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Review Article

EFFECT OF YOGA ON ESSENTIAL TREMOR: A NARRATIVE REVIEW

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ABSTRACT

Essential Tremor (ET), is a common movement disorder that is associated with rhythmic involuntary tremors mostly of the upper limbs during voluntary movement. Although there are some pharmacologic and surgical options, most patients do have limited relief and adverse effects, which led to the consideration of complementary therapies. **Objective:** This narrative review focuses on Yoga as an intervention in treating ET, including theoretical and existing clinical evidence backing the use of Yoga in managing ET. **Methods:** A literature search was run in PubMed, Scopus, and Google Scholar databases to select the studies related to the pathophysiology of ET, effects of Yoga, and empirical studies that have examined Yoga-based interventions in tremor or ET patients. Both conceptual and experimental work were encompassed. **Results:** ET correlates with cerebello-thalamo-cortical dysfunction and GABAergic impaired inhibition. Yoga can deal with these pathophysiological factors via the increase of GABA level, autonomic stabilization, and postural and motor control improvement. Pilot studies have also shown that Yoga can lessen the severity of tremors and enhance the balance of persons with ET. The evidence has however limited constraints in terms of small sampling size, absence of controls, and short period of follow up. **Conclusion**: Yoga may be an effective adjunctive therapy in ET, with promising effects and limited risk. However, larger and controlled studies are required to confirm its effectiveness and clarify its mechanisms.

INTRODUCTION

Yoga is an Indian practice representing union, aims to unite body, mind and soul. It includes various practices like *Asana* (Yogic Postures), *Pranayama* (Breathing Techniques), *Dhyana* (Meditation), *Mantra* Chanting and Relaxation Techniques[1,2]. Its multidimensional action on the nervous systems is increasingly studied in the medical context. The Yogic practices demonstrated to decrease stress, ease muscular-tension, and enhance occupational health[3]. Yoga has been observed to improve body balance, gait, cardiovascular function, quality of sleep, and health-related quality of life (HRQoL)[4]. Yoga has been emerged as a complementary therapy for various movement disorders, demonstrating significant therapeutic benefits across multiple neurological conditions like Parkinsonism, Multiple Sclerosis etc.[5-8]. The evidence reveals consistent positive effects on motor function, balance, quality of life (Qol), and psychological wellbeing in patients with movement disorders.

Essential tremor (ET), a chronic neurological disorder is characterized by involuntary and rhythmic shaking during voluntary movements. By consensus, ET is defined as "an isolated bilateral action/postural tremor of the upper limbs (hands and forearms) for at least three years, with or without tremor of the head, voice, or other body parts, and without other neurologic signs"[9]. It is a widespread movement disorder: pooled population studies give an estimated

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overall prevalence of approximately 1.3%, peaking strongly with age[10].

The tremor in ET is typically action-induced, occurring at 4–12Hz frequency, and mostly affects hands and forearms. Head or voice tremor is also common in many patients. The amplitude of tremor tends to get bigger with time causing gradual impairment of activities such as eating, writing or grooming[11,12]. The compromised sleep quality and excessive daytime sleepiness are the most commonly reported problems which may be associated with pharmacological agents commonly prescribed for the management of ET[13]. Stress is also an aggravating factor in ET[14,15]. Patients with ET often experience an impaired QoL[16]. At present, no curative or disease-modifying therapy exists for ET; available interventions remain purely symptomatic.

First-line pharmacotherapy includes nonselective β-blockers (like propranolol) and anticonvulsants (like primidone), showing Class I evidence of effectiveness[17]. These agents reduce tremor severity by roughly 50% in about half of patients, but their use is often limited by adverse effects such as drowsiness, fatigue, and cognitive slowing. Second-line therapy can include other drugs (e.g., topiramate, gabapentin, benzodiazepines, botulinum toxin to head tremor). In the case of medication-refractory ET, surgical therapies, e.g., deep brain stimulation (DBS) of the thalamic-ventral-intermediate-nucleus may results to tremor reduction[10].

Nevertheless, such invasive interventions are risky and some patients develop a phenomenon of habituation or diminished long-term effect. The habituation phenomenon may be related to the re-organization of brain circuitry of tremor and chronic suppression of tremor-related oscillations. Summing up, although there are a number of therapies, a significant proportion of ET patients are not fully treated, and they cannot tolerate side effects[10].

Indeed, many ET patients experience various side effects and unsatisfactory responses with standard treatments. New therapies that target tremor-generating circuits are thus required. It prompts interest in non-pharmacological interventions that may alter neuromuscular control or central excitability. Specifically, mind-body interventions (including Yoga) are under consideration as a complement to enhance motor performance and QoL in ET. The evidence base reveals consistent positive effects on balance, motor functions, Qol, and psychological wellbeing in patients of movement disorders[5–8].

Pathophysiology of ET

The exact etiology of ET remains unclear. The traditional pathological studies have observed that the brains of ET have degenerated Purkinje cells, distorted cerebellar structure, even though the idea of primary cerebellar neurodegeneration remains controversial. The evidence to suggest that the ET is characterized by abnormal oscillatory activity on the cerebello-thalamo-cortical circuit[18].

Initial hypotheses have had the inferior olive as the tremor pacemaker, but this has been replaced mostly by a multiple-oscillator model: the sources of shaping tremors are generators in the brainstem, cerebellum, and in the motor cortex, into a circuit that produces a rhythmic output[18].

Notably, altered (inhibitory) GABAergic transmission is one of the factors highlighted by functional imaging and neurophysiology. Imaging studies demonstrate lower cerebellar GABA levels and higher benzodiazepine-receptor availability (a surrogate of GABA deficits) in ET patients, suggesting that the cells have reduced inhibitory tone in tremor pathways[18,19].

ET is clinically differentiated by its action (vs. resting) tremor pattern compared to that of Parkinson disease[9]. However, cerebellar involvement is highlighted in that numerous ET patients exhibit non-obvious cerebellar conditions (e.g. mild gait ataxia, eye movement abnormalities)[18]. The heterogeneity of ET is clinical, demographical and genetic in nature, may underlie the diverse inconsistencies reported across studies.

The exact etiology of ET remains unclear. The traditional pathological studies have observed that the brains of ET have degenerated Purkinje cells, distorted cerebellar structure, even though the idea of primary cerebellar neurodegeneration remains controversial. Based on these findings, several hypotheses have been proposed to explain the underlying pathophysiology of ET, as outlined below[18,19].

Pruning defects (climbing-fibre theory)

ET may arise from defective synaptic pruning of climbing fibres on Purkinje cells, driven by reduced GluR2/GluRδ2, leading to abnormal expansion of climbing-fibre territory into the parallel-fibre zone and multi-Purkinje innervation. These changes promote hypersynchronous cerebellar oscillations that, in animal models, are sufficient to generate ET-like action tremor that responds to propranolol, primidone and alcohol[18,19].

Cerebellar GABA deficiency

Modest Purkinje cell loss and reduced GABA_A/GABA_B receptor expression in the dentate nucleus, together with reduced GABA in CSF and

cerebellum, suggest impaired inhibitory (GABAergic) tone in cerebellar output pathways. This reduction in inhibitory control may allow abnormal oscillatory activity within the cerebello-thalamo-cortical circuit, which is supported by the clinical observation that GABA-enhancing medications and alcohol can alleviate symptoms in many individuals with ET[18,19].

Genetic and environmental factors

Multiple genetic loci and variants confer risk or protection, while many patients report a positive family history, indicating a strong hereditary component. Environmental exposures such as β-carboline alkaloids (harmane/harmaline), pesticides, heavy metals and possibly ethanol can interact with this genetic background to trigger or modify ET expression.

Inferior olivary dysfunction/degeneration

The inferior olive (IO), an intrinsic oscillator and the source of climbing fibers, has long been implicated because harmaline-induced IO hyperactivity produces ET-like tremor that is suppressed by standard ET medications. Although most quantitative post-mortem studies do not show uniform IO neuronal loss, occasional ET cases with IO degeneration and strong IO-dependent animal models support a hypothesis that IO hyperactivity or degeneration contributes to tremor in at least a subset of patients[18,19].

Probable Mode of Action of Yoga

Yoga is recognized as a complementary and alternative medicine (CAM) [20]. Various studies proved the benefits of Yoga on different neurological disorders[21] Yogic interventions contribute to stress reduction and improvement in concentration, stability, strength, and QoL[22-24]. A recent controlled study has reported that a structured Yoga-asana regimen let to increase muscular strength of the limbs, trunk flexibility and static balance as compared to control[25].

Yoga may influence ET symptoms via several neurochemical pathways. Yoga training modulates the central neurotransmitters. In healthy individuals, a single *Yoga asana* session resulted in a 27% increase in whole-brain GABA concentration, while a corresponding control did not exhibit this change[26]. Similarly, in a controlled trial, 12 weeks of Iyengar Yoga (60 minutes three times a week) produced significant improvements in mood and anxiety compared to walking, which was positively correlated with increase in thalamic GABA levels[27]. Pharmacologic GABA stimulants frequently minimize tremor; thus, an activity that enhances native GABA could possibly restore inhibitory equilibrium in tremor circuits[18]. In brief, the increase in inhibitory neurotransmission by Yoga can minimize the motor oscillations that are excessive in ET.

Yoga facilitates the state of relaxation and autonomic control. Tremors are likely to be enhanced with chronic stress and high sympathetic tone. A meta-analysis shows that regular Yoga practice reduces physiological stress markers: eg., Yoga interventions significantly reduced evening cortisol, resting heart rate, and blood pressure compared to controls. Practically, Yoga results in better autonomic balance, reduces fight-or-flight drive and increased parasympathetic (vagal) activity[28]. This may result into a more relaxed muscle tone at rest and decreased episodes of tremor triggered by stress. Likewise, meditative and breathing aspects of Yoga train interoception and motor control, increasing the capability of stabilizing purposeful movements during the stress.

Yoga supports control of posture and body awareness. Many poses in Yoga involve slow, careful shifts in weight and holding steady muscle contractions. These practices train the nervous system to coordinate opposing muscles working together and enhance feedback from the body's position sense. While direct research on Essential Tremor (ET) is limited, studies involving other groups show that Yoga improves balance, flexibility, strength, joint awareness, and coordination[25,28]. For instance, Yoga programs for older adults have notably improved balance and proprioception in the lower limbs[29], likely through neuroplastic gains in brain. By analogy, patients with ET practicing Yoga might develop better muscle stabilization. Stronger core and postural muscles, along with better fine motor control gained through shifting postures, may help make voluntary movements smoother. In ET patients, slight improvements in muscle stiffness or reflex sensitivity could reduce tremors during movement.

Overall, Yoga combines slow, mindful movement with controlled breathing and focused attention, engaging neural pathways in ways that may help counteract the underlying causes of ET. It could boost inhibitory brain signaling, lower stress, and sharpen motor control. These possible effects are similar to those seen with other exercise treatments, suggesting Yoga might produce common neural benefits. For example, resistance training has been shown to reduce tremor intensity and improve hand coordination in people with ET[30]. In Yoga, these physical benefits are combined with mindfulness and relaxation practices, which may provide improvements not only in movement but also in mental and emotional wellbeing.

Clinical and Experimental Evidence

Current empirical evidence on Yoga for Essential Tremor (ET) is limited but promising. The first pilot study conducted by Vance et al. (2019) involved six ET patients who participated in an 8-week Vinyasa Yoga program, attending 60-minute sessions weekly led by a Yoga instructor. Five out of the six participants experienced noticeable improvements in their tremor scores, with an average reduction of 15.3% on the Tremor Research Group Rating Scale. They also showed about a 10% improvement in balance, measured by the Fullerton scale. QoL and anxiety measures did not change significantly, but no adverse events occurred[31]. Similar results came from a related case series presented as a conference poster, where ET patients following the same 8-week Yoga program demonstrated tremor reductions on daily living and performance assessments, in some cases improving by as much as 35%, along with better functional balance[32]. Together, these findings suggest that Yoga could be a feasible and safe practice for people with ET and may offer modest benefits in reducing tremor severity and enhancing postural control.

Exercise beyond Yoga has also shown promising benefits for patients with ET. Take resistance training, for example, studies have found that even a short period of targeted arm strength exercises can lead to noticeable improvements in muscle power and hand coordination in those with ET[30]. This suggests that focused, challenging motor training can help the neuromuscular system work better. Similarly, *Yoga* that involves gentle yet controlled movements, might offer similar results. Evidence suggests that relaxation therapy may help patients with ET. In a small ET case series, behavioral relaxation training has been reported to reduces both tremor intensity and subjective disability. For instance, Chung et al. guided two older adults, one with ET and one with Parkinson's tremor, through progressive muscle relaxation exercises, and EMG recordings confirmed that their tremor reduction lasted for at least two weeks after the training[33]. These results imply that simple relaxation techniques can translate into benefit into tremor reduction.

Till date, no large RCTs have been published, researchers have taken a key step by designing a standardized "Integrated Yoga Module" specifically for people with ET. A panel of experts created and reviewed this program, combining Yoga postures, breathing practices, and meditation. They agreed that most of the practices are essential and well-suited to ET patients[34]. They recommend conducting feasibility studies and controlled clinical trials to confirm its effectiveness. The tremor and balance improvements seen so far are modest but consistent with the expected effects on motor control. Although no placebo-controlled trials have been conducted, similar benefits observed in pilot studies, resistance training, and relaxation exercises suggest that Yoga training could potentially affects motor function in ET.

Limitations and Challenges

Although the initial findings are encouraging, the research on Yoga for ET has clear shortcomings. Each study so far has been small, uncontrolled, and focused only on short-term outcomes[31,32]. Such designs are prone to placebo effects and selection bias. Since patients know they're practicing Yoga, truly blinded tremor assessments are nearly impossible, and there is no sham-Yoga comparison.

Another complication is the wide variability among ET patients. They differ greatly in age, anatomical distribution of tremor and tremor severity. A Yoga routine that feels engaging and beneficial for younger, more active individuals may not be appropriate for older adults who are delicate, have advanced disease, or live with other health concerns. A study has focused on structured approaches like *Vinyasa* flow, but these may not be suitable for diverse patient populations[31].

It's not easy to measure progress in ET. The tools used to rate tremor severity can differ a lot between evaluators, and tremor strength can vary from day to day, making it tough to know if a change is real. Studies haven't followed people long enough to see if there are lasting effects. Studies also haven't directly explored exactly how Yoga influences the brain and body in ET. There's a real need for more robust research to truly see how Yoga can be helpful for patients with ET. An integrated Yoga module for ET has been developed and validated by experts. However, its clinical acceptance requires a feasibility study[34].

Bringing Yoga into the care of ET has several. Finding qualified instructors, especially those familiar with neurological conditions, can be difficult, and support from insurance or clinics for Yoga therapy is still uncommon. How well patients might stick with a *Yoga* program over the long term is also uncertain. There is also limited awareness of ET as a distinct medical condition among both patients and healthcare providers[35]. Importantly, Yoga should be seen as an add-on to, not a replacement for proven treatments like medication or DBS. At present, the idea of Yoga for ET is still more of a promising concept than an established therapy and needs further evidence.

Yoga alone is unlikely to replace pharmacologic or surgical therapies, and should be considered complementary rather than curative. There is a risk of

overstating the benefits of Yoga or presenting it as a standalone treatment, which may lead to inadequate management of ET.

Future Research Recommendations

Research consistently indicates that intervention trials or RCTs for ET should aim to recruit at least 30–60 participants to achieve meaningful and reliable results. Given the variability and relative rarity of the condition, such trials often require multi-site collaboration and extended recruitment periods to obtain representative and reliable results.

Studies consistently recommend recruiting minimum samples of 30-60 participants for adequately powered ET intervention trials, requiring multi-site collaboration and extended recruitment periods to overcome these fundamental limitations[36].

CONCLUSION

ET is a chronic and progressive movement disorder, which may primarily result from dysfunction in the cerebellar motor networks and reduced inhibitory control. Yoga, including physical postures (asanas), breathing exercises (pranayama), and mindfulness practices (meditation and relaxation), offers a holistic approach that may help in addressing neurological challenges. Yoga may help in enhancing GABAergic inhibition, which is often reduced in ET patients[18,27], stabilize autonomic functions to reduce stress-related tremor triggers[28], and, strengthen motor control via improved posture, proprioception, and muscle coordination. Although the clinical evidence is still limited, preliminary studies suggest that regular practice of Yoga may help in reducing tremor intensity and improving balance in individuals with ET[31,32].

Nevertheless, high-quality evidence is lacking. Most existing studies are small pilot trials, highlighting the need for well-designed research. Future research should include RCTs comparing Yoga to active controls, objective measurements of tremor and muscle activity, and exploration of underlying neural changes. If these benefits are confirmed, Yoga could serve as a valuable complementary therapy for ET, supporting motor function and enhancing Qol. Until then, it should be considered an experimental but generally safe approach that warrants further study.

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