Yoga In Neurotology

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Introduction:

This write-up is designed to introduce you to the simple world of yoga where you can restore your balance and regain balance-confidence through simple poses and techniques called *asanas*. Yogic asanas if properly performed, help to overcome the haunting fear and apprehension of an impending fall or that of recurrence of an attack of dizziness that plagues most balance disorder patients.

Balance disorders severely jeopardise quality of life. Head spins or vertigo is just a part of the overall morbidity in a balance disorder patient. There is much more to it. Diseases of the balance system disturb the homeostasis of the body and mind. The mental discomfort induced by a balance disorder is

no less than the physical morbidity induced by it. The primary (but not the sole) purpose of the balance system is to maintain postural and visual stability. Postural stability implies the faculty by which an erect posture can be effortlessly maintained without stumbling or falling, and visual stability implies visualising a stable and clear image of the visual surroundings.

The mechanism of balance

The maintenance of balance entails acquiring sensory inputs from different sense organs primarily (1) the eyes, (2) the vestibular labyrinths in the ears, and (3) proprioceptors which are sense organs in the soles of the feet in the buttock, back and other parts of the body. Each of these sensors inform the brain about the stability of the surroundings, the stability /position of the head on the shoulders and that body on the ground where the subject is positioned. Information from these different sensors is first integrated

in the brain. Next, this information about the stability and orientation of the ground and the surroundings is compared with similar experiences stored in the brain in a system called vestibular memory. Based on this, the brain decides which body muscles and eye muscles to contract and at what speed and in what order so that the body remains physically stable, does not fall and the eyes see a clear stable and unwavering image. If the former fails, we fall or feel unstable and it latter fails we get head spinning.

So the maintenance of balance entails collecting information through different sensors, then integrating all the sensory information in the brain, and then as and when necessary, taking informed and judicious decision on how to use the muscles of the body & eyes in the best possible way and with minimal expenditure of the body's resources to maintain stable posture and perceive a stable image of the visual surroundings.

Maintenance of balance involves the perfect, coordinated and harmonious functioning of different parts of the brain. The parts of the brain involved are not just the structures that control muscles and joints of the body that can prevent a fall or just the muscles of the eyes that can effectively move the eyes to ensure that the subject visualises a stable image of the surroundings. The highest echelons of the brain that provide the sense of stability and confidence / mental security pertaining to balance are also a part of the balance system. The balance system is also intimately connected with the psychic system that generate fear / apprehension / emotions as well as the cognitive system which engages in perception, attention, and other higher functions. The balance system is not something that is confined to the balance sensors in the ears (vestibular labyrinths) but involve structures and biological mechanisms much beyond that. No wonder,

balance disorder patients have many comorbidities involving multiple biological systems.

Let's begin…

Yoga is very relevant in the management of balance disorders as Yoga is a holistic therapy. Balance disorders are not just head

sinning or imbalance/ unsteadiness/ dizziness. These are just a small part of the morbidity of a balance disorder patient. Balance disorder patients have co-morbidities affecting the psychic, cognitive, perceptual and autonomic systems. Very commonly they are irritable, lack attention, have poor perceptive powers, harbour a underlying fear, and apprehension, have anxiety and many other morbidities, some physical /organic, some psychic and some cognitive. Balance disorder patients hence need a therapy that addresses all the different morbidities at the same time. Most, if not all balance disorders therefore need a holistic therapy. Balance some organic have organic, emotional, cognitive, and psychic ramifications. Hence, a holistic treatment management system that can target the multiple morbidities together is mandatory for restoring normalcy in balance disorder patients.

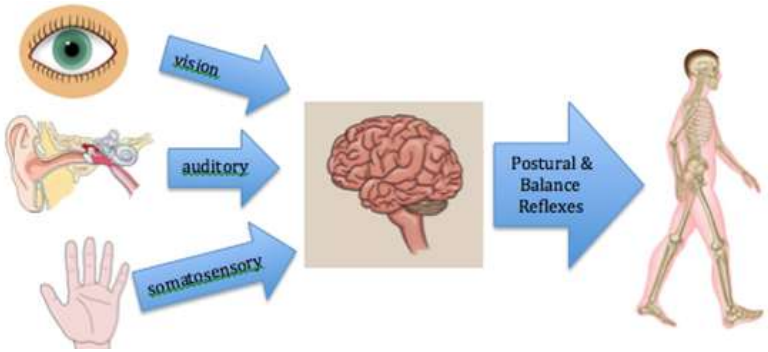
Why Yoga?

Yoga is a way of life and if one considers the relevance of holistic therapy in balance disorder patients, Yoga appears to be the best therapeutic modality most suited for management of balance disorders with its varied co-morbidities.

Yoga and Balance

A comprehensive yoga routine offers an excellent opportunity to foster mental

qualities like balance, equanimity, and serenity, as it harmonizes the body, mind, and spirit. Additionally, within yoga are specific methodologies designed to steer both body and mind towards deeper states of harmony, inner peace, and communication with the outside world.



Achieving optimal body balance relies on the effective functioning of three key systems:

- **Vestibular system**
- **Visual system**

- **Somatosensory system**

Yoga, being a methodology of multisensory integration, helps in enhancing the coordination and amalgamation of these systems.

Findings

"Our results provide substantial evidence that postural control in healthy young adults can be improved through practicing hatha yoga."

https://pubmed.ncbi.nlm.nih.gov/25035623/

Yogic Approach to Various Aspects of Balance

For the uninitiated, in Yoga, balance extends much beyond the physical act of standing on one foot with the torso twisted precariously; yoga represents a journey of self-awareness and mental concentration. Yoga is a holistic process, a lifestyle change where the goal is establishing inner equilibrium. Balance disorders need holistic therapy that affects both the body and the mind. The psyche is as important as the body in yoga.

The yogic approach to attain this inner equilibrium or balance can be broadly classified under seven heads:

- **Cognition and Focus**
- **Stress**
- **Diet**
- **Gravity alignment**
- **Stability**
- **Muscular Strength and Endurance**
- **Circulation**

Impact of Yoga on Cognition and Focus:

Cognition refers to the complex array of mental processes that enable us to acquire knowledge, understand information, and execute goal-directed actions. This includes fundamental functions like perception and attention, which filter and process sensory input, as well as higher-level abilities such as learning, problem-solving, memory,

language, and visuo-spatial processing. These interconnected processes collectively form the basis of human intelligence, allowing us to effectively navigate and interact with our surroundings, interpret sensory data, and make informed and judicious decisions in novel and challenging situations.

The maintenance of balance involves collecting information from the different sensors which is perception, storing the collected information in vestibular memory and retrieving the information later on as and when necessary, i.e., when encountering a similar situation (memory and learning), deciding on the best possible solution to maintain correct posture in any challenging situation (problem -solving), and on the basis of it judiciously analysing the situation and executing the appropriate motor activity to maintain postural and visual stability with minimum expenditure of the body's physical resources (executive

function). Hence the maintenance of balance is a cognitive process, and cognitive enhancement is a primary requirement in the management of balance disorders. Yoga enhances cognitive faculties.

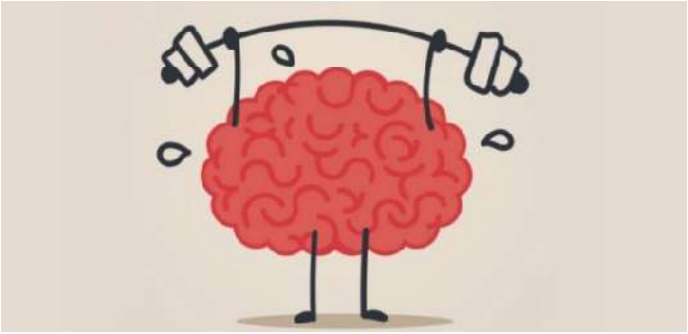
Attention and Awareness: Yoga and mindfulness which again is a part of yoga enhance body awareness, improving spatial orientation and thereby reducing dizziness. Dizziness is defined as impaired spatial orientation. Mindfulness is awareness of one's internal states and its relationship with

the surroundings. It is defined as the state of being conscious or aware of the self and the immediate surroundings and mentally concentrating on our current thoughts and on what we're sensing in the present moment. It is achieved by focusing one's awareness on the present moment, while calmly acknowledging and accepting one's feelings, thoughts, and bodily sensations. Focussing thoughts on the present feelings is a particularly important part in the maintenance of balance.

Motor Learning: Balance exercises improve motor control by leveraging brain plasticity to strengthen neural connections related to perception, memory, and decision-making.

Anticipation and Prediction: Yoga improves balance by improving cognitive skills like enhancing the power of mental focus, spatial

awareness, and decision-making as regards employing the most economical way of maintaining balance in difficult situations through practising challenging poses. (asanas). Proper practice enhances perception, attention, and executive function, all essential for maintaining equilibrium in dynamic and difficult environments where the subject is prone to lose balance or get an erroneous sense of movement (vertigo).



Dual-Task Performance: Yoga trains "dual-tasking," improving balance by dividing

attention between physical and mental demands, like staying balanced while focusing on breath. This fortifies resource allocation, which is crucial for those with balance disorders.

Confidence and Motivation: Yoga enhances cognitive function by boosting self-efficacy and motivation, reducing fear and stress, and improving mood and emotional regulation. All of these are vitally important in restoring balance once the balance system has been compromised.

Compensatory Strategies: Yoga helps the brain compensate for impaired balance senses by strengthening proprioception and cognitive strategies, improving equilibrium even with compromised sensory input.

Higher BDNF Levels: Yoga increases BDNF, a protein crucial for neuron health, leading to improved learning, memory, and cognitive function.

Findings

"Significant improvement in depression scores and serum BDNF levels, and reduction in serum cortisol in the yoga groups, have been described in previous reports. A significant negative correlation was observed between change in BDNF (pre-post) and cortisol (pre-post) levels in the yoga-only group (r = -0.59, p = 0.008). In conclusion, yoga may facilitate neuroplasticity through stress reduction (and cognitive enhancement) in depressed patients."

https://pubmed.ncbi.nlm.nih.gov/27174729/

Stress Reduction through Yoga:

Stress is considered a major contributing factor to the development of non-communicable diseases (NCDs), including Cardiovascular diseases, Diabetes, Cancer, Mental health disorders, etc. Stress has also

shown to have significant effects on neurotological disorders. Th other way round, it has also been proven that balance disorder increase mental stress and induce psychical ailments like anxiety and depression. Anxiety has two-way relationships with mental stress; one perpetuates the other.

Stress Reduction and HPA Axis Regulation: Chronic stress disrupts the balance system via the HPA (hypothalamic-pituitary-adrenal) axis; yoga mitigates this by lowering stress hormones, thus protecting the balance system and the cells of the vestibular labyrinth in the inner ear.

Neural Pathway Modulation and Sensory Integration: Yoga practices improve balance by changing brain pathways for better signal processing and enhancing the integration of the 3 sensory inputs visual, vestibular and

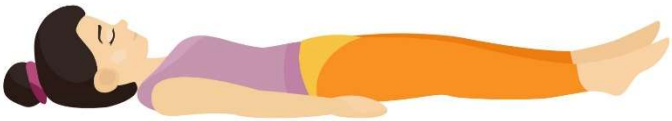
proportionating on the basis of which balance in maintained.

Yoga offers benefits by enhancing sensorimotor integration, improving postural control, improving cognition which includes mental focus and promoting psychological well-being.

Increased Alpha Brain Waves: Alpha brain waves, are increased by Yoga. The alpha waves are associated with reduced stress and enhanced relaxation. This implies that yoga induces relaxation, reduces stress.

Reduced Mind-wandering: Yoga reduces mind-wandering, fostering present-moment focus and mindfulness, which directly combats stress-related mental agitation. This enhanced mindfulness, a key benefit of yoga, helps manage stress-induced neurological symptoms.

Decreased Cortisol Level: Stress hormones like cortisol and adrenaline disrupt the body's homeostasis and jeopardises the smooth and harmonious functioning of the vestibular system, causing vertigo, dizziness, and imbalance. Yoga lowers cortisol, the main stress hormone, directly reducing stress and anxiety. This hormonal shift lessens muscle tension, improving physical balance and coordination.



Parasympathetic Activation: Yoga activates the parasympathetic nervous system, which counteracts the body's stress response. This helps to reduce the levels of stress hormones

like cortisol, which exacerbates balance disorders.

By promoting physical and mental relaxation, yoga helps to calm the nervous system, reducing the overall ,sense of anxiety, irritability, mental agitation and mental tension that often causes or accompanies dizziness.

Lifestyle and Metabolic Improvement through Yogic Diet and Practices:

Yoga draws most of its lifestyle and diet related wisdom from Ayurveda. Yoga and Ayurveda are two complementary and interconnected systems of holistic health and wellness that originated in ancient India.

Yoga and Digestive Health: Yoga stimulates the Vagus nerve, improving brain-gut communication. This enhances digestive

function and reduces symptoms like indigestion, bloating, and constipation, which are common in balance disorder patients.

Yoga for Age-Related Issues: Yoga eases age-related constipation and insomnia, both common in elderly balance disorder patients. Daily yoga practice helps aged neurotological patients to improve bowel movement and sleep quality.

Ayurveda and Digestive Function: Ayurveda considers proper digestion essential for overall health. Digestive dysfunction can contribute to various includes diseases, balance related disorder. Indigestion has a psychic impact, disturbs mental tranquillity which in turn aggravates the psychic impact of balance disorders.

Balanced *Vata Dosha*: According to Ayurveda, *vata dosha* is associated with movement and is often the root cause of balance problems. An Ayurvedic diet can help reduce the *vata dosha*. Vata or Vayu is the energy of movement and is compared with Kinetic energy within the body. All the movements in the universe and inside the body are considered to be because of "Vata". Vata regulates and governs the movement of blood, breath, and transmission of nerve impulses; it also modifies mental processes

like thought, creativity, and communication. Vata also plays an important role in Sensory perceptions like touch, taste, hearing etc. It is also believed to be responsible for the elimination of waste products from the body.

Weight Issues: Being overweight or obese can put additional strain on the musculoskeletal system, making it harder to maintain balance and stability. Proper Ayurvedic diet helps us is maintaining a healthy weight and improve balance.

Reduced Inflammation: - Certain Ayurvedic spices have anti-inflammatory properties. Reducing inflammation improves nerve function and muscle coordination, contributing to better balance.

Findings

Wilcoxon's sign rank test has shown that the yoga group had statistically significant changes in most of the parameters in PSQI and PAC-QOL ($P \leq 0.05$). Mann Whitney test revealed that yoga group has better improvement in the sleep quality and constipation related QOL ($P \leq 0.05$) compared to the controls.

https://pubmed.ncbi.nlm.nih.gov/34391308/

Yoga Improves Body's Alignment to the Axis of Gravity:

Yoga emphasizes on body alignment to help the yoga practitioners achieve balance, stability, and proper posture in each pose. Regular practice of yoga trains the body to become more aware of its alignment to the plane of gravity and to naturally find the right balance for maximum stability. It trains the body and adapts the brain to maintain balance in different challenging postures.

Lengthens and Strengthens the Spine: Yoga postures engage core muscles to lengthen the spine, counteracting gravity's compression. Regular practice improves posture and overall spinal alignment, thus improving balance.

Proprioception Enhancement: Yoga enhances proprioception by challenging the body's awareness of its position in space. It trains the brain to efficiently process signals from muscle and joint receptors, improving balance and alignment with gravity.

Increases focus and concentration: Holding a balancing pose requires mental focus on maintaining the body's centre of gravity within the perimetry of the single foot. This focus translates to better balance in everyday activities as well.

Yoga to improve Stability:

As mentioned earlier, maintaining stability relies on the intricate coordination of three primary systems within the body: the **visual system, the vestibular system, and the somatosensory system.**

Yoga postures (asanas) often engage multiple muscle groups, strengthening them

and improving overall body stability. Core muscles, crucial for balance, are particularly targeted in many yogic poses (asanas).

Neuroplasticity and Brain Function: Yoga promotes neuroplasticity, altering brain activity and structure, which strengthens rejuvenates neural pathways enhancing neural transmission and promotes sensory-motor integration. This enhancement improves brain-body communication and coordination. The maintenance of balance is all about this only. The neural pathways involved in maintaining balance (postural and visual stability) are ramified all over the brain and involve the nerves (neural pathways) in the limbs and trunk, more importantly the lower limbs (legs) and the core muscles (muscles around the spine and the hips). Efficient and fast neural transmission between the scattered structures in the brain and the limbs and

trunk needs a very healthy nervous system. Yoga fortifies neural transmission and sensory motor integreation.

Stimulates vestibular reflexes: Yoga is a robust method for stimulating vestibular reflexes. Varied movements in Yoga activate the vestibular system, improving balance and spatial awareness, which reduces mental stress and anxiety. Training posture in different planes strengthens these reflexes, fostering better control ad overall well-being. The feel of mental and physical well-being and the self-confidence related to balance, the feel of physical stability as opposed to a persistent insecurity about physical balance, are all enhanced by yoga.

Postural Control: Yoga poses or asanas challenge postural control, engaging the

vestibulospinal reflex, which helps coordinate muscle activity to maintain upright posture and balance.

Strengthens Somatosensory system: Yoga increases brain volume in several key regions, including the somatosensory cortex and visual cortex. The somatosensory cortex houses a mental representation of the body; the superior parietal cortex, which is responsible for directing attention; and the visual cortex which steers visual attention are all stimulated (hence functionally improved) by yoga. All of this is instrumental in improving balance and reinforcing the feel of stability.

Develops mindfulness: Enhancing stability through yoga has the potential of playing a pivotal role in fall prevention, as yoga

encompasses elements of mindfulness, body awareness, self-acceptance, and courage. All balance disorder patients have some sense of insecurity related to balance and lack confidence and hance harbour a fear of fail. This makes them confined to home or their perceived place pf safety be it the bed or a particular chair in the house/workplace. This, in turn, further aggravates the balance disorder.

Yoga breaks this vicious cycle of one perpetuating the other. Whereas conventional vestibular physiotherapy improves physical stability, yoga acts on both the body and the mind. This augments the much needed feel of being stable, reduces the sense of physical insecurity and improves the patient's level of confidence related to balance.

Findings

“Yoga has an advantage over Vestibular Rehabilitation since it offers a customized cure for giddiness in addition to symptom relief. Yoga might be a great alternative to the conventional VR because along with enhancing overall body relaxation, it is affordable and is easy to learn.”

”https://pubmed.ncbi.nlm.nih.gov/39290846/

Yoga improves Muscular Strength and Endurance:

Strengthening of muscles is fundamental in balance rehabilitations as it bolsters the stability of joints, proprioception, and movement control to minimise swaying in different conditions of day-to-day life. This can be easily achieved by the regular Yogic practices as this translates into reducing the risk of fall, improvement in ability to perform daily activities, in turn promoting functional recovery and an enhanced quality of life.

Isometric Contractions: Holding yoga poses strengthens muscles through isometric contractions, particularly the muscles of the

legs and that of the core muscles, that stabilize the hips, the spine and the pelvis.

Builds muscle memory: The slow, deliberate movements in Yoga enhance neuromuscular coordination that builds muscle memory, improving the body's ability to control precise movements. This leads to better stability, posture, and alignment in both static and dynamic situations.

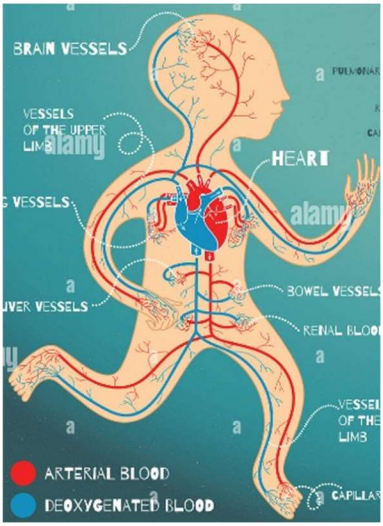
Muscle Tone and Coordination: Yoga enhances balance and fall prevention by improving muscle tone, coordination, and strength, particularly through eccentric contractions that build core and leg muscle strength. Strong core and leg muscles are essential for maintaining balance.

Progressive overload: Like weight training, yoga can be practiced with progressive overload. This means gradually increasing the difficulty of the practice over time, such as by holding poses for longer or transitioning between poses more quickly. This challenges the muscles and facilitates increase of muscle mass and muscle strength both are important for maintain balance. Sarcopenia which is one of the commonest causes of unsteadiness and falls in aged patients can be prevented and in most cases also corrected by yoga as it improves muscle mass and muscle strength.

Focus on underused muscles: Yoga targets often-neglected stabilizer muscles, crucial for joint stability and support, unlike everyday activities or traditional workouts. Strengthening these muscles enhances

overall balance and reduces the risk of falls and injuries.

Yoga for improved Circulation:



If the heart fails to pump enough blood to the brain, sensations of dizziness, faintness, or a sinking sensation is perceived.

Increased Blood Flow and Oxygen Delivery: Yoga enhances balance by increasing blood flow to muscles, joints, and the brain, improving oxygen and nutrient delivery. This supports optimal function of brain regions crucial for balance, cognition, and emotion, potentially mitigating neurodegeneration. Neurodegeneration in the brain be it age -related or otherwise, is one of the commonest causes of dizziness and unsteadiness.

Increased Nitric oxide production: Certain yoga practices, like *Pranayama* (regulated breath exercises), increase the production of nitric oxide in the body. Nitric oxide is a vasodilator, implying that it helps relax and dilate blood vessels, improving overall

circulation more specifically cerebral microcirculation.

Waste removal: Improved circulation from yoga asanas facilitates metabolic waste removal, optimizing tissue function. Twisting, inverted, forward bending poses, and dynamic practices like Sun Salutations aid in detoxification, lymphatic drainage, digestive waste removal, and toxin elimination through sweat. The general well being achieved by this vastly improves balance, improves confidence about the perceived physical stability and reduces the sense of insecurity and the persistently bugging apprehension of an impending loss of balance that most balance disorder patients have.