



# Neuroplastic Effects of Trāṭaka Kriya: A Review of Visual-Attention Training and Its Implications for Myopia Management

Ayan Singh<sup>1</sup>, Hemant Kumar Kaushik<sup>2</sup> and Dr. Anuja Rawat<sup>3</sup>

<sup>1</sup> Ph.D. Scholar, Department of Naturopathy & Yoga, Hemvati Nandan Bahuguna Garhwal University, Srinagar, Garhwal, Uttarakhand, India.

<sup>2</sup> Ph.D. Scholar, Department of Naturopathy & Yoga, Hemvati Nandan Bahuguna Garhwal University, Srinagar, Garhwal, Uttarakhand, India.

<sup>3</sup> Associate Professor, Department of Naturopathy & Yoga, Hemvati Nandan Bahuguna Garhwal University, Srinagar, Garhwal, Uttarakhand, India.

<sup>1</sup> Author Email: [ayansinghrathour3@gmail.com](mailto:ayansinghrathour3@gmail.com)

<sup>2</sup> Author Email: [hkaushik209@gmail.com](mailto:hkaushik209@gmail.com)

<sup>3</sup> Corresponding Author Email: [dr.anujarawatyoga@gmail.com](mailto:dr.anujarawatyoga@gmail.com)

## ABSTRACT:

*Trāṭaka Kriya, a traditional yogic practice of visual concentration, has been recognized for enhancing mental focus and visual stability. Recently, scientific attention has focused on its potential to enhance neuroplasticity and support visual attention training, which may improve visual performance and aid in myopia management. However, scientific evidence on its neurocognitive and ocular effects remains limited and inconclusive. To analyze the neuroplastic effects of Trāṭaka Kriya and evaluate its potential as a relevant visual attention training technique for myopia management. A systematic literature search was conducted across several electronic databases to identify studies that examine the cognitive, psychological, and visual effects of Trāṭaka and related yogic practices. The initial search yielded 339 records, of which 116 duplicates were removed. After applying the eligibility criteria and screening, 5 studies were selected for final analysis. These studies included 334 participants aged 12-50 years and primarily employed randomized or controlled experimental designs, with intervention durations ranging from 8 to 12 weeks. The findings indicate that Trāṭaka-based interventions may enhance several neurocognitive functions, including attentional control, working memory, visuomotor coordination, and psychological well-being. These improvements suggest possible experience-dependent neuroplastic changes in neural networks related to attention and visual-motor processing.*

*However, current evidence remains limited regarding the direct effect of Trāṭaka on refractive error or the progression of myopia.*

**Keywords:** Trataka Kriya, Yoga, Visual Attention Training, Neuroplasticity, Neurocognition, Myopia, Ocular Health.

## **INTRODUCTION:**

The World Health Organization and global reports estimate that currently, at least 2.2 billion people worldwide have a vision impairment. Uncorrected refractive error (URE) is a significant cause of vision impairment worldwide (World Health Organization, 2019). Myopia, or nearsightedness, is a refractive error in which light focuses in front of the retina instead of directly on it, resulting in blurred vision of distant objects (Steinmetz et al., 2021). Myopia has become a widespread global health issue, especially affecting younger individuals (Liang et al., 2025). As of 2020, the worldwide population stands at 7.79 billion individuals, with 2.64 billion (33.9%) affected by myopia (Jong & Brennan, 2022). The global prevalence of myopia in children and adolescents has increased from ~ 24.3% in 1990 to ~ 35.8% in 2023 (Liang et al., 2025).

Myopia has increased dramatically across the globe in recent decades, and now it impacts a significant portion of the population. This trend is especially noticeable in East and Southeast Asia, where myopia affects 80-90% of young adults (Maulvi et al., 2025; Ng & Lai, 2022). Severe forms of myopia, including high and pathological myopia, are particularly worrisome because they increase the risk of permanent eye damage - such as scleral thinning, retinal and choroidal degeneration, and myopic maculopathy, which in turn, raises the risk of legal blindness and chronic vision loss. As a result, myopia is no longer just a simple vision problem but has become a critical public health concern with major consequences for blindness rates, quality of life, and healthcare systems worldwide (Bourke et al., 2023). Current myopia control and vision correction methods include optical approaches like orthokeratology, multifocal or defocused contact lenses, special glasses; drugs such as low-dose atropine; behavioural strategies like increasing outdoor time and reducing near work; newer methods like repeated red-light therapy; vision therapy; and refractive surgeries for stable myopia in older teens and adults, including radial keratotomy, PRK, and LASIK (Cho & Cheung, 2012; Lam et al., 2020; Zaabaar et al., 2025).

Optical methods like orthokeratology and peripheral-defocus lenses can slow myopia progression but require strict adherence and regular upkeep. They carry risks, including an increased likelihood of microbial keratitis, corneal staining, and other changes, especially with overnight lens use. These lenses may also reduce contrast sensitivity or impair low-light or peripheral vision (Liu & Xie, 2016; Maulvi et al., 2025). Low-dose atropine is commonly used for myopia management, but its exact mechanism remains unclear. Higher doses improve control but cause more side effects, such as light sensitivity, blurred near vision, and rebound after stopping. Long-term safety and optimal dosing, especially across various groups, remain uncertain (National Academies of Sciences, 2024). Behavioural and environmental strategies help prevent myopia but are less effective once myopia develops, offering limited slowing of its progression (Walline, 2016). New adjunctive therapies show promise in clinical trials for reducing axial elongation. However, as

these therapies are new, long-term data are limited, and their mechanisms and optimal procedures are still being studied(Zheng et al., 2025). Refractive surgeries like PRK and LASIK improve vision and reduce dependence on corrective lenses but carry risks such as dry eyes, glare, halos, incorrect correction, loss of effect over time, corneal haze or scarring, irregular astigmatism, and, rarely, reduced visual acuity. For severe myopia, removing substantial corneal tissue can weaken the cornea and increase the risk of long-term complications, such as ectasia(Shojaei et al., 2009).

Similarly, Yoga therapy, alongside other treatments, offers a safe, affordable, non-invasive option for myopia management suitable for all ages(Gupta & Aparna, 2020). It doesn't require medication, machines, or complex equipment and can be easily practiced at home, work, parks, or quiet places. Modified yoga forms are available for children, seniors, pregnant women, and those with special needs, making it a widely accessible and effective health approach(Gothe & McAuley, 2016; Sivaramakrishnan et al., 2019). In classical Hatha Yoga texts, Shatkarmas, or Ṣaṭkriyā, are six main purification techniques designed to cleanse the body and mind(Mukhopadhyay, 2023). These foundational practices aim to remove toxins, balance systems, and improve mental clarity. Techniques like Trāṭaka strengthen eye health by activating ocular muscles and reducing eye strain. Tratakā, one key method, involves steady gazing to stimulate the optic nerves, strengthen eye muscles, and enhance eye health (Swathi et al., 2021). It also promotes mental focus, emotional stability, and enhances awareness, linking external practice with internal meditation(Pramanik & Chatterjee, 2024).

Visual attention involves the brain's ability to focus on parts of a scene while ignoring others, filtering important information for deep processing(Evans et al., 2011; MANGUN, 1995). It enhances neural representation, binds feature into perceptions, and aids perception, recognition, and response. From a yogic view, Trāṭaka Kriya sharpens concentration. The study by Hyun et al. shows that the role of attention in binding surface-feature information to spatial locations in visual perception strengthens eye muscles, improves blood flow, and reduces strain, potentially leading to clearer vision (Hyun et al., 2009). Trāṭaka also promotes mental concentration and stabilizes the mind (yogic ekagrata). It enhances the brain's ability to focus on visual attention, helping the mind filter and integrate visual inputs. This supports healthy eye function and clearer, more stable vision (Pramanik & Chatterjee, 2024; Rajbhoj et al., 2024). In this context, neuroplasticity, the brain's ability to modify the visual cortex and neural circuits, occurs in the adult visual system(Gilbert & Li, 2012). Perceptual learning and attention-driven adaptations show that focused visual tasks cause synaptic remodelling, reorganization, and cortical changes in both low- and high-level areas (Horton et al., 2017). This demonstrates that the adult brain can change through new visual experiences or training(Consorti et al., 2022). Repeated sensory-motor feedback, sustained attention, fixation training, and increased awareness can induce neuroplasticity. Studies indicate that visual perceptual learning can improve visual acuity, binocular vision, stereopsis, and perception, even in those with ocular disorders or after corrective procedures(Tian et al., 2024; Tsaousis et al., 2024).

Trāṭaka Kriya involves repeated engagement of visual and attentional neural pathways through sustained gazing and focused attention. From a neuroplasticity perspective, such continuous visual-

attentional engagement may reinforce neural circuits related to visual attention, ocular-motor coordination, and visual information processing. Neuroplastic mechanisms enable the brain to reorganize and refine these neural networks in response to repeated experience and training (Polat, 2009; Tang et al., 2015).

In myopia management, prolonged near work and excessive screen exposure are known factors that can strain the visual system and disrupt normal visual-attentional functions. Yogic practices like Trāṭaka may improve attentional stability, visual endurance, and coordination between the eyes and the brain. These mechanisms suggest that practising Trāṭaka can support more efficient visual processing and helps maintain visual health (Rosenfield, 2011). Currently, direct empirical evidence that links neuroplastic changes in the brain to Trāṭaka practice and its specific effects on myopia management is lacking. However, existing literature suggests that one-pointed visual concentration enhances attention and induces adaptive changes in neural plasticity. These findings point to a plausible neurocognitive pathway through which Trāṭaka influences visual function. Therefore, this study addresses the gap and explores the relationship between Trāṭaka practice, neuroplastic adaptations in the brain, and their potential implications for individuals with myopia.

### Objectives of the study:

1. To explore the potential implications of Tratakā-induced neuroplasticity for myopia management, particularly in relation to visual strain, prolonged near-work activities, and to identify existing research gaps for future investigation.
2. To review the existing literature on Trāṭaka Kriya and related yogic visual concentration practices, with emphasis on their effects on neurocognitive functions such as attentional control, working memory, and cognitive regulation.
3. To examine the neuroplastic mechanisms associated with Trāṭaka practice, including its influence on visual processing, attentional networks, and eye-brain coordination, along with its effects on visual and visuomotor performance.

### Review of Literature:

#### 1. Ancient Literature:

In the Haṭha Yoga Pradīpikā, the classical foundational treatise on Hatha Yoga, it is stated that the practice of Trāṭaka eliminates all eye diseases (Saraswati, 2006).

निरीक्षेन्निश्चलदृशा सूक्ष्मलक्ष्यं समाहितः ।

अश्रुसंपातपर्यन्तमाचार्यैस्त्राटकं स्मृतम् ॥ (ह. प्र. २/३१)

मोचनं नेत्ररोगाणां तन्द्रादीनां कपाटकम् ।

यत्नतस्त्राटकं गोप्यं यथा हाटकपेटकम् ॥ (ह. प्र. २/३२)

The Gheranda Saṃhita also states that the practice of Trāṭaka eliminates all eye problems and grants divine sight (Saraswati, 2012).

त्राटकम् निमेषोन्मेषकं त्यक्त्वा सूक्ष्मलक्ष्यं निरीक्षयेत् ।

पतन्ति यवदश्रूणि त्राटकं प्रोच्यते बुधैः ॥ (घे. सं. ५३)

एवमभ्यासयोगेन शाम्भवी जायतेध्रुवम् ।

नेत्रदोषा विनश्यन्ति दिव्यदृष्टिः प्रजायते ॥ (घे. सं. ५३)

Trāṭaka improves concentration and memory by primarily influencing the ajna chakra and brain function. The practice requires the practitioner to focus the mind and restrain its restless tendencies. Its objective is to produce single-pointed mental focus, known as ekagrata, and to awaken inner vision. External distractions prevent the attainment of ekagrata because they engage the senses with the external environment, resulting in a loss of mental energy. In particular, visual associations and identification with external stimuli significantly contribute to this energy drain (Saraswati, 2012).

Another Hatha yogic text, Asana Pranayama Mudra Bandha, elaborates on the benefits of Tratakā, stating that regular practice of Tratakā Kriya enhances the clarity and brightness of the eyes. It helps regulate the nervous system and reduces nervous tension. Additionally, it supports memory improvement and fosters better concentration. It also stimulates the Ajna Chakra and serves as an effective preparation for meditation (Saraswati, 2009).

In the Hatha Ratnavali (1/54-55), Tratakā is described as the practice of steady, focused gazing at a subtle object with unwavering attention, without blinking, until tears flow. According to yogic authorities, this process is recognised as Tratakā. The practice is traditionally viewed as helpful for relieving eye disorders, reducing drowsiness, and enhancing overall visual and mental clarity (Gharote et al., 2002).

Also, Swami Rama discusses Tratakā Kriya within the framework of concentration and meditation techniques under chapter 4 in his book “In The Path of Fire and Light (Vol. 1)”. He describes Tratakā as a form of external gazing (bahir tratakā), in which the practitioner steadily focuses on a specific object. In particular, he highlights candle gazing as a common method in which attention is fixed on the flame without distraction. According to Swami Rama, the regular practice of Tratakā helps preserve and maintain good eyesight and provides resistance against ocular disorders. Furthermore, he notes that this practice strengthens the eye muscles, resulting in increased clarity and brightness and an overall enhancement in the appearance of the eyes (Rama, 1996).

## **2. Review of Scientific Literature:**

Kabir et al. (2021) conducted an experimental study to assess the effects of ocular exercises and yoga-based interventions on myopia. The intervention included eye exercises, Tratakā (Antarang and Bahirang), Yog Nidra, and Sarvangasana practiced over 3 weeks. The results showed significant improvement in those with low myopia, while the benefits were relatively limited in individuals with high or simple myopia (Kabir et al., 2021).

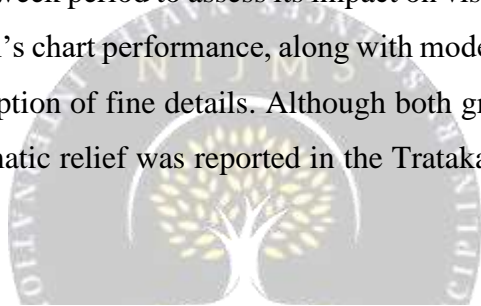
Similarly, Desai et al. (2020) did a randomized controlled trial to examine the effects of yogic eye exercises on myopia in students. The intervention involved practices such as palming, vertical and horizontal eye movements, Nasikagra, and Tratakā, over a period of 4 weeks. The study shows that yogic eye exercises improved refractive power in the experimental group, indicating potential clinical benefits of yoga in managing myopia (Desai et al., 2020).

A study by Tuteja and Singh (2020) employed a pre-post single-group experimental design to evaluate the impact of integrated yoga therapy on refractive errors. The intervention included Om chanting, Surya Namaskar, selected asanas, eye exercises, pranayama, palming, Snellen chart viewing, and

meditation. The study assessed subjective changes after the intervention and found that at the 3-month follow-up, self-assessment scores increased significantly, indicating that integrated yoga therapy enhanced ocular health among participants(Tuteja & Singh, 2020).

In the same way, Harnoorkar et al. (2016) conducted an experimental study to examine the effects of isolated and combined yoga therapy and Ayurveda practices on distant vision in individuals with myopia. The intervention protocol comprised eye exercises, Trataka, and palming to assess their impact on visual function. The findings indicated that the group receiving the combined Ayurveda and Yoga intervention demonstrated the most positive outcomes. A reduction in symptoms such as eye strain, burning sensation, and excessive tearing was observed across all groups. Furthermore, Trataka and eye exercises were found to enhance ocular muscle tone, highlighting their role in improving visual comfort and overall eye health(Harnoorkar & Rukmani., 2016).

Also, Gopinathan et al. (2012) conducted a clinical trial that evaluated the efficacy of Trataka Yoga Kriya and eye exercises as non-pharmacological methods for the management of Timira (ametropia and presbyopia). The study involved 66 participants, and the intervention, mainly focused on Trataka Yoga Kriya, was administered over a 3-week period to assess its impact on visual function. The findings revealed a one-line improvement in Snellen’s chart performance, along with moderate enhancement in visual clarity, contrast sensitivity, and the perception of fine details. Although both groups showed nearly similar levels of improvement, greater symptomatic relief was reported in the Trataka Yoga Kriya group(Gopinathan et al., 2012).



Author (Year)	Study Design	Participants (n, age)	Intervention & Duration	Outcome Measures	Key Findings
Baishya et al. (2025).	RCT (pre-post)	n=92 12-20 yrs	60 min, 3 days a week for 8 weeks (yoga module incl. Trāṭaka Kriya)	3 Attentional Network (alerting, orienting, conflict control)	yoga intervention significantly enhanced attentional control (orienting and conflict networks), improving focus and reducing cognitive-emotional distractions in competitive archers.
Yadav & Rathore (2022)	pre-post randomized experimental design	n=50, 18-25 yrs	Specific yoga module (1 hr/day) with Bhramari + Trāṭaka+ Jala Neti, 6 days per week for 12 weeks	Shooting Score ( Archery Shooting Test) Eye Hand Coordination Test	The experimental group showed a significant improvement in attention-related performance: higher shooting scores and fewer errors in the coordination task.
Sourori Khorashad (2024)	Randomized study + 3-month follow-up	n=40 12-15 yrs	Respiratory training, Postural training, Relaxation training, Concentration training(Trataka)	Selective & divided attention test (SDA); N-back (working memory, working memory capacity)	Yoga and Medication improved working memory and selective/divided attention, with a positive correlation to drug concentration.
Tiwari et al. (2018)	Randomized comparative study	n=48 18-25 yrs	Trāṭaka kriya for 8 weeks	Refractive error, visual acuity	Not significantly effective in reducing refractive errors and improving visual acuity.

Table 1: Published Study on Neuroplastic and Neurocognitive effects of Trataka Kriya.

## Methodology

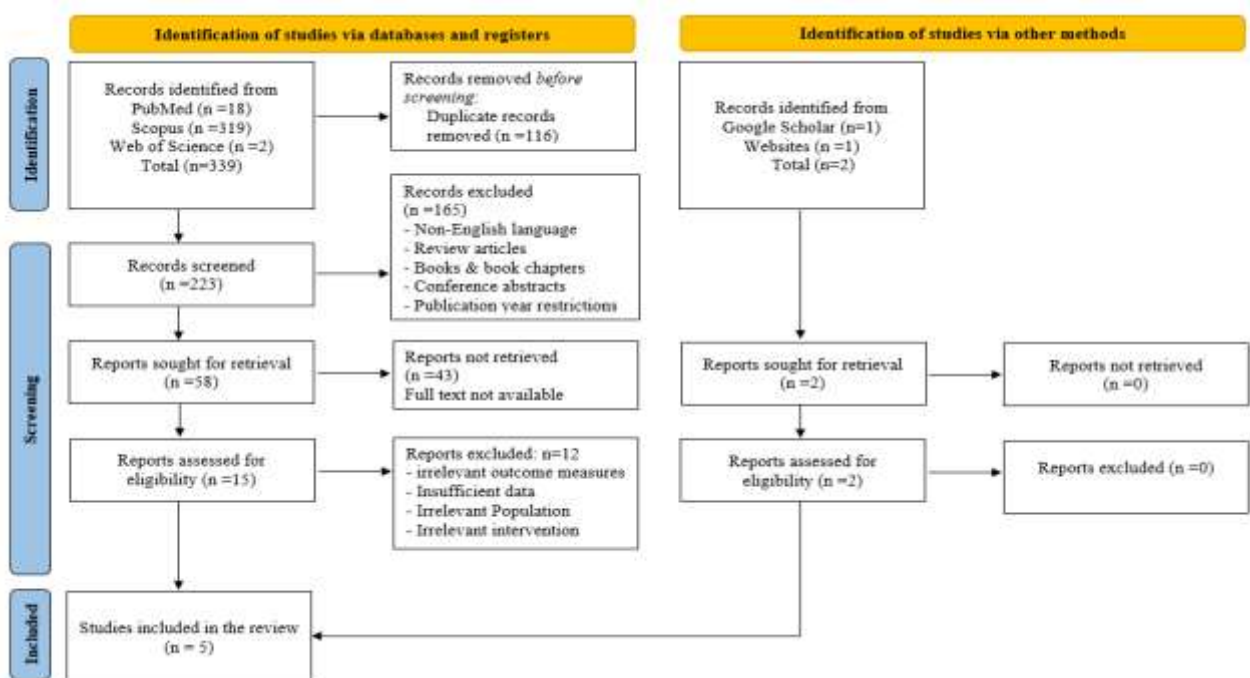
## Literature Search-

A comprehensive literature search was conducted across electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, to identify relevant studies for this narrative review. The search strategy used the keywords “Neuroplasticity,” “Myopia,” “Tratakā,” and “Cognition” in different combinations. The Boolean operator AND was applied to refine the search and improve specificity, using combinations such as “Tratakā AND Neuroplasticity,” “Tratakā AND Cognition,” and “Myopia AND Neuroplasticity.” Relevant articles were identified through title and abstract screening, followed by selection of studies aligned with the review objectives.

## Study Selection-

This review included only original research articles directly relevant to the topic. To ensure methodological rigour and improve the quality of evidence, the selection was limited to Randomized Controlled Trials (RCTs). Only studies that explicitly implemented Tratakā Kriya as an intervention were considered eligible. Studies published before 2016 and those in languages other than English were excluded from the review.

## Data Abstraction-



**Fig.1 Study selection process**

A systematic literature search was conducted across multiple electronic databases to identify studies on the neurocognitive and visual effects of Tratakā and related yogic practices. The initial search yielded 339 records; 116 duplicates were removed, leaving 223 studies for screening. During the title and abstract screening, 165 studies were excluded for reasons including non-English publications, review articles, books or book chapters, conference abstracts, and studies outside the specified publication year. After this step, 58 studies were considered potentially relevant and sought for full-text retrieval; however, 43 studies could not be accessed due to the unavailability of full texts in accessible databases or institutional resources, leaving 15 studies for eligibility assessment. During the full-text review, 12 studies were excluded for irrelevant outcome measures, insufficient data, irrelevant study populations, or interventions that did not

specifically involve Trāṭaka or yogic visual practices. Thus, 3 studies met the inclusion criteria from the database search. Additionally, 2 more studies were identified through manual and open searches (Google Scholar and academic websites), bringing the total to 5 included in the final qualitative synthesis.

### **Result:**

Across the 5 studies included, 334 participants aged 12 to 50 were examined to assess the impact of Trāṭaka Kriya-based interventions on attention, cognitive performance, and visual psychomotor skills. All studies used randomized designs, with intervention periods lasting from 8 to 12 weeks. Trāṭaka was practiced either alone or as part of a comprehensive yoga program.

The reviewed studies indicate that Trāṭaka Kriya and yoga-based visual concentration practices may influence several neurocognitive domains associated with neuroplasticity, including attention regulation, working memory, cognitive control, and visuomotor coordination. These cognitive processes are closely related to visual processing and may indirectly enhance visual efficiency and ocular health. The observed enhancement in attentional control and neural adaptability suggests potential cognitive benefits of Trāṭaka practice. Nevertheless, direct empirical evidence supporting its role in myopia reduction remains limited, underscoring the need for further research.

### **Effects on Attentional Networks and Cognitive Control:**

The studies indicate that Tratakā-based yogic interventions enhance attentional networks and cognitive control, suggesting possible neuroplastic changes in brain systems involved in sustained attention and executive functioning. According to the study, which was done by Baishya *et al.*, an 8-week yoga program including Trāṭaka significantly improved attentional control in competitive archers, particularly in orienting and conflict control networks related to selective attention (Baishya *et al.*, 2025).

Similar improvements in attention-related performance were reported by Yadav and Rathore, who found that a yoga module including Bhramari Pranayama, Tratakā, and Jala Neti significantly improved eye-hand coordination and shooting accuracy. These outcomes indicate enhanced sensorimotor integration and attentional stability, which may reflect neuroplastic adaptations in visual-motor pathways (Yadav & Rathore, 2022).

### **Effects on Working Memory and Higher Cognitive Functions:**

Evidence from the included studies indicates that Tratakā-based interventions may improve working memory and higher cognitive functions, reflecting potential neuroplastic changes. Sourori Khorashad reported significant improvements in selective attention, divided attention, and working memory capacity after a yoga program including Tratakā. Enhanced N-back performance further suggests improved cognitive processing efficiency (Khorashad, 2024; Tang *et al.*, 2015).

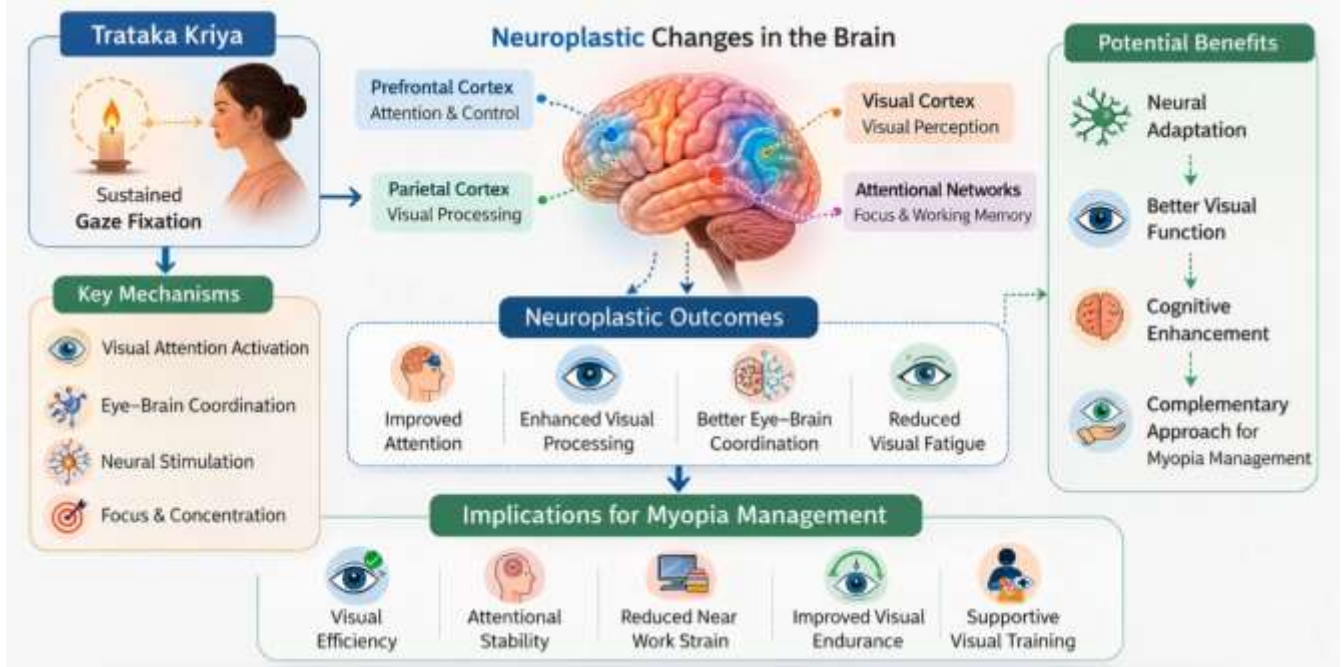


Figure 2: Neuroplastic effects of Trataka Kriya

### Psychological Regulation and Neuroplastic Stress-Reduction Effects:

Another aspect of Trataka-related neuroplasticity is its positive effect on stress and emotional regulation. The study by Singh *et al.* shows that regular Trataka practice significantly reduced stress and anxiety while improving mental well-being, sleep quality, and self-perception, indicating better emotional regulation (Singh et al., 2025).

### Trataka and Visual Function: Evidence Related to Myopia:

Although Trataka shows positive effects on cognitive and psychological outcomes, evidence for its direct impact on myopia or refractive error is limited. Tiwari *et al.* found that an 8-week Trataka practice did not significantly improve refractive error or visual acuity in young adults. This suggests that Trataka may not directly affect the structural factors of myopia, such as axial length or corneal curvature (Tiwari et al., 2018).

### Discussion

This review explored the neuroplastic effects of Trataka Kriya and its potential as a visual-attention training exercise relevant to myopia management. Results from five studies involving 334 participants aged 12-50 years indicate that Trataka-based yogic practices may enhance neurocognitive functions, including attentional control, working memory, visuomotor coordination, and psychological regulation. These findings suggest that Trataka functions as a focused visual-attention training method that could boost neural adaptability and support cognitive processes related to visual performance.

The reviewed studies reported improvements in attention and cognitive control. For example, Baishya et al. found that a yoga program including Trataka enhanced attentional control, particularly in orienting and conflict resolution. Similarly, Yadav and Rathore observed better eye-hand coordination and shooting accuracy. These findings indicate improved sensorimotor integration and attentional stability, which may reflect neuroplastic changes in visual-motor pathways (Baishya et al., 2025; Yadav & Rathore, 2022)

Studies by Lutz *et al.* and Tang *et al.* show that regular attention training can strengthen neural circuits in the prefrontal cortex and parietal attention networks, which help regulate attention and visual processing. In yoga, Trāṭaka involves steady visual fixation, repeatedly engaging these attention systems, and potentially supporting functional neural adaptations(Lutz et al., 2008; Tang et al., 2015)

Some studies also found improvements in working memory and cognitive functions. Sourori Khorashad reported better selective attention, divided attention, and working memory. Similarly, Bhogal et al. observed reduced stress and anxiety, along with improved mental health and sleep quality(Khorashad, 2024; Singh et al., 2025).

However, the evidence regarding the direct effect of Trāṭaka on myopia is limited. Tiwari et al. reported that the eight-week Trāṭaka exercise did not significantly alter refractive error or visual acuity. Myopia is primarily associated with axial elongation of the eyeball and environmental factors such as long working hours (Morgan et al., 2012). Trāṭaka may not directly influence the structural determinants of myopia. Instead, it can indirectly support visual function by enhancing visual attention, visual endurance, and eye-brain coordination(Tiwari et al., 2018).

Despite encouraging results, several limitations still exist. Most studies used small sample sizes and brief intervention periods, and Trāṭaka was frequently included in combined yoga programs, making it hard to isolate its specific effects. Future research should involve larger randomized controlled trials with extended follow-up periods and incorporate objective eye measurements, such as axial length and accommodation response. Additionally, advanced tools such as EEG or functional MRI could help clarify the neural mechanisms underlying Tratak-related neuroplasticity. Overall, the current evidence suggests that Trāṭaka Kriya may be a useful visual-attention training method that boosts neurocognitive functions; however, its direct role in reducing myopia remains unconfirmed.

### **Conclusion:**

The present review suggests that Trāṭaka Kriya may induce neuroplastic changes and could be relevant for myopia management through visual attention training. The studies analyzed indicate that Tratak-based yogic practices can improve attentional control, working memory, visuomotor coordination, and psychological stability. Overall, Trāṭaka seems to serve as a visual concentration technique that promotes neural adaptability and reinforces attention-related visual processing networks. However, current evidence does not clearly show that Trāṭaka directly reduces refractive error or myopia. Instead, studies suggest that it may indirectly improve visual efficiency and mental stability, which helps in tasks requiring sustained visual attention. Therefore, Trāṭaka can be viewed as a supportive visual-attention training practice, but more well-designed long-term studies with proper eye measurements are needed to confirm its role in myopia management.

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