

PHARMACODYNAMICS OF TARPANA AND ITS UTILITY IN MANAGEMENT OF MYOPIA

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ABSTRACT

Nearsightedness, or myopia, is the most common refractive error of the eye, and it has become more prevalent in recent years. Nearsightedness can be corrected with glasses, contact lenses or refractive surgery. All these treatments are not much patient friendly and also not the actual solution to the pathology occurring in eye. Tarpana is one of the popular ocular therapies that is performed in Ayurveda and which is known to have a definite answer to the problem of Myopia. Thus it becomes necessary to explore the mode of action of Tarpana and give exact pharmacodynamics picture of the therapy so that its utility can be explained in scientific way. With this view an attempt was made to discover the scientific facts which can ascertain the Ayurvedic concepts. After a critical review of various researches, scientific texts and Ayurvedic classics it is concluded that Tarpana acts on the principle of Bahya Snehana. It can successfully cross the defensive barriers present in eye for absorption and nourishes the ocular and periocular structures, strengthens the sphincters & brings about changes in dioptric power and visual acuity.

Key words: Tarpana, Myopia, nearsightedness, Snehana.

INTRODUCTION:

Eyes hold special status among all the senses. Eyes are the most precious gift of the God to the living beings. Good vision is crucial for social and intellectual development of a person. Recent data suggests that a large number of people are blind in different parts of the world due to high refractive errors especially myopia. Various surveys in India have found the myopia prevalence ranging from 6.9% to 19.7%.^{1,2} Due to the significance of myopia as a global public health concern, it was chosen as a priority for Vision 2020,

World Health Organization's global initiative for the elimination of avoidable blindness by year 2020.³ Ayurvedic ocular therapies also known as Kriyakalpa are well known now a day in management of Myopia which is considered as Timira in Ayurveda. Among them also Tarpana is used frequently and classical references also justify the clinical utility of Tarpana in management of Myopia. Thus an attempt has been made to elaborate the clinical utility in management of myopia & to evaluate its pharmacodynamics in light of available scientific knowledge and under-

standing of the ocular therapies.

Ayurvedic concept of Tarpana:

The literary meaning of the Tarpana is to give nourishment to the eye through Ghruta, Ghruta Manda, medicated Ghruta, Vasa, Majja, (bone marrow), milk etc. Acharya Charaka in Sutrasthana Snehadhyaaya explained that “Snehoanilam Hanti” which means that Snehana is the supreme treatment for Vata Dosha.⁴ He mentioned Akshi - Tarpana as one of the 24 Snehapravicharana in Sutrasthana 13th chapter.⁵ Ghruta is used primarily for Tarpana. Ghruta is effective in subsiding Pittaja and Vataja disorders, it improves Dhatus and is overall booster for improving Ojas.⁶ The Ghruta has the quality of trespassing into minutest channels of the body. Hence when applied in the eye, it enters into deeper layer of Dhatus and cleanses every minutest part of them. Moreover, Ghruta due to its Sansakaranuvartana quality easily imbibes the properties of other drugs processed with it without leaving its own properties.⁷ Ghruta is also Sheeta Veerya, hence the eye being the site of Alochaka Pitta can be effectively managed by constantly using Ghee for Akshi Tarpana. Ghruta also contains properties like Balya, Brimhana and Rasayana, so it gives strength to the overall tissues of the eyeball as well as to the nervous tissues.

To provide nourishment the prerequisite is the absorption of drug through the ocular surface. But the eyes are supplied with variety of defence mechanisms for protection that offers the barrier in drug absorption.

Challenges in ocular drug delivery & Tarpana: Tarpana can also be considered as a route of ocular drug delivery through topical administration. For most of the topically applied drugs, the site of action is usually different layers of the cornea, conjunctiva, sclera, and the other tissues of

the anterior segment such as the iris and ciliary body (anterior uvea). Upon administration, precorneal factors and anatomical barriers negatively affect the bioavailability of topical formulations.

Pre-corneal factors include:⁸

- solution drainage,
- blinking,
- tear film,
- tear turn over, and
- induced lacrimation

Tear film, whose composition and amount are determinants of a healthy ocular surface, offers the first resistance due to its high turnover rate. Mucin present in the tear film plays a protective role by forming a hydrophilic layer that moves over the glycocalyx of the ocular surface and clears debris and pathogens.⁹ Human tear volume is estimated to be 7 µl, and the cul-de-sac can transiently contain around 30 µl of the administered ocular drug. However, tear film displays a rapid restoration time of 2–3 min, and most of the topically administered solutions are washed away within just 15–30 s after instillation. Considering all the precorneal factors, contact time with the absorptive membranes is lower, which is considered to be the primary reason for less than 5% of the applied dose reaching the intraocular tissues.¹⁰ In case of Tarpana the volume of drug retained over ocular surface is much higher in comparison to the eye drops thus mucin itself may get diluted by the Ghruta or any other Tarpana drug removing the hydrophilic layer barrier and provides more drug available for absorption. In addition, various layers of the cornea, conjunctiva, and sclera play an important role in drug permeation. The cornea, the anterior most layer of the eye, is a mechanical barrier which limits the entry of exogenous substances into the eye and protects the ocular tissues. It can be mainly divided into the

epithelium, stroma, and endothelium. Each layer offers a different polarity and a potential rate-limiting structure for drug permeation. The corneal epithelium is lipoidal in nature which contains 90% of the total cells in the cornea and poses a significant resistance for permeation of topically administered hydrophilic drugs. Furthermore, superficial corneal epithelial cells are joined to one another by desmosomes and are surrounded by ribbon-like tight junctional complexes (zonula occludens)^{11,12}. Presence of these tight junctional complexes retards paracellular drug permeation from the tear film into intercellular spaces of the epithelium as well as inner layers of the cornea. Tarpana is mostly done with lipophilic drugs in the form of Ghruta, Vasa etc. thus it can be well absorbed through lipoidal membrane and also it can nourish this membrane so that its function gets improved. Moreover, Tarpana is done in lukewarm form that may dilate the tight junctional complexes thus allowing paracellular drug permeation. The stroma, which comprises 90% of the corneal thickness, is made up of an extracellular matrix and consists of a lamellar arrangement of collagen fibrils. The highly hydrated structure of the stroma poses a significant barrier to permeation of lipophilic drug molecules. Endothelium is the innermost monolayer of hexagonal-shaped cells. Even though endothelium is a separating barrier between the stroma and aqueous humor, it helps maintain the aqueous humor and corneal transparency due to its selective carrier-mediated transport and secretory function.¹³ Furthermore, the corneal endothelial junctions are leaky and facilitate the passage of macromolecules between the aqueous humor and stroma.¹⁴ Thus, corneal layers, particularly the epithelium and stroma, are considered as major barriers for ocular drug

delivery. It is vital to understand that the permeant should have an amphipathic nature in order to permeate through these layers. Certain drugs used for Tarpana like Siddha Kshira are of this nature. Compared to cornea, conjunctival drug absorption is considered to be nonproductive due to the presence of conjunctival blood capillaries and lymphatics, which can cause significant drug loss into the systemic circulation thereby lowering ocular bioavailability. Conjunctival epithelial tight junctions can further retard passive movement of hydrophilic molecules.¹⁵ However, in Tarpana the drug used is significantly in high dose that can give enough bioavailability even after the loss in systemic circulation or in other words it can act both locally and systemically. The sclera, which is continuous with the cornea originates from the limbus and extends posteriorly throughout the remainder of the globe. The sclera mainly consists of collagen fibers and proteoglycans embedded in an extracellular matrix. Permeability through the sclera is considered to be comparable to that of the corneal stroma. Recent reports indicate that the permeability of drug molecules across the sclera is inversely proportional to the molecular radius.¹⁶ Tarpana when did with Siddha Ghruta, it contains more small chain fatty acids having small molecular radius than the long chain fatty acids. Thus, they may get readily absorbed.

Pressure effect and refractive index:

Tarpana exerts extraocular pressure to the lens thus increasing its axial length. Though this pressure effect is transient but due to the oleation and hydration provided by Tarpana may improve the accommodation which can retain this pressure effect for longer duration.

More contact time: Ghruta preparations used in Akshi-Tarpana are in the form of

suspension containing different particles of the drugs and the particles do not leave the eye as quick as solution. Tissue contact time and bio availability is more hence therapeutic concentration can be achieved by Akshi – Tarpana.

Accommodation and visual acuity: Accommodation is the ability of the eye to change the refractive power of the lens to automatically focus on objects at various

distances. It is a complex constellation of sensory, neuromuscular and biophysical phenomena by which the overall refracting power of the eye changes rapidly to image objects at different viewing distances clearly on to the retina.¹⁷ Tarpana may act over accommodation capacity of eye by providing nutrition not only to the cornea but also to the sphincter muscles and nerves innervating it.

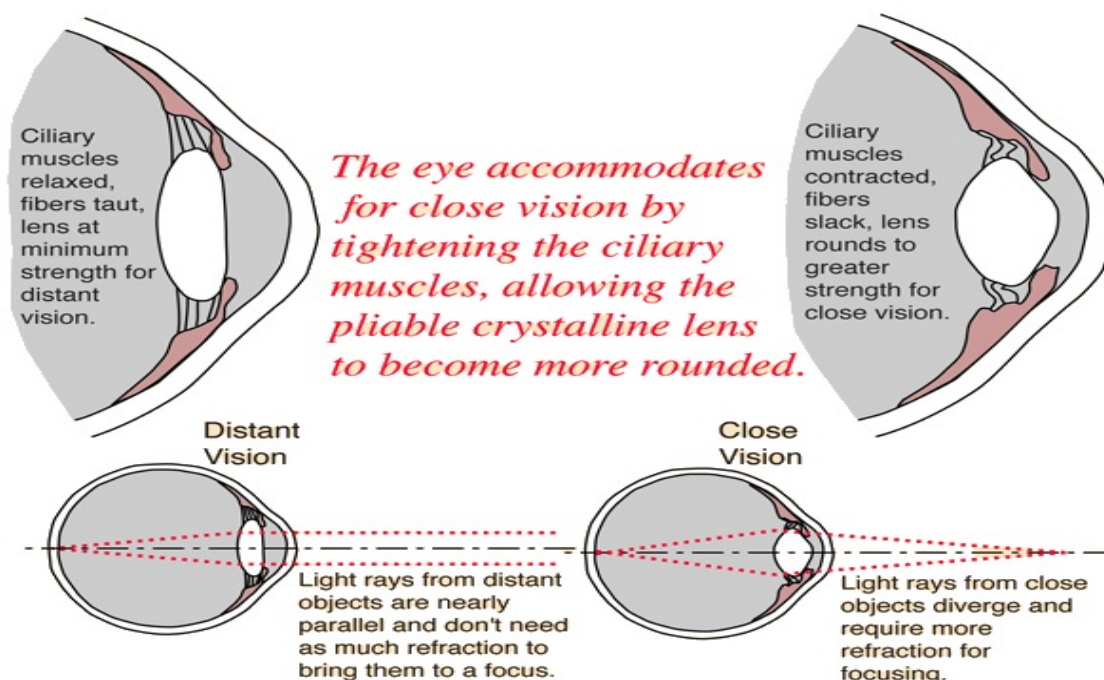


Fig 1: changes in lens shape by accommodation for distant and close vision

Nutritional supplement from Tarpana drugs: Ghruta is used widely for Tarpana which contains mainly omega-3 & 6 fatty acids, Vit A, E & K & antioxidants.¹⁸ Milk is also used for Tarpana which contain variety of Vitamins, minerals, amino acids etc.¹⁹

Review of researches to understand the clinical utility:^{20,21,22,23,24}

Tarpana is used in Shalakya – a branch of Ashtang Ayurveda to treat mainly Myopia. Variety of Tarpana formulations have been tried in various researches. Its clinical utility can be understood by reviewing these researches.

The dioptric power of the spherical lens was reduced by 9 to 20 % in most of the researches. Durastha Avyakta Darshana or indistinct distant vision, Netrasrava, Netradaha , Netrayasa , and Shirobhitapa were reduced statistically significantly (P<0.001). clinical refraction, for spherical lens, average improvement of 14-26 % can be achieved through Tarpana. In old myopes also about 20% improvements can be seen with Tarpana. Jeevantyadi Ghruta, Triphala Ghruta, Go-Ghruta, Ghrutamanda, Patoladi Ghruta have been used in various researches.

CONCLUSION:

After reviewing various researches and available scientific data regarding Tarpana it can be concluded that, Tarpana is a superior therapy than merely using eye drops. Tarpana acts on the principle of Bahya Snehana. It can successfully cross the defensive barriers present in eye for absorption and nourishes the ocular and periocular structures & also strengthens the sphincters. On virtue of drug utilised for Tarpana it also provides nutrition directly to the target organ. Changes in dioptric power and visual acuity are evident hence can be used for successful management of myopia.

REFERENCES:

- Jain IS, Jain S, Mohan K. The epidemiology of high myopia-changing trends. *Indian J Ophthalmol* 1983;31:723-8
- Mohan M, Pakrasi S, Zutshi R. Myopia in India. *ActaOphthalmolSuppl* 1988;185:19-23.
- McCarty CA, Taylor HR. Myopia and vision 2020. *Am J Ophthalmol* 2000;129:525-7
- Agnivesha, Charakasamhita. Varanasi, India: Chaukhamba Sanskrit Series; 2004. Charaka Siddhithana. 1/7, P 678
- Agnivesha, Charakasamhita. Varanasi, India: Chaukhamba Sanskrit Series; 2004. Charaka Sutrasthana. 13/25, P 83
- Agnivesha, Charak Samhita, Rashtrita Sanskrita Sansthan, New delhi, reprint 2006; sutrasthana13 / 14
- Agnivesha, Charakasamhita. Varanasi, India: Chaukhamba Sanskrit Series; 2004. Charaka Sutrasthana. 13/13, P 82
- Ananthula HK, Vaishya RD, Barot M, Mitra AK. Duane's Ophthalmology. In: Tasman W, Jaeger EA, editors. Bioavailability. Philadelphia: Lippincott Williams & Wilkins; 2009
- Gipson IK, Argueso P. Role of mucins in the function of the corneal and conjunctival epithelia. *Int Rev Cytol.* 2003;231:1-49. doi: 10.1016/S0074-7696(03)31001-0.
- Ahmed I. The noncorneal route in ocular drug delivery. In: Mitra AK, editor. Ophthalmic drug delivery systems. New York: Marcel Dekker; 2003. pp. 335-63
- Klyce SD, Crosson CE. Transport processes across the rabbit corneal epithelium: a review. *Curr Eye Res.*1985;4(4):323-31. doi: 10.3109/02713688509025145
- McLaughlin BJ, Caldwell RB, Sasaki Y, Wood TO. Freeze-fracture quantitative comparison of rabbit corneal epithelial and endothelial membranes. *Curr Eye Res.* 1985;4(9):951-61. doi: 10.3109/02713689509000002
- Barar J, Javadzadeh AR, Omid Y. Ocular novel drug delivery: impacts of membranes and barriers. *Expert Opin Drug Deliv.* 2008;5(5):567-81. doi: 10.1517/17425247.5.5.567.
- Sunkara GK. Membrane transport processes in the eye. In: Mitra AK, editor. Ophthalmic drug delivery systems. New York: Marcel Dekker, Inc; 2003. pp. 13-58
- Saha P, Kim KJ, Lee VH. A primary culture model of rabbit conjunctival epithelial cells exhibiting tight barrier properties. *Curr Eye Res.* 1996;15(12):1163-9. doi: 10.3109/02713689608995151.
- Geroski DH, Edelhauser HF. Transscleral drug delivery for posterior segment disease. *Adv Drug Deliv Rev.* 2001;52(1):37-48. doi: 10.1016/S0169-409X(01)00193-4.
- Kaufman PL. Accommodation and Presbyopia: Neuromuscular and Biophysical Aspects, in Hart WM, editors: Adler's Physiology of the eye: 9th Ed. St Louis: CV Mosby; 1994. p. 391-411.
- https://en.wikipedia.org/wiki/Ghee#cite_note-16 retrieved on 21 feb 2016
- <https://en.wikipedia.org/wiki/Milk> retrieved on 21 feb 2016
- Durgesh Prasad Gupta¹, Manjusha Rajagopala², Kartar Singh Dhiman A clinical study on Akshitarpana and combination of Akshitarpana with Nasya therapy

- in Timira with special reference to myopia AYU, 2010;31:473-7.
21. Poonam, R. Manjusha, D. B. Vaghela, and V. J. Shukla A clinical study on the role of Akshi Tarpana with Jeevantyadi Ghrita in Timira (Myopia) Ayu. 2011 Oct-Dec; 32(4): 540–545
22. Poonam, R. Manjusha, D. B. Vaghela, and V. J. Shukla A clinical study on the role of Akshi Tarpana with Jeevantyadi Ghrita in Timira (Myopia) Ayu. 2011 Oct-Dec; 32(4): 540–545
23. Manesh Kumar, a comparative study on the efficacy of Tarpana and Triphaladi drug compound in the management of Timira w.s.r. to myopia, MD Thesis, IPGT & RA, Jamnagar, 2003
24. Vinayaka Ashu, A clinical study on the efficacy of Tarpana and Shatavaryadi churna in the management of Timira w.s.r. to Myopia. MD Thesis, IPGT & RA, Jamnagar, 2004

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