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EXPLORING THE NETRA PATALA AND ITS INTER-RELATIONSHIP WITH VISION

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ABSTRACT

The exploration of *Netra Patala* within *Ayurveda* frameworks presents a captivating synthesis of ancient wisdom and modern scientific understanding, delving into the essence of ocular health. By meticulously analysing Ayurveda texts and integrating with contemporary ophthalmology, a profound correlation emerges, shedding light on the intricate mechanisms underlying vision and its disorders.

Netra Patala, elucidated by luminaries like *Acharya Sushruta* and *Acharya Dalhana*, serves as the cornerstone of vision in *Ayurveda*, encompassing both anatomical and functional dimensions. Disturbances within these layers manifest a spectrum of vision-related ailments known as *Timira Vyadi*, affecting *Drishti* or *vision*. The symbiotic relationship between *Patala* and *Drishti* reveals the profound interplay between anatomical structures and visual function, with dysfunction in *Netra Patala* directly impacting vision. This convergence with modern neurology underscores the intricate neural circuitry underlying vision perception, transcending mere anatomical entities and embodying a holistic paradigm of ocular function and perception.

The breakdown of *Netra Patala* highlights the sequential involvement of anatomical and neural structures, from the outermost to the innermost layers of the eye, elucidating their roles in the complex process of vision perception. *Pratham Patala* encompasses the Iris, ciliary

muscles, and associated nerves, extending to the pre-tectal nucleus and its pathways. *Dwitiya Patala* involves the extra-ocular muscles and related nerves, connecting to the Superior colliculus. *Tritiya Patala* comprises the retina, optic nerve, and optic pathway extending to the visual cortex, with emphasis on sparing the posterior-most part. *Chaturth Patala* encompasses the fovea and macula, along with optic nerve fibres transmitting information to the visual cortex.

In essence, the exploration of *Netra Patala* within *Ayurveda* unveils profound insights into the anatomical and therapeutic dimensions of vision disorders. Integrating these insights with modern ophthalmology enriches our understanding of ocular health and underscores the holistic approach essential for optimal vision care.

KEYWORDS: *Netra Sharir, Netra Patala, Drishti*, Ayurveda eye anatomy, eye structure.

INTRODUCTION

In *Ayurveda*, the intricate concepts of *Drishti* (Vision) and *Netra Patala* (Ocular layers) have been elucidated by eminent scholars such as *Acharya Sushruta* and *Acharya Dalhana*. These concepts form the foundational framework for understanding ocular health and vision-related disorders. Through a comprehensive exploration, we aim to bridge the insights from *Ayurveda* teachings with modern ophthalmological perspectives.

Netra Patala, integral to the *Netra Sharir* (Ocular system), serves as a crucial component in the manifestation of vision-related ailments like *Timira* (Blurring of vision), *Kancha* (Hazy vision), and *Lingnasha* (Loss of vision).[1] *Acharya Dalhana* emphasized the fundamental role of *Netra Patala* in the pathogenesis of vision disorders, establishing its significance in Ayurvedic therapeutics.[2]

Furthermore, the *Samprapti* (Pathogenesis) of *Timira* involves disturbances in the Netra Sira, indicating a neural basis for vision disorders. The term "*Roopavahi Sira*"[3] suggests a neural pathway responsible for vision perception rather than solely a vascular supply, aligning with modern neurology's understanding of ocular functions.

To Understand the intricate interplay between *Netra Patala* and vision perception an examination of the mechanisms underlying vision through the lens of modern ophthalmology is needed. This article aims to delve into each neural pathway of the eye, elucidating their roles in vision perception and their potential connections to the lower limbs and feet. By

bridging ancient Ayurvedic wisdom with modern ophthalmological insights, we strive to enhance our understanding of ocular health and pave the way for holistic approaches to vision care.

Pratham patala

The dilation and constriction of the pupil play a critical role in achieving clear vision. When focusing on a distant object, a fully constricted pupil (Approximately 2 mm in diameter) enables sharp vision from around 2 meters to infinity, while a fully dilated pupil (Approximately 8 mm in diameter) allows sharp vision from about 7 meters to infinity.[4]

Similarly, the accommodation of the lens is crucial in optics to ensure that the image forms precisely on the retina. A thinner lens can result in the image forming behind the retina, as seen in hypermetropia, while an overly spherical lens may cause the image to form in front of the retina, as observed in myopia. Improper maintenance of pupil size and lens shape can lead to blurred vision, a symptom described by A*charya Sushruta* as "*Avyakta Darshana*"[5] in *Pratham Patalagata Timira*. *Acharya Dalhana* further notes that this symptom may not always be present; sometimes, vision remains completely normal. This is especially evident when environmental lighting conditions are optimal, requiring minimal adjustment of pupil size or lens shape for clear image formation.

Furthermore, considering the location of the first *Patala*, which is described as being in the outermost part of the eye (*Bahaya*) and *Tejo-Jala Ashrita*, it appears that the iris (Which regulates pupil size) and ciliary muscles (Responsible for lens accommodation) are part of the *Prathama Patala*. However, their functioning relies heavily on the short and long ciliary nerves and their neural pathway, involving the hypothalamus and pre-tectal nucleus in the mid-brain, suggesting a functional association with the *Pratham Patala*.

Moreover, changes in the refractive index of the aqueous humor in this region can also cause blurred vision. The production of aqueous humor is controlled by the ciliary body, which is innervated by the long and short ciliary nerves. Thus, considering the entire neural pathway of these nerves and their associated structures in the eye and brain as part of the *Pratham Patala* seems appropriate.

Additionally, *Acharya Dalhana* identified the first *Patala* as *Rakta Ashrita*. Given the close relationship between the ciliary body, iris, and aqueous humor, which is produced through the choroid plexus, this aligns with the characterization of the *Pratham Patala* as *Rakta Ashrita*.

Since the functions of lens accommodation, pupil size maintenance, and clarity of the aqueous humor are attributed to the *Pratham Patala*, it follows that all refractive errors should be considered as *Pratham Patalagata Vyadi*.

Dwitiya patala

The primary symptoms outlined in the second *patala* are[6]

- Perceptual distortions regarding distances, where objects may seem either closer or farther away than their actual positions.
- Challenges experienced in threading a needle, indicating difficulties in fine motor coordination.

In this scenario, the individual struggles to focus on a single object placed in front of their eyes and also experiences difficulties in depth perception. Now that we've understood the symptoms of *Dwitiya Patala*, let's explore the neural pathways involved in the optic tract related to near vision focusing.

The superior colliculus, situated in the tectal region of the midbrain, regulates eye movements through all three extraocular muscles via the accommodation and convergence pathway. The accommodation reflex directs visual attention to nearby objects, preventing double vision and enhancing depth perception through convergence and pupil constriction. It comprises components from both the central and peripheral nervous systems, including the visual association cortex, cerebellum, and the parasympathetic nervous system.

The reflex pathway involves the optic nerve, optic chiasm, optic tract, thalamic lateral geniculate nucleus, and visual cortex. Efferent signals originate from the Edinger-Westphal nucleus, controlling the pupil sphincter and ciliary muscles via the oculomotor nerve. The accommodation reflex functions through three primary responses

a. Convergence of both eyes is facilitated by the contraction of the medial rectus muscles and relaxation of the lateral recti. This ensures that the focus is maintained on the nearby object and accurately projected onto the fovea.

b. The contraction of the medial rectus muscles and relaxation of the lateral recti specifically contribute to maintaining focus on the nearby object.
c. Pupil constriction enhances depth of focus by preventing divergent rays from distant objects. In response to light and near fixation, pupil constriction decreases the amount of crystalline lens exposed, which is believed to expand the depth of field and enhance visual acuity.[7]

A classic sign of a lesion in this circuit is the inability to thread a needle, as precise image focus relies on an accurately functioning convergence and accommodation reflex. Additionally, conditions such as micropsia, macropsia, pelopsia, and teleopsia—all related to distortion of visual perceptions—occur when focusing is compromised. The Alice in Wonderland syndrome,[8] characterized by visual perception distortion, is a typical example of such lesions, with the posterior eye field being the main area affected.[9]

Given that the symptoms of convergence reflex lesion and *Dwitiya Patalagata Vyadi* are similar, it appears that the medial rectus muscle, the oculomotor nerve, the superior colliculus, the paramedian reticular formation of the pons, and the posterior eye field should be considered part of the *Dwitiya Patala*.

Furthermore, the superior colliculus is involved in regulating all extraocular muscles and their actions via the oculomotor, trochlear, and abducens nuclei in the midbrain and pons. While we've focused on the convergence reflex here due to its relevance to the symptomology of the second *Patala* described in *Ayurveda*, a comprehensive understanding of neural pathways, connections, and extraocular muscle function is essential for addressing conditions related to eye muscle paralysis (ophthalmoplegia) associated with *Dwitiya Patalagata Vyadi*.

Additionally, it's worth noting that the second *Patala* is described as *'Mamsa Ashrita*,' indicating involvement with the eye muscles.

To summarize, all extraocular muscles controlling eyeball movements, their associated nerves and nuclei, and the superior colliculus should be considered part of the *Dwitiya Patala*.

Tritiya patala

- All ocular conditions linked to the optic pathway manifest symptoms indicative of *Tritiya Patalagata Vyadi*.[10]
- According to the Sushruta Samhita, in Tritiya Patalagata Vyadi, the loss of vision aligns with the location of *Dosha* in *Drishti*. For instance, *Dosha* situated in the upper part of *Drishti* result in an inability to see below, and vice versa.
- Understanding visual field concepts, retinal fields, and optic nerve fibers reveals that light rays hitting the upper part of the retina originate from the lower visual field. These rays are processed via Barum's loop and reach the visual cortex at the upper bank of the calcarine fissure through the parietal lobe. Hence, any condition affecting the upper part of the retinal disc, genico-calcarine tract related to Barum's loop, or fibers along the pathway from the retina leads to vision loss below eye level, as seen in inferior Antopia.
- Conversely, light rays striking the lower part of the retina originate from the upper visual field, processed by Mayer's loop, and reach the lower bank of the calcarine fissure through the temporal lobe. Consequently, conditions affecting the genico-calcarine tract related to Mayer's loop result in vision loss above eye level, as observed in superior quadrantopia.
- According to *Acharya Sushruta*, widespread *Dosha* distribution leads to constricted vision. This occurs when damage affects the entire retinal disc, fibers, or visual cortex, except for the foveal part of the retina, central fibers in the optic nerve, or the posterior-most part of the visual cortex. Lesions sparing these areas result in constricted vision, as seen in conditions like Homonymous Hemianopia with Macular Sparing. Peripheral involvement of the fovea, associated fibers, and posterior visual cortex can lead to a condition where facial features are indistinguishable, as described by *Acharya Sushruta* in *Tritiya Patalagata Timira* symptoms, often indicating macular degeneration.
- Additionally, *Acharya Sushruta* notes that *Dosha* in the middle part cause double vision, while *Dosha* in two areas result in triple vision. Shifting *Dosha* locations lead to multiple images of a single object, indicating involvement of the secondary and tertiary visual cortex.
- Thus, an analysis of the symptomatology of *Tritiya Patalagata Timira* highlights its association with the retina, optic pathway, and visual cortex, excluding the macular region and posterior-most part associated with the fovea.

Chaturth patala

In the symptoms described by *Acharya Sushruta* for *Chaturth Patalgata Timira*, it's observed that the *Dosha* causes a complete obstruction of vision, leading to *Lingnasha*.[11] This typically occurs when there's extensive damage to the optic pathways, affecting the entire retina, including the macula, and the optic nerve due to internal or external factors. Additionally, conditions affecting the entire optic pathway or lesions in the visual cortex can also result in total blindness. It's interesting to note that *Acharya Sushruta* mentions that in the early stages of *Chaturth Patalgata Timira*, individuals may perceive exceptionally bright objects such as the sun or a torch. This resembles the experience of patients in the initial phases of macular degeneration before complete vision loss sets in. Consequently, it seems that the fourth *Patala* is associated with the Macula Lutea, which is the central region of the optic nerve and optic pathway, as well as the posterior part of the visual cortex responsible for macular function.

DISCUSSION

Unveiling the four *netra patala*

To fully grasp the structural aspect of *Patala*, *Netra Patala* are discussed in two contexts:

a. Structural aspect: This includes the tissue they are situated in and their location within the eye (From outer to inner).
b. Functional aspect: Association with different parts of vision according to *Timira Vyadhi* symptoms.

After a detailed examination of the four *Netra Patala* concerning vision and their related *Vyadhi*, it's evident that *Patala* cannot be seen as a single anatomical entity. Rather, it encompasses the entire neural circuit responsible for various aspects of visual perception.

Regarding the eye's structure, the following can be considered as the four *Patala* from outer to inner

1. ***Pratham patala*:** Includes the iris, ciliary muscles, short and long ciliary nerves.
2. ***Dwitiya patala*:** Comprises the extra-ocular muscles, oculomotor, trochlear, and abducens nerves.
3. ***Tritiya patala*:** Involves the retina without the fovea and the optic nerve.
4. ***Chaturth patala*:** Consists of the fovea, macula, and optic nerve fibers transmitting information from the fovea.

On the Functional and Clinical side, the four *Patala* must be understood as

1. ***Pratham patala*:** Involves the iris, ciliary muscles, short and long ciliary nerves, pre-tectal nucleus, and associated pathways.
2. ***Dwitiya patala*:** Comprises the extra-ocular muscles, oculomotor, trochlear, and abducens nerves, superior colliculus, and associated pathways.
3. ***Tritiya patala*:** Includes the retina without the fovea, the optic nerve, optic pathway, and visual cortex, excluding the posterior-most part.
4. ***Chaturth patala*:** Involves the fovea, macula, optic nerve fibers carrying information from the fovea, optic pathway, and the posterior-most part of the visual cortex.

It's intriguing to note a discrepancy in the descriptions of *Patala* by *Acharya Sushruta* and *Acharya Dalhana*. While *Acharya Sushruta* delineates them from outer to inner, *Acharya Dalhana* presents them from inner to outer when discussing *Patalagata Vyadi*. This observation aligns with my findings as well. For instance, anatomically, the Iris & ciliary muscles, Extra-ocular muscles, Retina, Fovea & Macula are positioned from outermost to innermost within the eyeball. However, functionally and clinically, the pre-tectal nucleus in the mid-brain, Superior colliculus, visual cortex, and the posterior-most part of the visual cortex are arranged from inner to outer in the brain.

Furthermore, examining the term *'Patala*,' it's formed by the combination of 'पट्' meaning 'to cover' or 'to spread,' and 'ला' meaning 'to give or take.' Consequently, *Patala* essentially denotes a structure that spreads and covers the entire eye, associated with the function of transmitting or receiving information from the eyes. This suggests that Patala shouldn't be viewed as a standalone structural entity.

In conclusion, the comprehensive depiction of the *Netra Patala* is summarized below

A. *1st Patala*

- Iris & ciliary muscles
- The short & long Ciliary nerves
- Pupillary reflex pathway
- Accommodation pathway
- Pathway for dilation of pupil
- Pathway for decreasing the convexity of the lens

- Pre-tectal nucleus in mid-brain

B. *2nd Patala*

- Extra-ocular muscles
- The oculomotor, trochlear and abducens nerves
- Superior colliculus
- The neural pathways associated with movement of eye ball

C. *3rd Patala*

- Retina without fovea
- Optic nerve
- The optic pathway
- Visual cortex sparing the posterior-most part

D. *4th Patala*

- Fovea & Macula
- Optic nerve fibers carrying information from fovea
- The posterior-most part of the visual cortex

CONCUSION

In conclusion, through meticulous analysis, a deep correlation emerges, unveiling intricate mechanisms underlying vision and its disorders. *Netra Patala*, elucidated by scholars like *Acharya Sushruta*, stands as a fundamental pillar of vision in *Ayurveda*, encompassing both anatomy and neural function. Dysfunction within these layers manifests as vision-related ailments, impacting *Drishti*. This convergence with modern neurology underscores the complexity of neural circuitry governing vision perception, emphasizing a holistic approach to ocular health. Integrating these insights enriches our understanding and care for vision disorders.

REFERENCES

1. Yadavji Trivikramji Acharya & Narayan Ram Acharya, Sushruta Samhita of Sushruta, Commentary of Dalhana, Nibandhasamgraha, Chaukhambha Sanskrit Sansthan, Varanasi Reprint Uttar tantra, chapter, 2009; 7: 5.

2. Yadavji Trivikramji Acharya & Narayan Ram Acharya, Sushruta Samhita of Sushruta, Commentary of Dalhana, Nibandhasamgraha, Chaukhambha Sanskrit Sansthan, Varanasi Reprint Uttar tantra, chapter, 2009; 1: 17-19.
3. Astangahrdayam composed by Vagbhata with the Vidyotini Hindi Commentary by Kaviraja Atrideva Gupta, Edited By Vaidya Yadunandana Upadhayaya, Published By Chaukhambh Prakashan Varanasi, Reprint edition Uttar tantra, chapter, 2009; 12: 1.
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6634360/#:~:text=While%20focusing%20on%20a%20point,7%20m%20distance%20to%20infinity.
5. Yadavji Trivikramji Acharya & Narayan Ram Acharya, Sushruta Samhita of Sushruta, Commentary of Dalhana, Nibandhasamgraha, Chaukhambha Sanskrit Sansthan, Varanasi Reprint; Uttar tantra, chapter, 2009; 7: 6-7.
6. Yadavji Trivikramji Acharya & Narayan Ram Acharya, Sushruta Samhita of Sushruta, Commentary of Dalhana, Nibandhasamgraha, Chaukhambha Sanskrit Sansthan, Varanasi Reprint; Uttar tantra, chapter, 2009; 7: 7-10.
7. Mathôt S. Pupillometry: psychology, physiology, and function. J Cogn, 2018; 1(1): 16. doi:10.5334/joc.18
8. Fricke TR, Tahhan N, Resnikoff S, et al. Global prevalence of presbyopia and vision impairment from uncorrected presbyopia: systematic review, meta-analysis, and modelling, Ophthalmology, 2018; 125(10): 1492-1499.
9. https://en.wikipedia.org/wiki/Alice_in_Wonderland_syndrome
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4302569/#:~:text=Alice%20in%20wonderland%20syndrome%20(AIWS,common%20perceptions%20are%20at%20night.
11. Yadavji Trivikramji Acharya & Narayan Ram Acharya, Sushruta Samhita of Sushruta, Commentary of Dalhana, Nibandhasamgraha, Chaukhambha Sanskrit Sansthan, Varanasi Reprint Uttar tantra, chapter, 2009; 7: 11-15.
12. Yadavji Trivikramji Acharya & Narayan Ram Acharya, Sushruta Samhita of Sushruta, Commentary of Dalhana, Nibandhasamgraha, Chaukhambha Sanskrit Sansthan, Varanasi Reprint; Uttar tantra, chapter, 2009; 7: 15-17.