

**VESTIBULATOR - A unique therapeutic device working as the
pacemaker for Vestibular Dysfunction.**

WHITE PAPER

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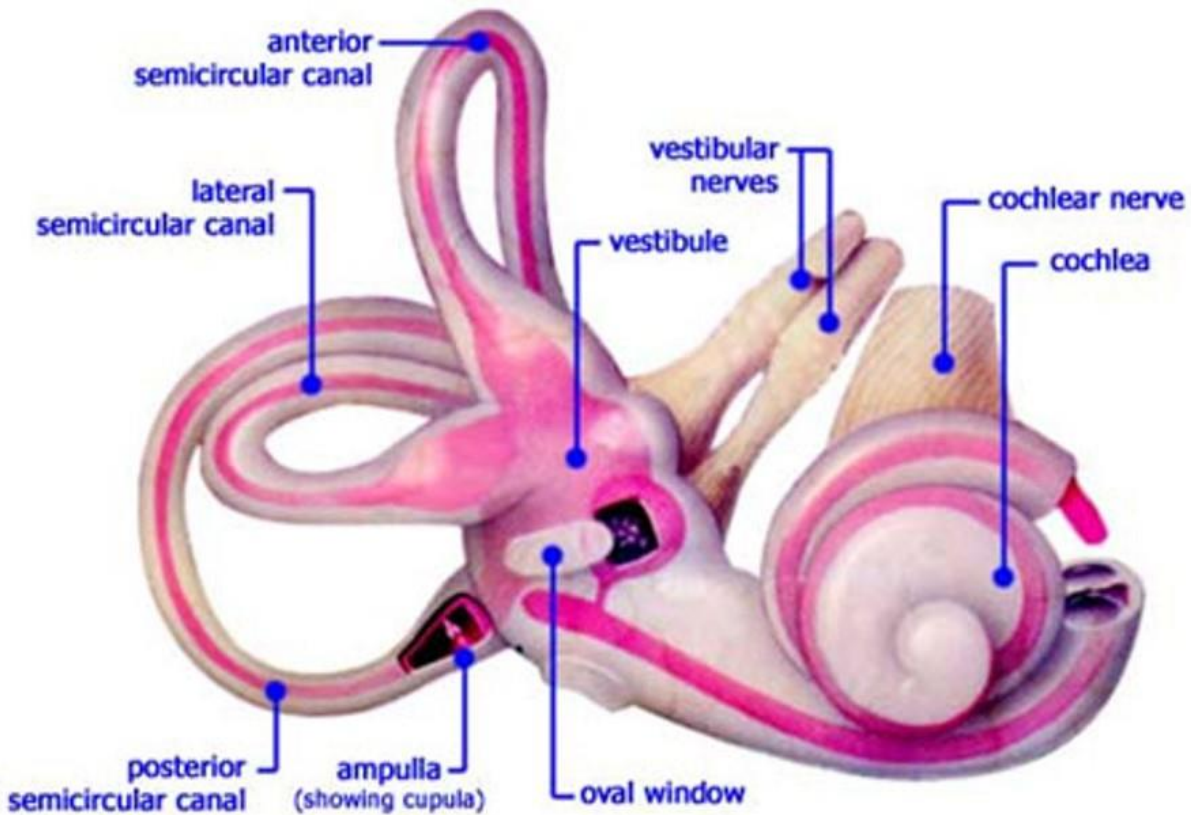
Abstract: Vestibulator - A unique therapeutic device working as the pacemaker for Vestibular Dysfunction.

The Vestibulator, an equipment designed by Transpact Enterprises Pvt. Ltd. works wonders for the cases with vestibular dysfunctions. It is a unique, innovative and mechanized digital healthcare solution (therapeutic device) based on co-patented technology of IRCC-IIT Bombay and Transpact Enterprises Pvt. Ltd.

This device is designed to offer optimum Vestibular Stimulation to the patients suffering from vestibular dysfunction due to direct or indirect pathology .example pediatric population suffering from Autism, ADHD and Cerebral Palsy.

Key words: Cerebral Palsy, Autism, Vestibular dysfunctions, Vestibulator, Socio-economic impact, Rehabilitation, Treatment methods.

Introduction: The Vestibular System an internal GPS of the body.



Vestibular apparatus is situated inside the inner ear adjacent to cochlea. It consist of three semicircular canals , utricle and saccule .Smallest movement of any part of the body or the movement of the environment stimulates the Vestibular network which informs the balancing brain (cerebellum) to balance the person’s body in space against gravitational forces .Example whether a person is walking or he is in the vehicle (Bus ,train, car), whether he is climbing steps or is in the lift , rotating in space or enjoying a ride on rollercoaster , the vestibulo – cerebellar network keeps him upright , not allowing him to be victim of gravitational forces which are continuously influencing the body. It is responsible for grounding a person in space. The automatic body orientation in space is the foundation of one’s body posture and therefore self-confidence and personality. It keeps one’s audio-visual network free for learning new things. The vestibular apparatus starts emerging from 8th week intrauterine life. The network starts forming with the fetal movements in the womb .The formation of the apparatus is completed by nine months, just before the birth to experience the first gravitational pull at the time of birth .If there are more than one fetuses in the womb or if, the expectant mother is

advised bed rest due to any medical reason, the vestibular system is less stimulated at the time of formation of the network and therefore, it works at low Voltage. Post birth optimum vestibular voltage results in normal tone of the skeletal muscles before birth, so there is an active participation of the child during delivery. If the child's muscle tone is low, the mother doesn't go into labor even at full term. In these cases, the labor pain is induced and most of the time emergency caesarean is required for safe delivery of the child.

Initially, the child is a victim of gravity. Over a period of time the Vestibulo-cerebellar network starts maturing resulting into motor milestones from getting head control by three months to independent walking by one year three months.

If, vestibular network is not functioning with optimum voltage, the child's muscle tone remains low; he/she becomes visually dependent for his/her body orientation in space and therefore unable to have eye contact. His/her eyes are not free to learn new things from the environment. The GPS of the body doesn't give right information to remain upright; the child automatically relies on the visual system for body orientation in space. The children with vestibular dysfunction have difficulty in perceiving gravity. They seek extra vestibular stimulation by climbing on heights, running around and jumping aimlessly. They get anxious in any new atmosphere or crowded place like mall or railway station as they lose track of their body in space. These are the children who are diagnosed with ADHD (Attention Deficit Hyperactivity Disorder) when they grow. They have lots of difficulty in coping up in academics in spite of average or above average intelligence.

Children suffering from Autism have defective network in certain areas of nervous system. The defective network in the area of trunk representation at cerebellar level (vermis of the cerebellum) results into impairment in the understanding of the total body in space. They seek extra vestibular input by fast rotations of the body in space or run around aimlessly without eye contact to understand about the environment. They move around fearlessly and many a times hurt themselves. Their auditory network gets inhibited with overactive vestibular network which affects in processing the language.

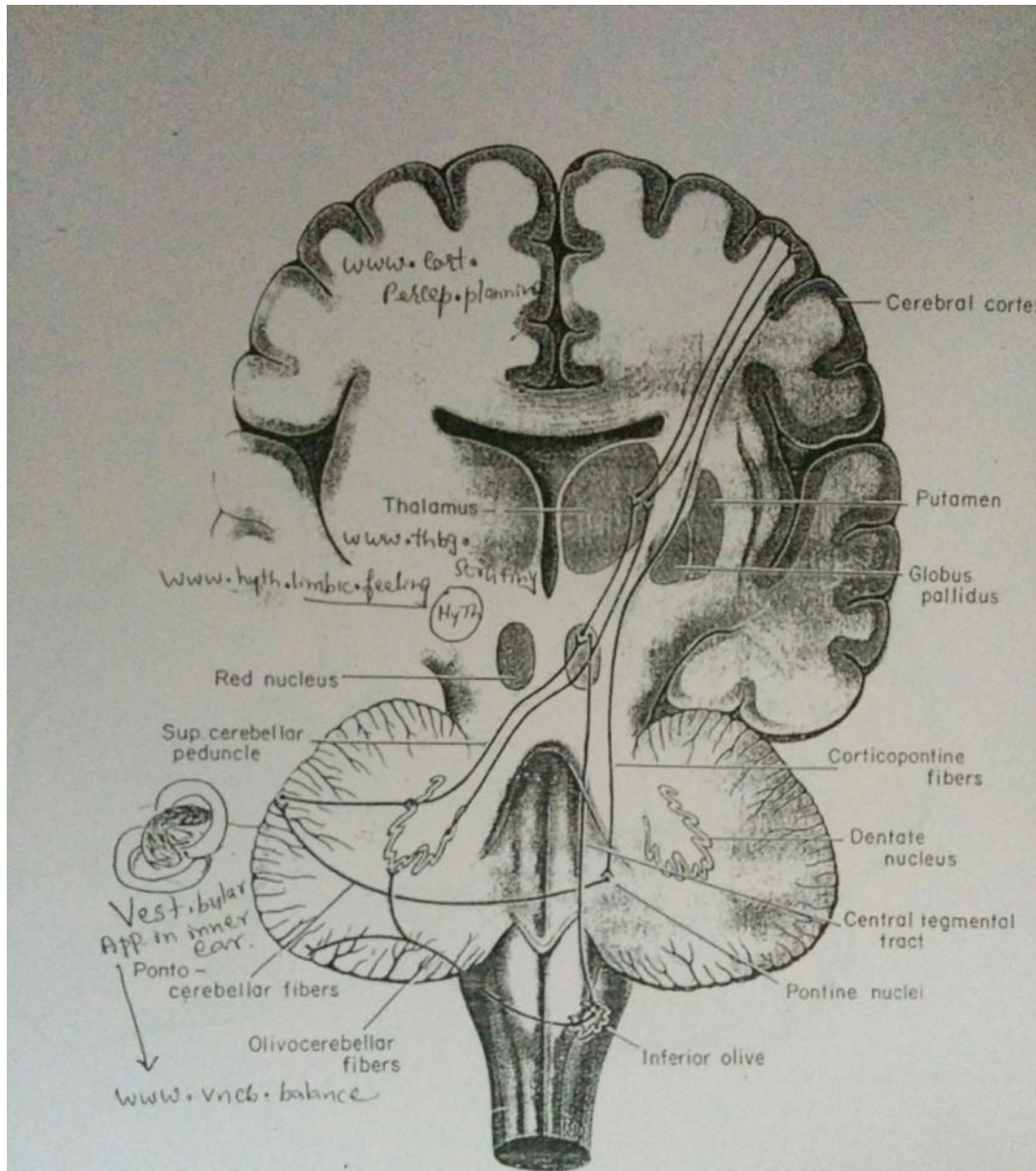


FIG. 14-21. Diagram of some of the principal afferent and efferent cerebellar connections. Cerebellar efferent fibers from the dentate nucleus are shown in blue. Corticopontine and pontocerebellar fibers (black) represent the most massive cerebellar afferent system. The principal inferior olivary nucleus receives uncrossed descending fibers from the red nucleus and periaqueductal gray via the central tegmental tract. Cortico-olivary fibers to the principal inferior olivary nucleus (not shown) pass via the medullary pyramids. Olivocerebellar fibers (black) cross, enter the inferior cerebellar peduncle and are distributed to: (1) cerebellar cortex as climbing fibers, and (2) the deep cerebellar nuclei.

The human nervous system may be understood as combination of different Websites:

1. Vestibulo-cerebellar network for survival www.vncb.balance
2. Hypothalamolimbic network for feelings and emotions www.hythlimb.feeling
3. Cortico-cortical network for perception www.cort.perception.

Unlike websites created by humans, God made websites are interdependent. If one is working defectively it will indirectly affect the function of the other website.

Example if Vestibulo-cerebellar network is defective , it will project the tension on the network of emotions , either the individual will be scared to move in new surroundings or will move fearlessly putting himself/herself in dangerous situations. His/her higher brain will be unable to perceive the environment properly.

In the cases with cerebral palsy, the higher brain is damaged and so has defective communication with the balancing brain resulting into functional impairment in Vestibulo-cerebellar network. The skeletal system becomes the victim of gravity resulting into either low muscle tone (hypotonia) or exaggerated muscle reactions to gravity with increased muscle tone (Spasticity or hypertonia).

The Vestibulo-cerebellar network gets consolidated once the structural growth is complete as the gravitational pull will remain constant once body reaches optimum height.

The Vestibulo-cerebellar network is the first network to function in life .It starts degenerating after the age of 35 years .As the age advances the person becomes the victim of gravity and is prone to loose balance in new environment .There is a need of Vestibular-Rehab for geriatric population to keep them upright, to prevent falls and there by avoid fractures which is very common in old age population.

Thus, Vestibular Rehab is the need for Pediatric cases of ADHD, Learning difficulty, Autism, Cerebral palsy and geriatric population.

Vestibulator:

The Vestibulator is equipment designed and patented by Transpact Enterprises Pvt. Ltd. in collaboration with IRCC, IIT Bombay.

The machine is designed to activate controlled Vestibular input depending upon the need of the child .It is programmed to give specific motions to specific child. There is a provision for the patients to be put in various positions viz to lie down in supine and prone position, chair sitting or kneeling, be in quadruped position or standing.

The machine is programmed to activate the vestibular network by offering antero-posterior tilts, lateral and angular tilts, horizontal acceleration and vertical acceleration over and above rotation from 0 to 360 degree.

The speed, velocity and angle of motion is controlled .It may be increased or decreased depending upon the need of a particular patient.

Traditional Vestibular Rehab is time consuming as different therapeutic tools are required for different motions example equilibrium board for lateral and antero-posterior tilts, stability trainer to challenge the balance, revolving chair or swing for rotation.

The Vestibulator is providing every motion which can be specifically controlled in speed, rate and velocity depending upon the need of an individual patient; thereby a therapist can get targeted results saving time and energy of the patient as well as him/herself.

Clinical Advantages of Vestibulator:

Efficiency: Vestibulator is ergonomically designed to impart all the positions to a patient from Supine and prone lying to sitting and standing during vestibular stimulation.

Accuracy: The Vestibulator is designed to provide desired vestibular stimulation with accurate amplitude, speed and number of cycles to a patient planned by the therapist.

Enhanced Monitoring: The integrated software in the machine is designed for keeping the detailed record of the patient's medical history, treatment and progress report .The cloud based data storage of personalized records aims at easy access and monitoring of treatment.

Cost Efficiency: The therapy sessions on Vestibulator along with simultaneous therapy sessions of regular sensory integration therapy for the children with ADHD, Autism and Neuro developmental therapy for cases with Cerebral Palsy or global developmental delay reduces the number of sessions required for improvement in the child. It is easier to achieve desired qualitative results with combined treatment .The faster results with combined treatment lessens the financial burden of the family and saves the time and energy of the therapist which helps her to have the time to handle more number of patients.

Features of Vestibulator:

1. Safety:

- Secured Railings with Emergency Stops.
- Infrared Security.
- Optical & Positional Sensors.
- Alarms.

2. User friendly:

- Separate Console for Operator.
- Child-friendly design.
- Biocompatible.
- Safety & Comfort for both Patient & Operator.
- Enhances Patients' Comfort & Tolerance.

- Reduces the Physical demand on the therapist.

3. Digital Connect:

- Cloud- based.
- IoT.
- Analytics.
- Business intelligence.
- Mobility.

Vestibulator and Current Management Techniques:

Currently the Vestibular Stimulation is provided during therapy sessions by equipment's like swings, slides, equilibrium boards and stability trainers .During initial sessions the child is treated on the equipment's with eyes open and once he/she shows visible improvements in orientation of the body in space and automatic balance he/she is treated with occluded vision for proper vestibular takeover .The treatment plan depends upon qualitative judgment of the therapist.

The therapy sessions on Vestibulator becomes very specific as it can provide desired degree of motion with desired speed , amplitude in desired positions decided by the therapist for a particular patient . Thereby achieve quicker qualitative results.