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Yoga based Ocular Exercise (Trataka): The Scriptural and Scientific Review

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Abstract

In this study, ancient texts and contemporary research findings are analysed to gain a better understanding of Yoga-based ocular exercise (Trataka). Our search terms included Trataka, yogic visual concentration, yoga eye exercise and Yoga ocular exercise. Based on the inclusion and exclusion criteria, a search of references published between 1924 and August 2021 yielded 22 articles. The limited studies demonstrated a positive effect on the regulation of autonomic functions, the enhancement of cognitive functions, the reduction of eye-related discomfort and ailments, and the enhancement of happiness and mental calmness. Regarding myopia and refractive error, trataka had no impact. The method itself was not consistent across all of the studies, and it differed from the scriptural description. The researcher has included a number of modifications and additions to the traditional methods. This technique's authenticity must be preserved. The internal mechanism of trataka is concerned with the process of attention and guides the practitioner to the higher levels of yogic state.

Keywords: Shodana Kriya, Trataka, Eye Exercise, myopia, attention.

Introduction

Yoga is a spiritual discipline that has been practised for thousands of years to help people achieve psychological and physiological homeostasis (Menezes et al., 2015; Telles, 2010). The ancient yogic scripture described many different yoga techniques and procedures. Hatha yoga is a popular approach that emphasises asana (yogic postures), pranayama (voluntary breath control), meditation, mudhra, bhandha (psychic lock), and shodhana kriyas (cleansing practices). Most recent studies have concentrated on yogic asana, pranayama, and meditation. Individually or in combination, the above techniques have demonstrated significant improvements in psychological and emotional well-being (Nanduri & Ram, 2020). Additionally, studies have demonstrated an improvement in physiological function and the management of psychological disorders (Menezes et al., 2015). Further, studies have indicated that it has a considerable impact on non-communicable disease (Nagarathna et al., 2020; Shantakumari et al., 2013).

The classical scriptures emphasise the importance of cleansing techniques (shodhana kriyas). Despite growing recognition of the usefulness of yoga, researchers that specialized in yoga-based therapies have neglected the Shodana Kriya This is because these researchers have focused their attention on other approaches, such as asana, pranayama, and meditation, rather than Shodana Kriya. Some of the well-known terminology used to describe the concept of 'Sodhana,' which implies internal cleansing or purification, include: Karma, Suddhikriya, Sauca, Nadisuddhi, Ghatasuddhi, and CittaSuddhi (Gharote, 1976). Hathapradipika and Gheranda

Samhita, two traditional classical hatha yoga texts, emphasise six types of cleansing techniques (Shatkriyas), with their primary mechanism of action being 'stimulation.' The techniques include dhauti (internal cleansing), basti (yogic enema), neti (nasal cleansing), trataka(TK) (concentrated gazing), nauli (abdominal massaging) and kapalabhati (frontal sinus cleansing).

TK, also known as concentrated gazing, is one of the purification techniques that has been investigated further within the Shodana Kriya. The present review examines the TK techniques, benefits, and mechanism from the perspective of traditional scriptural references as well as more recent research findings. In addition, the impact that the TK practises have on the autonomic and cognitive functions. Explore further the effects of TK on eye disorders and the syndrome known as computer vision. In addition, the review intends to make some suggestions for approaches that could be used in subsequent research. The review incorporates a scriptural analysis of TK practises as well as experimental findings.

METHODS

Searches for pertinent literature were conducted using the online databases PubMed, Scopus, and Google Scholar. In addition, the yoga journal known as Yogamimasa was explored through from the time it was first published in 1924 until the most recent issue was published in 2021 in order to acquire a deeper comprehension of the traditional method and the preliminary research on TK. Trataka, trataka kriya, tratak, yoga ocular exercise, yoga eye exercise, and yogic visual concentration are some of the terms that are included in the search key word. The search results were from the year 1924 up until the month of August 2021. After conducting a final screening and removing duplicates, we were able to include twenty two studies in the final review.

RESULTS

No	Author	Objectives	Intervention	Results
01.	Gore M et al., 1990	To study the effect of TK on Pyscho-Physiological Functions	TK training for 15 days	Relaxation, Emotional balance, feeling of pleasantness were increased. A shift from sympathetic to Parasympathetic happens during TK.
02.	Telles et al., 1997	Degree of optical illusion perceived	TK 30 min with asana and pranayama for one month	Significant decrease in the degree of optical illusion was found
03.	R.S.Bhogal and T.K.Bera 2004	To study the effect of TK on psychophysiological parameters, Attentional Fluctuation, and Neuroticism	TK 16 days	Reduction in neuroticism, GSR and attention fluctuation, increase in BSR indicating a better psycho-physiological health
04.	Kumari et al., 2005	Impact *Kapalabhati*, TK, and *pranayama* on academic stress	TK and *kapalabati* for 3 months	Reduced academic Frustration, conflict, and pressure academic anxiety
05.	Telles et al., 2006	effect of a combination of yoga practices on self-rated symptoms of visual discomfort in professional computer users	Asan 15 min, Pranayama 10 min, Joint exercise 10 min, TK 10 min, Relaxation 15 min	Yoga practice appeared to reduce visual discomfort
06.	Ramachandra et al., 2008	To study the effect of TK on intraocular pressure in normal subjects	TK for 7 days	Regular TK reduces intraocular pressure
07.	Sharma et al., 2010	To study the effect of TK on mental relaxation through a -E.E.G	TK at night for 25 days. 5,10,15 minutes	There is a positive effect of TK on mental relaxation as measured by EEG
08.	Taruna Mallick,	To study the change in the critical flicker fusion after a yogic visual	**Study group:** Eye exercise and TK	TK practice had a significant increase in critical flicker fusion compared to

	and Ravi Kulkarni, 2010	concentration practice (TK).	combined and C**ontrol group**: eye exercise alone	eye exercise group
09.	Gopinathan et al., 2012	Mild eye problem/ To evaluate the role of eye exercises and TK Yoga Kriya on *Timira* w.s.r. to Ammetropia and Presbyopia.	Group A: Eye exercise Group B: TK (one hour) Once in a day for 3 weeks	None of them got cured, mild and moderate improvement was found. Subjects felt better in TK group than exercise group
10.	Sonali Tripathi, and Anubhav Bhatnagar 2012	to evaluate the effect of a combination of yoga practices on symptoms of visual discomfort in regular users of computer	Asana, Pranayama, and TK (60 Minutes) for 90 days	Reduction in visual fatigue, improvement in tear film of the eyes were found
11.	Charu Bansal 2014	compare the effect of '*Saptamruta Lauha'* and Yoga therapy in myopia	TK *Jala neti Pranayama* for 3 months	No improvement found in myopia, but yoga showed improvement in associated symptoms
12.	BR Raghavendra, and V Ramamurthy 2014	to assess the changes in heart rate variability (HRV) following TK	TK for 15 days of conditioning 25 min per day **Control group**: eye exercise and silence	TK leads to increased vagal tone and reduced sympathetic arousal
13.	Talwadkar et al., 2014	To test the effect of TK on cognitive functions of the elderly	**Study group:** 26 days TK **Control group**: Quite sitting	TK has improved the cognitive functions and working memory of the elderly
14.	Talwadkar et al., 2014	To test the effect of TK on cognitive functions of the elderly	**Study group:** 26 days TK **Control group**: Quite sitting	TK has improved the cognitive functions and working memory of the elderly
15.	B.R. Raghavendra, and Prashanth Singh 2016	to assess the immediate effect of TK on cognitive performance using the Stroop colour word test	**Study group:** Eye exercise and TK combined and **Control group**: eye exercise and silence	TK showed improvement in selective attention, cognitive flexibility, and response inhibition compared to eye exercise.
16.	VN Harnoorkar, and Rukmani 2016	to analyse the efficacy of Yoga Therapy and Ayurvedic Medicine on distant vision among myopic	TK and Ayurvedic medication for 15 min /8-week,	Good Response was seen in Group C (Yoga + Ayurveda) as compared to Group A (Ayurveda) and Group B (Yoga)
17.	Tiwari et al., 2018	To compare the effects of Bates eye exercises and	TK and Bates eye exercise for 8 weeks	Bates exercises and TK Yoga Kriya were not significantly effective in reducing refractive errors and in

		TK Yoga Kriya on myopia.		improving visual acuity
18.	Sheikh et al., 2020	To study the effect of eye exercise on school aged children who attend online class.	Yogic eye exercise 60 minutes twice a day for 4 weeks and ergonomic advice.	Significant reduction was seen in eye fatigue
19.	Uday K. Dixit, and Sushma S 2020	To evaluate the effects of TK yoga on neuropsychological functions in myopic subjects	**TK** for 3 weeks	TK yoga has a significant improvement on neuropsychological functions
20.	G. Shathirapathiy et al., 2020	To evaluate the effect of TK on insomnia severity and quality of sleep, in people with insomnia	TK 45 min for 10 days.	TK is helpful in insomnia and increases quality of sleep
21.	A S Kusuma et al., 2021	to assess the effect of TK, a yogic cleansing technique, on blood pressure and heart rate variables in patients with hypertension	TK 30 min	significant reduction in blood pressure and mean heart rate
22.	Sushma and Uday K Dixit 2021	To assess the influence of TK yoga kriya on Visual Evoked potential in myopes	TK for 3 weeks	TK yoga has no significant effect on VEP (P100)

DISCUSSIONS

Techniques of Trataka: Scriptural and Traditional

TK is the practise of keeping one's gaze fixed on a very small object while resisting the natural reflex to blink while one's eyes are streaming with tears. The traditional Hatha Yoga text known as the Gheranda Samhita (GS) describes the practise of TK as "gazing at any small object without winking the eyes until tears begin to flow is referred to as TK by the wise". Additionally, Svātmārāma describes in Hatha yoga pradipika that “well-composed and maintaining steady gaze, one should stare at a little object until tears fall forth; this is referred to as TK by teachers”. Both the traditional texts GS and HYP talk about how important it is to be able to control blinking. This is because being able to control blinking is important for staying focused, aware, and making progress in meditation. According to the Gheranda Samhita, one of the advantages of practising TK is that it allows the practitioner to become more effective in reaching deeper levels of concentration (Mallinson, 2004). Antar TK, Madhya TK, and Bahya TK are the three categories that the practical approaches that yoga authorities use to categorise the practise (Gore et al., 1990). Furthermore, TK is classified into three types based on drsti: Nasagradrsti, Bhrumadhya, and Jatrudristi (Gharote, 1984). The above-mentioned practical method to TK has been thoroughly detailed elsewhere (Gharote, 1984; Gore et al., 1990). Additionally, traditional TK practise emphasises meditative yogic positions; more advanced TK practitioners favour Padmasana and Siddhasana over the other postures.

Techniques of Trataka: in recent studies

Many studies combine eye exercise with the fundamental TK practise, while others employ eye exercise as the first segment and TK as the second (Dimitrova & Trenceva, 2017; Gopinathan et al., 2012; Kim, 2016; Pandey et al., 2015; Ramachandra et al., 2008; Sheikh et al., 2020; Tiwari et al., 2018). The eye workout includes moving the eyeballs in an eight form, left and right, up and down, and diagonally (Telles et al., 2006). The eye training component might contribute to the physiological benefits (Harnoorkar & ., 2016). The only way to achieve deeper psychological and spiritual benefits is through the use of conventional methods. The essential instructions consist of selecting a relatively insignificant and abstract object, fighting the urge to blink, maintaining a motionless gaze, avoiding distractions, and stopping the practise when tears start to run down the cheeks (Gore et al., 1990; Mallick & Kulkarni, 2010).

Time Duration and object of gaze

The duration of the technique differs according to various scientific publications and yoga institutions. Some practitioners even cycle through TK for an extended period of time, with minor changes in gaze pattern. To maintain the validity of the practise, Hatha yoga pradipika II:32 and Ghiranda Samhita 1:54 are quite explicit in their descriptions: “one must hold the still gaze until the tear rolls down from the eyes and close the eyelids promptly” (Mallinson, 2004; Muktibodhananda, 2012). There is no indication that the practise will be carried out once again straight away. As a result, the duration of group practise is subjective and cannot be fixed. One study found a correlation between a subject's subjective feelings, such as mood, thought patterns, temperament, and level of relaxation, and the amount of time it takes to complete TK. It took longer for the subjects who were mentally distressed to complete the task than it did for the subjects who were calm and relaxed. Subjects required 50 seconds to 12 minutes for a single session (Gore et al., 1990). Additional research is needed to determine the relationship between metal state and practise period in order to determine the underlying process. The duration of TK varies between studies (Kusuma et al., 2021; B. R. Raghavendra & Singh, 2016; B. Raghavendra & Ramamurthy, 2014; Telles et al., 1997). The object chosen for gaze must be small and abstract, and it must not be limited to candlelight. The reasoning behind this is that the object in question should not cause the thought process to be triggered in order to keep one's mind steady.

Benefits reported in the traditional scriptures

According to the Hatha yoga pradipika II:33, the benefits include the following: "TK, which heals eye diseases and prevents sloth, should be valued and preserved with effort as one would a casket of gold" (Muktibodhananda, 2012). Additionally, Gheranda Samhita emphasises the advantages as treating all eye conditions, encouraging clairvoyance, and enabling "Sambhavimudra," a deeper level of concentration (Mallinson, 2004). The aspirant can make progress in their meditation practise by practising TK because it leads to Sambhavimudra. Scriptural benefits include avoiding sloth, achieving sambhavimudra, and improving concentration. As a consequence of this, TK makes an effort to direct one through the attainment of physical, mental, and spiritual benefits.

Effects of trataka on Autonomic functions

TK's psychophysiological impact was studied in 1989. Researchers observed 10 people performing traditional TK in Padmasana. The gaze lasted until tears flowed down the cheek. This ground breaking study made use of the Word Association Test (WAT) with a 10-word stimulus, Galvanic Skin Resistance (GSR), EEG, Heart Rate (HR), Plethysmogram (PTG), and Respiration Rate (RR). The fact that evaluations were conducted while TK was being practised is a unique aspect of this study. Assessments of autonomic function were carried out with the subject's eyes open and closed immediately before, during, and after the practise session. The subjects were finally able to write freely about their subjective experiences. According to the results, the emotional equilibrium shifted toward positive affect and contact seeking while remaining pleasant. Increased relaxation and alpha activity along with decreased heart rate (HR) and respiratory rate (RR) along with an increase in PTG (vasodilation) were all observed after receiving TK (Gore et al., 1990). A study looked at the effect of 16 days of TK on GSR, or Basal Skin Resistance (BSR). GSR was significantly improved when attentional fluctuation and neuroticism were reduced. It was observed that anger, suspicion, irritation, anxiety, and resentment were diminished. In addition to this, a noticeable rise in BSR was noticed (Bhogal & Bera, 2004). A study conducted on sixty adolescents of school-going age found a significant reduction in academic stress, such as frustration, conflict, and pressure, in addition to a mean reduction in anxiety levels among the participants. During the course of the trial, TK intervention was implemented for a total of three months. Consequently, this demonstrates that TK and kapalabhati are very effective in treating psychological issues and in elevating the mental steadiness of adolescents (Kumari et al., 2005). The immediate effect of TK on heart rate variability (HRV) and Respiration Rate (RR) was investigated in a study that took place after two sessions of TK on two separate days. The effects of the TK intervention are characterised by increased vagal tone and

decreased sympathetic arousal. Even though TK is known as a technique for purifying the body, it also has the potential to produce a calm state of mind that is comparable to that which is accomplished through meditation (B. Raghavendra & Ramamurthy, 2014). The immediate effect that TK had on blood pressure and heart rate showed a significant decrease in systolic blood pressure and heart rate in patients who suffered from primary hypertension. TK causes a reduction in the activity of the autonomic nervous system (Kusuma et al., 2021). A three-month yoga training programme that included TK had been shown to improve emotional control and heart rhythm in an early study (Pedro, 1984). After 25 days of TK practise, a sample of 50 graduate students' mental relaxation increased as measured by EEG (Kumar, 2010). Subjective accounts suggest that after practising TK, a person feels more relaxed, happy, quiet, and light, and that they also have a better pattern of sleep. Subjectively, people also reported having cathartic expressions of their emotions, such as crying or sobbing, and gradually reviving themselves. WAT revealed a more balanced psychological state (Gore et al., 1990). These emotional reliefs could be responsible for the increase in parasympathetic activity that was observed. Based on these results, it seems that TK makes the parasympathetic system more dominant because, like meditation, it focuses the mind on a single point of awareness.

In order to better understand the underlying process, as well as the significant parasympathetic activation that occurs after TK, it is interesting to look at what happens while TK is being practised. TK appears to change the Autonomic Nervous System while it is being practised, which results in an increase in HR and RR and a reduction in peripheral blood circulation (PTG, Vasoconstriction). This demonstrates sympathetic dominance as irritation or the need to wink the eyes builds up during practise. After the eye has closed as a result of tear flow, all of the aforementioned metrics will shift in the opposite direction. As a result, there is a shift from sympathetic to parasympathetic dominance. A small agitation and deep relaxation support the words of Hatha yoga pradipika II:33, that TK prevents laziness and improves awareness. During this time period, contrasting feelings have a tendency to come to the surface and then be processed, which ultimately leads to a sense of calm, buoyancy, and happiness.

Effects of trataka on Attention and Cognition

As measured by Muller-Lyer standard lines, participants in the one-month yoga programme that also included TK practise showed significant improvements in their ability to avoid optical illusions. TK, in conjunction with other practises, has had an effect on the cognitive-judgmental factors of the subjects and has resulted in a decrease in the subjects' illusory perception (Telles et al., 1997). Using Visual Evoked Potential, the effect of TK was studied on 36 myopic participants from a medical college (VEP). No significant improvements in P100 latency were seen as a result of the intervention that lasted for three weeks, which suggests that changes in cognitive functioning may take more time than three weeks to manifest (Sushma & Dixit, 2021).

TK maintains a continuous flow of attention free of noise, according to a study showing a decrease in attention fluctuation after TK (Bhogal & Bera, 2004). TK sessions improved selective attention, reaction inhibition, and cognitive flexibility assessed by the adult Stroop-colour-word test (B. R. Raghavendra & Singh, 2016). After 26 days of TK practise, elderly people improved on cognitive tasks like digit span, six-letter cancellation, and tail making. The practise of TK has been shown to assist the elderly in warding off cognitive decline(Jagannathan et al., 2014). Myopic subjects' neuropsychological functions improved significantly after 3 weeks of TK kriya (Uday K. Dixit et al., 2020). The Critical flicker fusion CFF assessment was done before and after TK practise for each subject after 5 conditioning sessions. The individuals who practised TK saw a satisfactory improvement in their visual accuracy and perception, in contrast to the individuals in the eye exercise group, who saw a nonsignificant reduction(Mallick & Kulkarni, 2010).

Effects of trataka on eye disorders

According to Hatha yoga pradipika II–32, the benefit of TK is that it cures conditions related to the eyes (Muktibodhananda, 2012). TK able to improves blood circulation while also easing the strain that is placed on the eye muscles. A three group study (n=30) evaluated the effect

on myopic subjects on distant vision. One group was given only Ayurvedic treatment, another group was given only TK and eye exercises, and the third group was given both kinds of treatment for a period of eight weeks. Symptoms like eye watering, burning, redness, and eye strain improved in all three groups. Snellen's chart, which measures distant vision, showed no significant differences between groups, but myopia improved marginally (Harnoorkar & ., 2016). In another study, the effects of Bates eye exercises and TK Yoga Kriya on n=24 myopic participants were compared. After 8 weeks of training, neither of the interventions improved refractive errors or visual acuity, indicating that nonpharmacological techniques to myopia treatment are ineffective (Tiwari et al., 2018).

TK and Bates eye exercise groups were compared in a study for their effects on people with mild and early-stage eye problems. Neither intervention improved statistically. Both groups reported subjective improvement, but the TK group felt better. TK subjects felt better due to mind and muscle relaxation (Gopinathan et al., 2012). A comparison of the effects of ayurvedic medicine and visual Yogic activities is being conducted. Based on the findings, yogic practises were found to be more effective than medication in relieving symptoms including pain, headache, heaviness of the eye, tears of the eye, and eye strain. The calming effects on the brain and the strengthening of the eye muscles are two of the many benefits of TK Kriya practise. In accordance with the findings of previous studies, neither yoga activities nor medicinal treatments significantly improved clinical refraction or myopia (Bansal, 2014). In order to examine the effect that seven weeks of consistent TK training has on intraocular pressure; eight repeated measurements were taken at the end of each week of the study (IOP). The findings indicate that there was a discernible and consistent decrease in the IOP over the course of the study. The decrease in intraocular pressure (IOP) appears to have been caused by mental relaxation as well as a reduction in sympathetic activity (Ramachandra et al., 2008).

In a study, the impact of TK on the severity of insomnia as well as the quality of sleep among people who suffer from insomnia was investigated. Twenty-nine people who suffer from insomnia were given TK for a period of ten days. A significant drop was found in both the Insomnia Severity Index (ISI) and the Pittsburgh Sleep Quality Index (PSQI) scores following the intervention. It appears that TK could be a potential treatment modality for reducing the severity of insomnia because it helps reduce stress and promotes a calm state of mind (Shathirapathiy et al., 2020). Visual discomfort in computer professionals was studied after 60 days of TK, asanas, and pranayama. The findings demonstrated a significant reduction in visual discomfort, which included dryness, irritation, burning, redness, and photosensitivity (Telles et al., 2006).

In another study, long-time computer users were given 90 days of yoga and TK. According to the findings, yogic practises may be the most effective alternative treatment for eye discomfort. Visual fatigue was reduced, the tear film of the eyes improved, and other eye discomfort was alleviated based on self-measures (Tripathi & Bhatnagar, 2012). Examination done among 44 school aged children on eye discomfort, fatigue, blurred vision and headaches, dry eyes and other symptoms of eyestrain. After 4 weeks yogic eye exercise and ergonomic advice a significant reduction in eye fatigue (Sheikh et al., 2020).

Conclusion

Traditional yoga texts appear to describe just a single gaze that is held for an extended period of time until tears start to run down the cheek. The time duration of the practise is subjectively determined by each practitioner's need and capacity; however, recent studies have invariably established the time duration of the practise as including repeated cycles of gazing. Recent research has added eye exercises and palming as the first step and gazing as the second. Studies have shown that eye exercises can help with health problems. TK has shown significant benefit on autonomic function, cognition, relaxation and sleep. According to findings, TK does not appear to help alleviate myopia symptoms, but it does help alleviate a variety of eye discomforts. However, putting more emphasis on the health benefits and changing the practise will take away from the

real yogic purpose of TK (Bhole, 1989). According to the Gheranda Samhita, the real purpose of practising TK is to make progress along the yoga path. During TK, attention phenomena are similar to passive sustained attention flow (gazing), leading to Central Pattern Mask (Marcel, 1983). Therefore, it is anticipated that the final stage of TK will continue to involve "Blanking of Attention" (Kulkarni, 2010), which will result in an internal process that is unaffected by any external influence.

The results of future research should be designed to investigate whether or not TK can influence performance on a task that requires visual attention. In addition, there is evidence to indicate that oculomotor behaviour is capable of modulating a common cortical network, which results in short-term plasticity. Therefore, research should take into account how TK affects neuroplasticity. Further research could include eye tracking and a more dispersed visual tracking regime to uncover the effect of TK on physiological, psychological, and spiritual dimensions.

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