic* scholars describe three possible outcomes of *Anjana* therapy depending on how correctly it is performed. These are *Samyakyoga* (proper administration), *Atiyoga* (excessive administration), and *Heenayoga* (insufficient administration)**.**

4.6.1 *Samyakyoga* (Proper Application)

When *Anjana* is administered correctly, certain favorable signs may appear. In the case of *Lekhana Anjana*, these include reduction of stickiness in the eyes, a feeling of lightness, absence of discharge, improved clarity, and relief from symptoms. For *Prasadana Anjana*, proper administration results in improved comfort of the eyes, better color and strength of ocular tissues, a feeling of freshness, and overall improvement in visual function.

4.6.2 *Atiyoga* (Excessive Application)

If *Anjana* is applied excessively or inappropriately, adverse effects may occur. In the case of *Lekhana Anjana*, these may include abnormal eye movements, stiffness, discoloration, drooping of the eyelids, roughness of ocular structures, and excessive discharge. Such symptoms are considered to arise due to aggravation of *Vata Dosha*, and they should be managed with nourishing therapies and measures that pacify *Vata*.

Similarly, excessive use of *Prasadana Anjana* may lead to mild ocular disturbances, which require corrective treatment with appropriate medications.

4.6.3 *Heenayoga* (Inadequate Application)

If the therapy is performed insufficiently or in an inadequate manner, the expected therapeutic effects may not occur. In such cases, *Doshas* may remain aggravated. Corrective measures such as *Dhumpana***,** *Nasya***,** or repetition of *Anjana* therapy may be advised to achieve proper results.

For *Ropana Anjana*, the features of proper, excessive, and inadequate application are generally similar to those of *Prasadana Anjana*, although the effects are considered moderate in intensity.

Ensuring the correct dose, method of application, and proper timing is therefore essential to obtain maximum therapeutic benefit from *Anjana* therapy while minimizing possible complications.

4.7 Materials Used in *Anjana Karma*

The performance of *Anjana Karma* requires certain basic instruments and medicinal substances to ensure proper application of the therapy. Classical *Ayurvedic* texts mention three essential components necessary for this procedure

- ***Anjana Shalaka*** – the applicator used for administering the medicine
- ***Anjana Patra*** – the container used for storing the preparation
- **Medicinal formulations** used as *Anjana.*

These materials play an important role in maintaining hygiene, precision, and therapeutic effectiveness during the procedure.

4.8 *Anjana Shalaka*[29-31]

An *Anjana Shalaka*, often referred to as a collyrium applicator, is a specialized instrument used for the application of *Anjana*. Classical descriptions state that it is generally a cylindrical rod measuring approximately eight angulas in length. The instrument may be prepared from materials such as metal, stone, or animal horn depending on availability and therapeutic considerations.

The terminal end of the *Shalaka* is designed to be smooth and rounded, resembling the shape of a flower bud. This structure allows the medicine to be applied safely along the eyelid margin without causing injury to the delicate ocular tissues. The design ensures controlled and gentle administration of the preparation.

4.9 *Anjana Patra*[32]

The container used for storing *Anjana* preparations is known as *Anjana Patra*. *Ayurvedic* texts recommend selecting the material of the container according to the medicinal properties of the formulation being stored. This helps preserve the potency and quality of the medicine.
In some classical descriptions, it is also suggested that the material used for preparing the *Anjana Shalaka* may be chosen in accordance with the nature of the drug, ensuring compatibility between the instrument and the medicinal preparation.

4.10 Routes of Ocular Drug Administration and Drug Absorption in Relation to *Anjana*[33-45]

The eye possesses a complex anatomical structure and protective physiological mechanisms that influence the delivery and absorption of drugs. In modern ophthalmology, medications can be administered through several routes depending on the target tissue and the severity of the disease. The main routes of ocular drug administration include topical, periocular, intraocular, and systemic delivery**.**

Periocular administration involves injections around the eye such as subconjunctival, sub-Tenon's, peribulbar, and retrobulbar injections, which are generally used to achieve higher drug concentrations in ocular tissues. Intraocular delivery methods, including intracameral and intravitreal injections**,** allow direct access to deeper structures of the eye. Systemic administration may also be used when the drug needs to reach ocular tissues through the bloodstream. However, among all these approaches, topical drug administration remains the most commonly used method, especially for diseases affecting the ocular surface and the anterior segment of the eye.

In *Ayurvedic* practice, *Anjana* can be understood within this context as a form of topical ocular therapy. In this procedure, a medicated preparation is applied to the lower palpebral conjunctiva or the conjunctival sac**.** Because the drug is directly placed on the ocular surface, it may interact with tear film components and subsequently penetrate the underlying ocular tissues. One of the major challenges in developing topical ophthalmic preparations is improving drug bioavailability and maintaining an adequate concentration of the drug for a sufficient period. This is difficult because several physiological factors reduce drug retention on the ocular surface.

4.10.1 Pre-corneal Factors Affecting Drug Absorption

Before reaching deeper ocular tissues, a topically administered drug must overcome several pre-corneal barriers, including tear secretion, blinking, nasolacrimal drainage, and reflex lacrimation. The tear film acts as the primary physiological barrier, and its continuous turnover significantly reduces drug residence time on the ocular surface. Blinking and drainage through the nasolacrimal duct further accelerate precorneal clearance. Consequently, only a limited fraction of the applied dose remains available for corneal or conjunctival absorption, resulting in inherently low bioavailability of many topical ophthalmic preparations.

4.10.2 Anatomical Barriers of the Eye

Apart from tear dynamics, the structural components of the eye also influence drug penetration. The cornea and conjunctiva are the primary barriers encountered by topical medications.

4.10.2.1 Corneal Barrier

The cornea consists of several layers, but three layers play a major role in drug transport:

- **Corneal epithelium** – an outer lipophilic layer that limits the penetration of hydrophilic substances
- **Stroma** – a hydrophilic middle layer that restricts lipophilic compounds
- **Endothelium** – an inner layer that offers comparatively less resistance to drug movement

Due to this biphasic nature, the cornea favors molecules possessing both lipid and aqueous solubility. Lipophilic drugs tend to pass through the epithelial cells via transcellular pathways, while hydrophilic molecules may diffuse through paracellular routes via tight junctions. Once the drug crosses the cornea, it enters the aqueous humor, from where it may distribute to structures such as the iris and ciliary body. Some drugs may bind to melanin within these tissues, forming a reservoir that gradually releases the drug and prolongs its therapeutic action.

4.10.2.2 Conjunctival Absorption

The conjunctiva also contributes significantly to drug absorption. Its surface area is considerably larger than that of the cornea and it is relatively more permeable to certain hydrophilic substances. However, the conjunctiva is richly supplied with blood vessels. Because of this vascularity, drugs absorbed through this route may enter the systemic circulation rather than reaching deeper ocular tissues, thereby reducing their ocular bioavailability.

4.10.3 Role of the Sclera

In addition to the cornea and conjunctiva, the sclera also participates in ocular drug transport. Although it is less vascularized, its structure allows certain molecules to diffuse toward internal ocular structures. The sclera is composed mainly of collagen fibers and mucopolysaccharides, which provide pathways for diffusion of drugs toward the vitreous body.

4.10.4 Systemic Loss of Topically Applied Drugs

Another important factor influencing ocular drug delivery is systemic absorption. After topical administration, a portion of the drug may reach systemic circulation through pathways such as the nasolacrimal duct, nasal mucosa, conjunctival blood vessels, or other ocular tissues. Once the drug enters systemic circulation, it must cross the blood-ocular barriers again to reach the target tissues, which significantly reduces the amount available for therapeutic action in the eye.

In addition to drainage, several other mechanisms contribute to drug loss from the ocular surface. These include evaporation of the tear film, binding of drugs to tear proteins, and metabolism by enzymes present in tears.

4.11 Relevance to *Anjana* Therapy

Considering these physiological and anatomical factors, *Anjana* therapy may be interpreted as a traditional topical drug delivery approach that primarily influences the anterior segment of the eye, extending up to the level of the crystalline lens. The active constituents present in *Anjana* formulations may enter ocular tissues depending on their physicochemical properties. Hydrophilic components may preferentially pass through conjunctival pathways, while lipophilic molecules may penetrate the cornea.

Thus, when viewed from a modern pharmacological perspective, the classical *Ayurvedic* procedure of Anjana demonstrates similarities with contemporary concepts of ocular drug delivery and absorption mechanisms.

4.11.1 Pharmacokinetics of *Anjana*

Pharmacokinetics refers to the processes involved in the absorption, distribution, metabolism, and elimination of a drug after its administration. Understanding these processes is essential for interpreting how topical ocular preparations exert their therapeutic effects. When a drug is applied to the eye, it must overcome several physiological barriers before reaching its target tissues. Drug absorption across ocular tissues mainly occurs through passive diffusion, carrier-mediated transport, and endocytosis**.** Among these mechanisms, passive diffusion is considered the predominant pathway for most ophthalmic drugs. In this process, drug molecules move across biological membranes along a concentration gradient without the requirement of metabolic energy. The efficiency of passive diffusion is influenced by several

factors such as lipid solubility, molecular size, and the degree of ionization of the drug, which is determined by the pH of the surrounding environment.

In addition to passive diffusion, certain molecules are transported through carrier-mediated mechanisms present on cellular membranes. This process may occur either as facilitated diffusion or active transport. Facilitated diffusion allows molecules to move along a concentration gradient with the assistance of carrier proteins but without energy expenditure. Active transport, on the other hand, requires energy and enables the movement of substances against their concentration gradient. Another mechanism known as endocytosis involves the engulfment of drug molecules by membrane-bound vesicles, allowing their entry into the cell. Through these mechanisms, topically administered agents, including *Anjana* preparations, may reach various ocular structures such as the conjunctiva, cornea, sclera, iris, ciliary body, lens, and other tissues.

From an *Ayurvedic* perspective, *Anjana* is available in three main pharmaceutical forms: *Gutika*, *Rasakriya*, and *Churna*. These forms can be conceptually correlated with modern ophthalmic dosage forms. *Rasakriya* preparations are semi-liquid and dissolve readily when applied to the ocular surface; therefore, they resemble modern ophthalmic solutions or eye drops**.** Because of their solubility and relatively smaller molecular dispersion, such preparations may be absorbed rapidly. However, they are also more likely to be eliminated quickly from the conjunctival sac due to tear turnover and nasolacrimal drainage, which may reduce their overall bioavailability.

In contrast, *Gutika* and *Churna* types contain fine particulate matter, and thus they may be compared with modern ophthalmic suspensions. Suspensions consist of finely divided insoluble drug particles dispersed in a liquid medium containing appropriate stabilizing agents. One advantage of such preparations is their ability to remain longer within the conjunctival sac, thereby increasing contact time between the drug and ocular tissues. This prolonged residence time may enhance absorption and extend the duration of therapeutic action.

Particle size plays an important role in determining the behavior of ophthalmic suspensions. Smaller particles dissolve more rapidly and may produce a quicker onset of action, but they are also more easily removed from the ocular surface. Larger particles, on the other hand, tend to remain in the conjunctival sac for a longer duration and release the drug gradually.

Therefore, an optimal particle size is necessary to balance drug retention and dissolution. In many ophthalmic preparations, particles smaller than approximately 10 µm are preferred because they minimize irritation while still allowing adequate drug availability.

Traditional methods of preparing *Gutika* and *Churna Anjana* involve grinding, milling, and fine pulverization**,** which may help achieve a suitable particle size distribution. However, classical literature does not specify a standardized particle size for these formulations. From a modern pharmaceutical viewpoint, maintaining an appropriate particle size may help improve therapeutic efficiency and patient comfort.

In contemporary pharmaceutics, the preparation of ophthalmic suspensions usually involves several steps such as preparation of the drug dispersion, development of the vehicle, addition of stabilizing agents, and homogenization. Although classical *Ayurvedic* formulations do not always include synthetic additives or preservatives, natural substances such as honey, *Ghee*, breast milk, and fresh plant extracts are often used as vehicles or adjuvants. These substances may contribute to viscosity, stability, and improved spreading of the preparation over the ocular surface. Nevertheless, proper hygiene and preparation techniques are important to ensure safety and prevent contamination.

Physicochemical characteristics such as pH, viscosity, tonicity, molecular size, and solubility significantly influence ocular drug absorption. Preparations that closely match the physiological conditions of the tear film are more likely to remain comfortable for the patient and may provide better therapeutic outcomes.

However, the absence of standardized in vitro permeability models and controlled release profiling for classical *Anjana* formulations limits precise prediction of intraocular pharmacokinetic behavior.

4.11.2 Probable Mode of Action of *Anjana*

When *Anjana* is applied to the ocular surface, it initially behaves as a foreign substance. This triggers protective responses of the eye such as reflex tearing and blinking, which help remove unwanted materials. As a result, a portion of the applied drug may be washed away from the eye through lacrimation or drained into the nasolacrimal duct. Some amount may also be lost due to evaporation, enzymatic degradation within tears, or binding with tear proteins.

Despite these elimination processes, a small portion of the preparation remains within the conjunctival sac, where it becomes available for absorption. In particulate preparations such as *Gutika* and *Churna Anjana*, micro-particles may settle in the cul-de-sac and prolong the contact time between the drug and ocular tissues. This increased retention may enhance the possibility of drug penetration.

Absorption of active components may occur through the cornea and conjunctiva, depending on their physicochemical properties. Lipophilic molecules are more likely to penetrate the corneal epithelium through transcellular pathways, whereas hydrophilic molecules may diffuse through the conjunctiva via paracellular routes. Once the drug crosses these barriers, it can enter intraocular fluids such as the aqueous humor and subsequently reach structures including the iris, ciliary body, lens, and vitreous body.

However, because the conjunctiva and surrounding tissues are highly vascularized, a portion of the absorbed drug may enter systemic circulation rather than remaining within the eye. Additionally, drugs reaching the aqueous humor may undergo metabolic degradation by ocular enzymes. These factors collectively influence the final concentration of the drug that reaches its intended site of action.

From a modern pharmacological standpoint, the effectiveness of *Anjana* therapy depends on several factors including drug solubility, particle size, viscosity of the preparation, pH compatibility with tear fluid, and molecular characteristics of the active compounds. These parameters determine the rate and extent of drug absorption across ocular tissues.

In *Ayurvedic* theory, however, the therapeutic effects of a medicine are also explained through qualitative pharmacological attributes such as *Rasa* (taste), *Guna* (properties), *Virya* (potency), *Vipaka* (post-digestive effect), and *Prabhava* (specific action)**.** These factors are believed to influence the interaction of the drug with bodily tissues and *Doshas*. Although these traditional concepts have not been fully correlated with modern biomedical science, they provide an additional framework for understanding the action of *Anjana* therapy.

Considering both classical descriptions and modern pharmacological principles, *Anjana* may exert its primary effects on the anterior segment of the eye, where topical medications typically act. However, according to *Ayurvedic* interpretations, the qualitative properties of the drugs used in *Anjana* may also influence deeper ocular structures.

5. DISCUSSION

Anjana therapy demonstrates a historically structured approach to localized ocular drug delivery, reflecting an early understanding of targeted pharmacotherapy within *Ayurvedic* ophthalmology. The procedure integrates pharmaceutical formulation, dosage regulation, application technique, and post-procedural measures, indicating that it was conceived as a structured therapeutic protocol rather than merely a symptomatic remedy. When interpreted through the framework of modern ocular pharmacokinetics, several aspects of *Anjana* demonstrate conceptual alignment with contemporary principles of drug delivery.

A major challenge in ophthalmic pharmacology is limited precorneal drug retention due to tear turnover, blinking, and nasolacrimal drainage. Classical *Anjana* preparations, particularly *Gutika* and *Churna* forms, may enhance ocular surface contact time because of their particulate or semi-solid characteristics. This feature resembles modern suspension-based and viscosity-enhanced formulations designed to prolong residence time. Furthermore, the advised ocular movements following application may promote uniform distribution within the conjunctival sac, potentially reducing localized pooling and premature elimination.

Despite these theoretical correlations, the pharmacodynamic and pharmacokinetic behavior of *Anjana* formulations has not been systematically evaluated using contemporary experimental models. Critical parameters such as particle size distribution, sterility assurance, pH compatibility, tonicity adjustment, and controlled-release kinetics require scientific standardization. In the absence of such validation, clinical reproducibility may vary depending on preparation technique and practitioner expertise.

Safety considerations are equally important. The ocular surface is highly sensitive, and inadequately standardized formulations may lead to irritation, inflammation, or secondary infection. Although classical texts provide qualitative guidance regarding potency and consistency, quantitative pharmaceutical benchmarks are essential for integration into evidence-based ophthalmic practice.

Therefore, *Anjana* therapy may be regarded as an early ocular drug delivery paradigm with meaningful translational research potential. Future investigations involving in vitro corneal permeability studies, tear film interaction analysis, pharmaceutical standardization, and well-designed clinical trials are necessary to define its evidence-based role within integrative

ophthalmology. Although earlier literature has described the classical framework of *Anjana*, comprehensive integration with modern ocular drug delivery science remains limited.

This article presents a conceptual synthesis of classical *Ayurvedic* descriptions and contemporary pharmacological principles. As it is based on textual and literature analysis, experimental validation and standardized formulation assessment were not undertaken. Further laboratory-based and clinical investigations are essential to substantiate the proposed pharmacokinetic interpretations.[46]

6. CONCLUSION

Anjana therapy may be interpreted as a traditional topical ocular drug delivery approach with conceptual alignment to modern pharmacokinetic principles. Its particulate and semi-solid forms may enhance precorneal retention compared to simple aqueous instillations. Although classical texts provide detailed procedural guidance, contemporary scientific validation through standardized pharmaceutical and clinical studies is required. Re-examining *Anjana* within a translational research framework may bridge traditional ophthalmic practice and modern drug delivery science.

7. REFERENCES

1. Murthy KRS. *Ashtanga Hridayam (English Translation)*. Vol. III, Uttara Sthana, Chapter 13/98. Varanasi: Chowkhamba Krishnadas Academy, 2012; 130.
2. Sharma PV. *Susruta Samhita (English Translation)*. Vol. III, Uttara Tantra, Chapter 18/4. Varanasi: Chaukhambha Vishvabharati, 2010; 211.
3. Murthy KRS. *Sarangadhara Samhita (English Translation)*. Uttara Khanda, Chapter 13/1. Varanasi: Chaukhambha Orientalia, 2012; 258.
4. Murthy KRS. *Ashtanga Hridayam (English Translation)*. Vol. I, Sutra Sthana, Chapter 2/5. Varanasi: Chowkhamba Krishnadas Academy, 2013; 23.
5. Sharma RK, Dash B. *Charaka Samhita (English Translation)*. Vol. I, Sutra Sthana, Chapter 5/15–17. Varanasi: Chowkhambha Sanskrit Series Office, 2014; 111.
6. Sharma PV. *Susruta Samhita (English Translation)*. Vol. II, Chikitsa Sthana, Chapter 24/18–20. Varanasi: Chaukhambha Vishvabharati, 2010; 492.
7. Dev RR. *Shabdakalpadruma*. Vol. I. Varanasi: Amar Publications, 23.
8. Sharma PV. *Susruta Samhita (English Translation)*. Vol. III, Uttara Tantra, Chapter 18/58. Varanasi: Chaukhambha Vishvabharati, 2010; 219.

9. Murthy KRS. *Sarangadhara Samhita (English Translation)*. Uttara Khanda, Chapter 13/66. Varanasi: Chaukhambha Orientalia, 2012; 265.
10. Murthy KRS. *Ashtanga Hridayam (English Translation)*. Vol. I, Sutra Sthana, Chapter 23/14. Varanasi: Chowkhamba Krishnadas Academy, 2013; 278.
11. Murthy KRS. *Bhavaprakasha (English Translation)*. Vol. I, Purva Khanda, Chapter 7/198–201. Varanasi: Chowkhamba Krishnadas Academy; 2011. p.621.
12. Sharma PV. *Susruta Samhita (English Translation)*. Vol. III, Uttara Tantra, Chapter 18/51. Varanasi: Chaukhambha Vishvabharati, 2010; 218.
13. Murthy KRS. *Ashtanga Hridayam (English Translation)*. Vol. I, Sutra Sthana, Chapter 23/8–9. Varanasi: Chowkhamba Krishnadas Academy, 2013; 277.
14. Murthy KRS. *Sarangadhara Samhita (English Translation)*. Uttara Khanda, Chapter 13/62–63. Varanasi: Chaukhambha Orientalia, 2012; 265.
15. Murthy KRS. *Bhavaprakasha (English Translation)*. Vol. I, Purva Khanda, Chapter 7/197. Varanasi: Chowkhamba Krishnadas Academy, 2011; 621.
16. Murthy KRS. *Bhavaprakasha (English Translation)*. Vol. I, Purva Khanda, Chapter 7/208–209. Varanasi: Chowkhamba Krishnadas Academy, 2011; 622.
17. Murthy KRS. *Ashtanga Hridayam (English Translation)*. Vol. I, Sutra Sthana, Chapter 23/16–17. Varanasi: Chowkhamba Krishnadas Academy, 2013; 279.
18. Sharma PV. *Susruta Samhita with Dalhana Commentary (English Translation)*. Vol. III, Uttara Tantra, Chapter 18/57. Varanasi: Chaukhambha Vishvabharati, 2010; 219.
19. Sharma PV. *Susruta Samhita (English Translation)*. Vol. III, Uttara Tantra, Chapter 18/68–73. Varanasi: Chaukhambha Vishvabharati, 2010; 222.
20. Murthy KRS. *Sarangadhara Samhita (English Translation)*. Uttara Khanda, Chapter 13/67. Varanasi: Chaukhambha Orientalia, 2012; 265.
21. Murthy KRS. *Ashtanga Hridayam (English Translation)*. Vol. I, Sutra Sthana, Chapter 23/23–24. Varanasi: Chowkhamba Krishnadas Academy, 2013; 280.
22. Sharma PV. *Susruta Samhita (English Translation)*. Vol. III, Uttara Tantra, Chapter 18/59–60. Varanasi: Chaukhambha Vishvabharati, 2010; 220.
23. Murthy KRS. *Sarangadhara Samhita (English Translation)*. Uttara Khanda, Chapter 13/68–70. Varanasi: Chaukhambha Orientalia, 2012; 265.
24. Sharma PV. *Susruta Samhita (English Translation)*. Vol. III, Uttara Tantra, Chapter 18/64–67. Varanasi: Chaukhambha Vishvabharati, 2010; 221.
25. Murthy KRS. *Ashtanga Hridayam (English Translation)*. Vol. I, Sutra Sthana, Chapter 23/26–30. Varanasi: Chowkhamba Krishnadas Academy, 2013; 281.

26. Murthy KRS. *Ashtanga Hridayam (English Translation)*. Vol. I, Sutra Sthana, Chapter 23/25. Varanasi: Chowkhamba Krishnadas Academy, 2013; 281.
27. Sharma PV. *Susruta Samhita (English Translation)*. Vol. III, Uttara Tantra, Chapter 18/75–83. Varanasi: Chaukhambha Vishvabharati, 2010; 223.
28. Sharma PV. *Susruta Samhita (English Translation)*. Vol. III, Uttara Tantra, Chapter 18/62–63. Varanasi: Chaukhambha Vishvabharati, 2010; 220.
29. Murthy KRS. *Ashtanga Hridayam (English Translation)*. Vol. I, Sutra Sthana, Chapter 23/12–13. Varanasi: Chowkhamba Krishnadas Academy, 2013; 278.
30. Murthy KRS. *Bhavaprakasha (English Translation)*. Vol. I, Purva Khanda, Chapter 7/205–206. Varanasi: Chowkhamba Krishnadas Academy, 2011; 622.
31. Ananthula HK, Vaishya RD, Barot M, Mitra AK. Bioavailability. In: Tasman W, Jaeger EA, editors. *Duane's Ophthalmology*. Philadelphia: Lippincott Williams & Wilkins, 2009.
32. Urtti A, Salminen L. Minimizing systemic absorption of topically administered ophthalmic drugs. Surv Ophthalmol., 1993; 37: 435–457.
33. Gipson IK, Argueso P. Role of mucins in the function of the corneal and conjunctival epithelia. Int Rev Cytol., 2003; 231: 1–49.
34. Ahmed I. The noncorneal route in ocular drug delivery. In: Mitra AK, editor. *Ophthalmic Drug Delivery Systems*. New York: Marcel Dekker, 2003; 335–363.
35. Gupta SK, et al. *Textbook of Clinical Ocular Pharmacology and Therapeutics*. 1st ed. New Delhi: Jaypee Brothers Medical Publishers, 2014; 29–49.
36. Hornof M, Toropainen E, Urtti A. Cell culture models of the ocular barriers. Eur J Pharm Biopharm., 2005; 60: 207–225.
37. Huang HS, Schoenwald RD, Lach JL. Corneal penetration behavior of beta-blockers. J Pharm Sci., 1983; 72: 1272–1279.
38. Tangri P, Khurana S. Basics of ocular drug delivery systems. Int J Res Pharm Biomed Sci., 2011; 2(4): 1541–1552.
39. Prausnitz MR, Noonan JS. Permeability of cornea, sclera, and conjunctiva: a literature analysis for drug delivery to the eye. J Pharm Sci., 1998; 87: 1479–1488.
40. Hämäläinen KM, Kontturi K, Murtomäki L, Auriola S, Urtti A. Estimation of pore size and porosity of biomembranes from permeability measurements. J Control Release, 1997; 49: 97–104.
41. Geroski DH, Edelhauser HF. Transscleral drug delivery for posterior segment disease. Adv Drug Deliv Rev., 2001; 52(1): 37–48.

42. Urtti A, et al. Systemic absorption of ocular pilocarpine is modified by polymer matrices. Int J Pharm., 1985; 23(2): 147–161.
43. Ambati J, et al. Transscleral delivery of bioactive proteins to the choroid and retina. Invest Ophthalmol Vis Sci., 2000; 41(5): 1186–1191.
44. Lang J, Roehrs R, Jani R. Ophthalmic preparations. In: *Remington: The Science and Practice of Pharmacy*. 21st ed. Philadelphia: Lippincott Williams & Wilkins, 2009; 856.
45. Gupta SK, et al. Ophthalmic formulations and ocular drug delivery. In: *Textbook of Clinical Ocular Pharmacology and Therapeutics*. 1st ed. New Delhi: Jaypee Brothers Medical Publishers, 2014; 65–86.
46. Gamage KS, Fiaz S, Kumar SP. Review of Anjana (Corrylium) procedure and its probable mode of action. Int J Ayurveda Pharma Res., 2016; 4(7): 34–42.