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Review Article

EFFICACY OF *KRIYAKALPA* IN OCULAR DISORDERS - AN INTEGRATIVE REVIEW

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ABSTRACT

The complex anatomical and physiological defence mechanisms of the eye make ocular medication delivery a significant therapeutic challenge. Drug penetration and bioavailability are significantly limited, especially to the posterior segment, by static barriers like the cornea, sclera, retina, blood–aqueous barrier, and blood–retinal barrier, as well as dynamic factors like tear turnover, conjunctival–choroidal circulation, and lymphatic drainage. In Ayurveda, *Kriyakalpa*- specialized local ocular therapeutic methods intended for focused and prolonged medication delivery- is used in *Shalakya Tantra* to methodically deal with these challenges. Based on *Dosha* predominance, disease stage, and tissue involvement level, therapeutic modalities including *Aschyotana*, *Seka, Anjana, Tarpana, Putapaka, Bidalaka*, and *Pindi* are thoughtfully adopted. *Kriyakalpa* exhibits processes similar to increased residence time, improved transcorneal and transscleral penetration, and decreased systemic absorption when examined through the lens of current pharmacokinetics. *Kriyakalpa* has been shown to have significant therapeutic effects in situations including xerophthalmia, inflammatory ocular disorders, refractive abnormalities, and degenerative diseases affecting the posterior segment, according to traditional Ayurvedic literature and new clinical and experimental research. This integrative synthesis shows *Kriyakalpa* as a clinically applicable and scientifically sound approach to overcoming ocular drug delivery obstacles present in contemporary ophthalmic practice.

INTRODUCTION

Social interactions, productivity, and quality of life all depend on vision. Ocular health is highly valued in traditional Ayurvedic literature, which declares that *"Sarvendriyanam Nayanam Pradhanam"*- the eye is the most vital of all sense organs. In addition to impairing functional ability, visual impairment has a negative impact on social and psychological well-being. The three main categories of Ayurvedic treatments are *Shastrapranidhana* (surgical measures), *Bahyaparimarjana* (external therapies), and *Antahparimarjana* (interior therapies). For the treatment of *Netra Rogas, Acharyas* focused on localised ocular interventions called *Kriyakalpa* because of the sensitive structure of the eye and its natural protective barriers.

Topical administration is still the most popular method of ocular medication delivery in contemporary ophthalmology. However, because of vascular clearance, corneal impermeability, and quick tear turnover, traditional eye drops have low bioavailability. These issues are similar to those identified centuries ago in Ayurveda, when tissue specificity, medication retention, and penetration were critical to therapeutic efficacy. As a result, *Kriyakalpa* is an early yet advanced model of site-specific ocular medication delivery that substantially resembles modern pharmacokinetic concepts.

MATERIAL AND METHOD

We gathered, systematically reviewed, and critically examined relevant works on modern ocular drug-delivery barriers, its Ayurvedic perspective, and *Kriyakalpa* from different Samhita and published sources.

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Ocular drug delivery issues are divided into the following categories by modern pharmacology: static barriers, which include the cornea, sclera, retina, blood–aqueous barrier, and blood–retinal barrier. Dynamic obstacles; Efflux transporters, lymphatic drainage, conjunctival–choroidal blood flow, blinking, and tear turnover. Particularly in posterior segment problems, these obstacles significantly limit medication entry and lower ocular bioavailability. Through the ideas of *Netra Raksha, Avarana*, and exact therapeutic localisation accomplished through *Kriyakalpa*, Ayurveda subtly recognises these difficulties.

Overview of *Kriyakalpa* modalities and Their Pharmacokinetic Correlation

Aschyotana

Injecting therapeutic solutions into the conjunctival sac, which works well for acute and early inflammatory diseases. Through repeated regulated dosing, it counteracts fast tear dilution.

Seka

Drug contact duration is extended and superficial tissue absorption is improved by continuously pouring medicinal solutions over closed eyes.

Anjana

Collyrium is applied over the palpebral conjunctiva to provide deeper penetration and sustained release, which is theoretically similar to semi-solid ocular formulations.

Tarpana

Ghrita preparations based on lipids are applied to the cornea and left there for a predetermined amount of time. Similar to sustained-release medication delivery systems, its *Snigdha, Sukshma*, and *Yogavahi* qualities promote trans-corneal diffusion and extended residence time.

Putapaka

Concentrated extracts are used to improve pharmacodynamic response and revitalise ocular tissues after *Tarpana*.

By avoiding intraocular obstacles and minimising systemic exposure, *Bidalaka* and *Pindi* external applications over the eyelids enable transdermal and trans-palpebral absorption.

***Kriyakalpa's* Clinical Effectiveness in Ocular Pathologies**

Xerophthalmia (Dry Eye Syndrome)

Clinical research shows that *Ghrita*-based *Tarpana* significantly improves tear film integrity, epithelium hydration, and ocular comfort because of its amphiphilic and unctuous qualities. Due to tear film instability, aqueous insufficiency, and increased evaporation, prolonged screen time in the current digital era has significantly increased the prevalence of Dry Eye Syndrome. The use of artificial tear substitutes, which are frequently expensive and only offer temporary symptom alleviation, is a major component of conventional therapy. An efficient, affordable, and long-lasting Ayurvedic substitute is *Netra Tarpana* with *Jeevantyadi Ghrita. Ghrita's Yogavahi* and *Sukshma* qualities, along with its extended tissue contact duration, allow the drug to enter deeper ocular *Dhatus* and tiny tear film channels, increasing bioavailability. *Ghrita's* lipophilic properties promote natural lacrimation, stabilise the tear film's lipid layer, lower evaporation, and nourish the cornea and conjunctiva. *Netra Tarpana* improves ocular nourishment, increases *Ojas*, and offers long-lasting relief in severe Dry Eye Syndrome when paired with *Vata-shamana* and *Chakshushya* therapies.

Ametropia

Anjana treatments have improved corneal topography and visual acuity, indicating adjustment of accommodative parameters and tear film optics. Myopia is associated with *Prathama* and *Dviteeya Patalagata* Timira in Ayurvedic literature. Preliminary clinical observations have shown that *Anjana Kriyakalpa*, especially *Pathyadi Varti Anjana*, has improved visual acuity and optical quality. Although further well-planned clinical trials are needed for scientific validation, this highlights its potential usefulness as a supportive treatment modality in the therapy of myopia.

Inflammatory Ocular Disorders

By locally suppressing inflammatory mediators, *Ashyotana, Seka, Vidalaka*, and *Pindi* successfully reduce redness, itching, and inflammation. In the *Amavastha* of *Netra Rogas*, where acute inflammation is predominant, *Vidalaka* is especially helpful. Because of the extended contact time and the skin permeability of the eyelids, it facilitates quick drug absorption, increasing local bioavailability. *Vidalaka* has a calming effect and offers rapid symptom relief. It is quite useful in treating acute inflammatory ocular diseases because it allows for deeper penetration into ocular tissues when paired with *Ghrita* or *Madhu*. Disorders of the posterior segment and degeneration. Because of their deeper tissue penetration and prolonged nutrition, *Tarpana* and *Putapaka* show promise in degenerative retinal diseases.

Degenerative and Posterior Segment Disorders

Drug entry to posterior ocular tissues is severely restricted by the blood–retinal barrier. Ayurveda involves systemic *Shamana* and *Shodhana* measures in in combination with repeated and prolonged local therapies to treat *Drishti-gata Rogas*.

Because of their deeper tissue penetration, lipid solubility, cumulative exposure, and prolonged feeding, *Tarpana* and *Putapaka* show promise in degenerative retinal diseases.

Correlations in Pharmacokinetics

Three main absorption routes are recognised by contemporary ocular pharmacokinetics:

- Corneal route: Beneficial for lipophilic medications; *Ghrita*-based treatments reflect this.
- Conjunctival–scleral route: Enables bigger molecules to diffuse into deeper tissues.
- Posterior diffusion: Improved by lipid solubility and extended contact. *Sukshma, Snigdha, Yogavahi*, and *Rasayana* are Ayurvedic qualities that correspond with increased permeability, extended residence time, and regenerative action.

Benefits of External *Kriyakalpa* and Adjunctive *Pindi* is particularly helpful for inflammatory disorders and eye damage. The procedure's mild pressure helps to lower intraocular pressure (IOP) by promoting local vasodilatation and enhancing aqueous humour outflow. It is a useful adjunct in traumatic and inflammatory *Netra Rogas* because of its combination mechanical and pharmacological activity, which helps to reduce inflammation, oedema, and ocular pain.

DISCUSSION

Kriyakalpa is a framework for ocular medicine delivery that is scientifically sound. While retentive techniques allow for deeper penetration, superficial modalities treat disorders of the anterior segment. Modern pharmacokinetic concepts like extended residence time, improved tissue permeability, and sustained drug release can logically explain the efficacy of treatments like *Netra Tarpana, Anjana, Vidalaka*, and *Pindi*. The research base for *Kriyakalpa* is strengthened by this integrated understanding, which also emphasises its applicability in modern, individualised, and integrative ophthalmic practice.

CONCLUSION

A key component of Ayurvedic ophthalmology, *Kriyakalpa* provides focused, long-lasting, and efficient ocular treatment. Its use in contemporary integrative ophthalmology practice is confirmed by its capacity to transcend physiological and anatomical limitations. Strong pharmacological plausibility and therapeutic significance are shown by treatments like *Pindi* in traumatic and pressure-related ocular diseases, *Vidalaka* in acute inflammatory states, *Anjana* in ametropia, and *Netra Tarpana* in severe dry eye syndrome. *Kriyakalpa* demands more scientific investigation and systematic incorporation into existing eye treatment procedures due to rising clinical and pharmacological data.

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