Neuraxis Training Apparatus and Method Thereof

Field of the Invention

~~[0004]~~ The present invention relates to training device. In particular, the present invention relates to apparatus and method for training neuraxis.

Background

~~[0002]~~ Human nervous system is responsible for motor, sensorial, cognitive, behavioural and emotional functions of a human. The nervous system coordinates the actions of the person and transmits signals between different parts of its body. It consists of two parts, the central nervous system (CNS) and peripheral nervous system (PNS). The CNS, also known as the Neuraxis contains the brain (rhombencephalon, mesencephalon, and diencephalon) and spinal cord. The PNS consists mainly of nerves, which are fibers branched out from the CNS to every other part of the body. The PNS also includes the enteric nervous system, which is a semi-independent part of the nervous system whose function is to control the gastrointestinal system.

~~[0003]~~ The nervous system controls and coordinates how the human senses, moves, thinks, and behaves in his everyday life in response to his environment. All information pertaining to the environment is brought into the neuraxis, which will process the information and thereafter, yield appropriate reactions based on the information. The reactions are then communicated back to the corresponding organs.

~~[0004] Dysfunction of the neuraxis and part thereof may lead to human~~ developmental delays such as poor sensorimotor skills, because information needed by the human to develop is not well communicated between the brain and the body. For example, a child with developmental delay does not experience a sense of dizziness when being spun on a chair. Although his vestibular system (i.e. a system that is responsible for maintaining balance by monitoring motion of head and stabilizing eyes relative to the environment) is intact, he is still not able to sense the dizziness. Apparently, it is his neuraxis that is not functioning well such that the spinning stimulus inputs are not projected well to other parts of the neuraxis, thereby ~~the subject that is being spun cannot generate proper reactions such as dizziness.~~

~~[0005]~~ When the vestibular apparatus is fired up in response to the stimulus, it sends stimulus inputs into two separate pathways to the cerebellum, i.e., a direct pathway that projects the stimulus directly into the cerebellum and an indirect pathway that projects the stimulus into the cerebellum via the vestibular nuclei in the brainstem.

~~[0006]~~ Once reached the cerebellum, the cerebellum sends stimulus inputs to the superior colliculus, and thalamus, which then projects the stimulus inputs to the primary motor and primary sensory cortices, and hypothalamus of the brain. These would then further project the inputs into the premotor and prefrontal cortices. From the premotor and prefrontal cortices, responses to the stimulus projections are sent back to the primary motor cortex, cerebellum, basal ganglia, reticular formation, brainstem nuclei, and spinal cord to the trunk and limbs. The premotor and prefrontal lobes are for executive functions, volitional eye and limb movements, motor learning

and planning, motor programs and sequencing, speech, social appropriateness, judgment, organizational skills, working memory, inhibition or excitation of antigravity muscles (shunt muscles), autonomic system regulation, learning and behavior.

~~[0007]~~ The cerebellum also projects the responses back into the vestibular nuclei and reticular formation via its fastigial nucleus and its cortex. In fact, the cerebellar projections to the vestibular nuclei outnumber those from any sources, because these cerebellar's projections are very important for maintaining human homeostasis. The maintenance of human homeostasis includes postural adjustments and stability, coordinated and stereotyped movements such as walking, and eye movements. Deficits in the cerebellum projections would show up as postural instability, ataxia in gait and movements, hypotonia, decomposition of movements, dysmetria in movements and in saccades, poor pursuits (which results in poor reading skills), dysarthria, and impaired cognitive functions.

~~[0008]~~ In maintaining human bipedalism, the projections from the vestibular nuclei in the brain stem influence the spinal cord to control postural tone of trunk and limbs, thereby maintaining good posture. This type of projection is through the vestibulospinal tracts, both lateral and medial. These vestibulospinal tracts are for antigravity muscles that affect postural changes to compensate for tilts and movements of the body and limbs. They are also important for stability of head positions as the human moves and coordination of head movements with eye movements. These help to keep people from falling and to allow humans to have a

good balance, postural tone and position sense (from proprioception and visual cues). Accordingly, the stability, tone and movements of the trunk and limbs are controlled.

~~[0009]~~ Apart from the trunk and limbs, the projections from the vestibular nuclei in the brainstem also influence eyes to generate appropriate eye movements in response to head movements via the abducens, oculomotor and trochlear nucleus and resulting cranial nerves. This is known as Vestibular Ocular Reflex (VOR).

~~[0010]~~ VOR is by which gaze can stay fixed on an object even though the head is moving or being moved. VOR is important in everyday life as in walking, talking, reading, running, jumping, being in the bus or car, etc. Exaggerated nystagmus is one of the resultant neuropathology that arises when the VOR is not working properly. Other related functional deficits are learning problems, visual problems, balance and motion sickness, neck and shoulder pains, hand and eye discoordination, etc.

~~[0011]~~ The stimulus inputs from sensory, motor, and autonomic pathways for the maintenance of body balance and homeostasis are relayed to the reticular formation in the brain stem. These inputs include those extensive connections between the vestibular and cerebellar system with the dorsal motor nucleus of the vagus and the pontomedullary reticular formation. The reticular formation regulates sleep, consciousness and arousal, breathing, feeding, swallowing, vocalizing, homeostasis, control of blood pressure and pulse, regulation of blood chemistry, gastrointestinal function, alimentation and elimination, control of posture and eye movements, and the modulation of the parasympathetic and sympathetic systems. Pathologies related to this area include dysautonomias and unusual pain and discomfort symptom patterns.

~~[0012]~~ With the projections paralleling the auditory pathways and those traversing the reticular formation, the projections reach up to the thalamus. The projections are projected to the parietal lobes (primary somatosensory cortex and association areas) and posterior insula near the auditory cortex. Together with the cerebellar projections, these projections give the conscious appreciation of body orientation and sense. Together with visual and proprioceptive input, they generate appropriate sense of orientation and movement. In conclusion, cerebellum, brainstem, and other parts of neuraxis must function well to integrate all projections so that human nervous system is able to properly response to any kind of stimulus.

Summary

~~[0013]~~ In light of the above, there is an objective of the present invention to provide an apparatus adapted to train neuraxis of a trainee.

~~[0014]~~ One aspect of the present invention provides a training apparatus for training neuraxis of a trainee. The training apparatus comprises a base, a frame rotatably mounted on the base in a vertical manner defining a vertical axis and a cabin for receiving the trainee. The cabin has a yaw-axis, a pitch-axis and a roll-axis that are perpendicular to each other. The cabin is pivoted to the frame on a pivoting point, through which a lateral axis is defined. The lateral axis is perpendicular to the vertical axis. When the cabin is in an upright orientation, the yaw-axis of the cabin is in line with the vertical axis. The training apparatus further comprises a driving assembly that operatively drives the rotation of the frame and cabin to rotate about the vertical axis and horizontal axis, respectively When the cabin is reclined about the lateral axis

into a recumbent orientation, and is rotated about the vertical axis by the driving assembly, the cabin rotates about the roll-axis.

~~[0015]~~ Another aspect of the present invention provides a method for operating a training apparatus. The method comprises providing a training apparatus comprising a base, a frame rotatably mounted on the base in a vertical manner defining a vertical axis, and a cabin having a yaw-axis, a pitch-axis and a roll-axis that are perpendicular to each other, wherein the cabin is pivoted to the frame on a pivoting point, through which a lateral axis, which is perpendicular to the vertical axis, is defined, and a driving assembly that operatively drives the rotation of the frame and cabin to rotate about the vertical axis and horizontal axis, respectively. The method further comprises rotating the cabin about the lateral axis and/or rotating the cabin about the vertical axis. When the cabin is reclined to a recumbent rotation and rotated about the lateral axis, the cabin accordingly rotates about its roll-axis.

Brief Description of the Drawings

~~[0016]~~ This invention will be described by way of non-limiting embodiments of the present invention, with reference to the accompanying drawings, in which:

~~[0017]~~ Fig. 1A illustrates a perspective view of a neuraxis training apparatus for training neuraxis of a trainee in accordance with one embodiment of the present invention;

~~[0018]~~ Fig. 1B illustrates a perspective view of the neuraxis training apparatus of Fig. 1A with cabin in recumbent orientation;

~~[0019]~~ Fig. 1C illustrates a side view of the neuraxis training apparatus of Fig. 1A with cabin in recumbent orientation;

~~[0020]~~ Fig. 1D illustrates a front view of the neuraxis training apparatus of Fig. 1A;

~~[0021]~~ Fig. 1E illustrates a side view of the neuraxis training apparatus of Fig. 1A;

~~[0022]~~ Fig. 1F illustrates a side view of the neuraxis training apparatus of Fig. 1A; and

~~[0023]~~ Fig. 2 illustrates a block circuit diagram of the neuraxis training apparatus controllable by a computer system, in accordance with one embodiment of the present invention.

Detailed Description

~~[0024]~~ The following descriptions of a number of specific and alternative embodiments are provided to understand the inventive features of the present invention. It shall be apparent to one skilled in the art, however that this invention may be practiced without such specific details. Some of the details may not be described in length so as to not obscure the invention. For ease of reference, common reference numerals will be used throughout the figures when referring to same or similar features common to the figures.

~~[0025]~~ The present invention provides a neuraxis training apparatus capable of stimulating and training neuraxis of a trainee. In one embodiment, the neuraxis

training apparatus is suitable for providing neuraxis training on trainee to reduce or address nervous system dysfunctions. The nervous system dysfunctions include, but not limited to, postural instability, ataxia in gait and limb movements, extrapyramidal disease and features (tremors, chorea, hemiballismus, and dystonoia) hypotonia, decomposition of movements, dysmetria in movements and in saccades, poor pursuits (which results in poor reading skills), dysarthria, positional and intentional tremors, Parkinson disease, dystonias, learning problems, dyslexia, Attention Deficit Hyperactivity Disorder (ADHD), autism spectrum disorders, visual problems, balance and falls, motion sickness and vertigo, neck and shoulder pains, sleep issues, feeding and swallowing problems, aphasia, dyspraxia, control of blood pressure and pulse, gastrointestinal function, dysautonomias, unusual pain and discomfort symptom patterns, Obsessive-compulsive Disorder (OCD), intellectual and behavioural disorders, developmental delays, cerebral palsy, plegias, motor and sensory dysfunctions.

~~[0026]~~ Fig. 1A to Fig. 1F illustrate the neuraxis training apparatus **100** in accordance with one embodiment of the present invention. The neuraxis training apparatus **100** is a two-axes rotational apparatus that allows the trainee to experience rotation about three axes of rotations, wherein the three axes are perpendicular to each other in a three-dimensional (3D) space.

~~[0027]~~ Fig. 1A illustrates a perspective view of the neuraxis training apparatus **100**. The neuraxis training apparatus **100** comprises a chair **101** encased by a cabin **105**. The cabin **105** has three-axes, i.e. yaw-axis **111**, pitch-axis **112** and

roll-axis **113**. The cabin **105** is provided with an access opening **106** that allows the trainee to get into the cabin **105**.

~~[0028]~~ During a training session, the trainee gets into the cabin **105** through the access opening **106** and sits on the chair **101**. The side of the cabin **105** that is provided with the access opening is herein referred as the front side of the cabin **105**. The trainee sits securely on the chair **101** by means of safety straps (not shown). The safety straps may include head strap, shoulder strap, waist strap, and limb straps. It shall be understood to persons skilled in the art that any fastening means known in the art may be used as to secure the trainee to the chair **101**.

~~[0029]~~ Still referring to Fig. 1, the cabin **105** is supported on a base **102** through a frame **107**. The cabin **105** is pivoted at its two lateral sides to the frame **107** through a first lateral shaft **112A** and a second lateral shaft **112C**, by which, a lateral axis **112B** across the first and second lateral shafts **112A** and **112C** is defined. Accordingly, the cabin **105** is operationally rotatable about the lateral-axis **112B**.

~~[0030]~~ The base **102** includes a plurality of extending legs **103**, each having a slip-resisting device **104** disposed at its distal end. The slip-resisting device **104** stabilizes and prevents the training apparatus **100** from slipping over when the training apparatus **100** is operating. The slip-resisting device **104** may be a stopper or a brake made of rubber.

~~[0031]~~ In another embodiment of the present invention, the base **102** may be secured on the ground directly. It is also possible that the base **102** is a heavy weight that supports the entire apparatus on the ground.

~~[0032]~~ Still referring to Fig. 1, the frame **107** is rotatably mounted on the base **102** through a vertical shaft **111A** in a vertical manner, by which a vertical axis **111B** is defined. When the frame **107** is rotated about the vertical axis, the cabin **105** pivoted therein is thereby rotated.

~~[0033]~~ When the neuraxis training apparatus **100** is not in operation, the cabin **105** is oriented in a default upright manner, wherein the yaw-axis **111** and the pitch-axis **112** of the cabin **105** are in line with the vertical axis **111B** and the lateral axis **112B**, respectively. In such arrangements, the cabin **105** is rotatable about its yaw axis **111** and pitch axis **112** through the rotations about the vertical axis **111B** and lateral axis **112B**. The rotations about the respective axis may be independently controlled and driven through a driving assembly.

~~[0034]~~ In one embodiment, the driving assembly comprises a first motor that drives first or second shaft **112A** to rotate the cabin **105** about the lateral axis **112B** and a second motor that drives the vertical shaft **111A** to rotate the frame about the vertical axis **111B**.

~~[0035]~~ Through the driving assembly, the cabin **105** is rotatable about its pitch-axis **112B** through the first motor. On the other hand, the cabin **105** is rotatable about the yaw-axis **111B** through the second motor. Accordingly, the

cabin **105** is rotatable freely in its yaw axis and pitch axis at any desired speed and direction through the driving assembly.

~~[0036]~~ Through the two-principle axes, i.e. the vertical and horizontal axes, it is possible to rotate the cabin **105** in its roll axis **113B**.

~~[0037]~~ To rotate the cabin **105** about its roll-axis **113**B through the two-axes rotational training apparatus **100**, the cabin **105** is first reclined to a recumbent orientation relative to the base support and maintained it in that orientation. Fig. 1B illustrates a perspective view of the training apparatus with the cabin **105** in recumbent orientation, while Fig. 1C illustrates a side view of the training apparatus with the cabin **105** in the recumbent orientation. Once the cabin **105** is inclined in the recumbent orientation, the second motor is actuated to drive the vertical shaft to rotate. In that case, the cabin **105** is literally rotated about its roll axis in any desired angle and speed accordingly. In effect, a trainee who sits on the recumbent cabin **105** would experience a rotation about the roll axis **113B**. As such, the neuraxis trainer apparatus **100** allows the cabin **105** to rotate about the yaw, pitch and roll axes through the two principal axes, i.e. the vertical and horizontal axes.

~~[0038]~~ It shall be noted that rotation of the cabin **105** about the lateral axis and rotation of the frame **107** about the vertical axis may be controlled separately or simultaneously in any combinations. This provides limitless ranges of rotational movements to the training apparatus **100**.

~~[0039]~~ It shall be noted that the cabin **105** is able to rotate freely about all the axes of rotation without any obstacles such as electrical wiring of the apparatus. The trainee sitting on the chair **101** encased by the cabin **105** is rotated thereby.

~~[0040]~~ Fig. 1D illustrates a front view of the training apparatus **100**. If desired, a door may also be hinged to provide a closure to the cabin **105**.

~~[0041]~~ Fig. 1E illustrates a side view of the training apparatus **100**. The cabin **105** is provided with a window **108** to provide the user with a view to the surrounding environment.

~~[0042]~~ Fig. 1F illustrates a top view of the training apparatus **100**. The cabin **105** may be made of any kind of materials that perform sufficient strength and durability. The material may be carbon-fiber-reinforced polymer, PVC, PET or fiberglass.

~~[0043]~~ When used to train the neuraxis of the trainee, the training apparatus is run according to a training protocol. The training protocol includes variables such as the direction, the speed and the period of rotation. The training protocol varies according to the need of each respective trainee. A diagnostician runs several neurological tests and examination to determine suitable training protocol for the trainee.

~~[0044]~~ The operation of the training apparatus **100** is controlled by a computer system **200**. Fig. 2 illustrates a block diagram of the training system controllable by the computer system **200**.

~~[0045]~~ The computer system **200** allows the training apparatus **100** to execute any neuraxis training protocols according to the needs on the trainee. The training protocols includes the training apparatus **100** operation parameters, such as direction of rotation, speed of rotation, acceleration and deceleration, duration of the training, and the like. The training protocols are preferably formulated by medical doctors and professionals and may be tailored according to individual needs and physiological conditions of the trainee. As such, the training apparatus **100** is able to provide each trainee with an individualized training protocol, which undoubtedly provides targeted training to localized parts of the trainee's neuraxis.

~~[0046]~~ Whenever necessary, the computer system **200** will allow the operation to be interrupted by the operator anytime to change the functions and parameters of the training protocols in accordance with one embodiment of the present invention. In a further embodiment, the computer system **200** can be adapted with input interfaces for allowing the operator to control the rotations of the training apparatus **100** manually. Details of these operations will be illustrated herein below.

~~[0047]~~ Referring to Fig. 2 the computer system **200** comprises a processor **201,** a storage device **202**, a display device **203**, and an input device **204**. The processor **201** controls and commands the overall operations of the training apparatus **100** according to the training protocols supplied thereto.

~~[0048]~~ The storage device **202** stores instructions and training protocols to be executed by the processor **201**. The storage device **202** may also be configured for

storing temporary information related to execution of training protocols by the processor **201**.

~~[0049]~~ The display device **203**, such as liquid crystal display (LCD) or the like, for displaying operation state and parameters of the training apparatus **100**. The input device **204**, such as keyboard or joysticks, adapted to manipulate basic system settings of the training apparatus **100**, to provide instructions to the processor **201** and to input personal information regarding trainee into trainee's personal folder stored in the memory storage device **202**. The input device **204** can be doubled as controller for manually controlling the rotations of the cabin.

~~[0050]~~ The computer system **200** is adapted to control the driving assembly to drive the cabin to rotate in the two principle axes. Specifically, the driving assembly comprises a vertical motor **206**, a horizontal motor **207**, sensors **208** and motor controllers **205**. There are provided with two motor controllers **205**, one connected to the vertical motor **206** and another connected to the horizontal motor **207**. The motor controllers 205 are adapted to control the speed and direction of the rotations of the driving motors independently. The vertical motor **206** and horizontal motor **205** are further connected to the respective sensors **208** so the operations of the motor assembly can be monitored accordingly. The sensors senses operating status of the motors and transmit the signals to the respective motor controller **205**. The motor (**206**, **207**), the sensor **208** and the motor controller **205** form a close loop connection.

~~[0051]~~ During operation, the trainee sits in the training apparatus **100**. The operator of the training device **100** inputs or selects the training protocols to initiate the training through the computer system **200**. As motor controllers 205, as instructed by the computer system 200, control the motors to drive the cabin **105** to rotate, either independently rotating about the two principle axes, or in combination thereof. The real-time rotational movement of the cabin is sensed by the sensor **205** coupled to the motor. The information regarding the cabin movement is then feedback to the processor **201**. The processor **201** processes the information and output them as a graphical representation on the display device **203** in real-time. The graphical data can be displayed to the operator via the displaying device **203**. The graphical data is then stored in the trainee's personal folder. The collected graphical data can thus be further studied and followed-up to evaluate the trainee progress in response to the training.

~~[0052]~~ In yet a further embodiment, the training apparatus **100** may further incorporate with necessary monitoring or intensive-care equipment for monitoring the conditions of the trainee in real-time. One example of the equipment is Video Nystagmography (VNG).

~~[0053]~~ An alarm may also be provided for alerting the operator of the training apparatus when the training apparatus is faulty, or operation of the training apparatus **100** is not according to the operator's controls and training protocols. The alarm may also be coupled to the seat belt of the training apparatus that the alarm will be activated if the seat belt is not securely fastened.

~~[0054]~~ Through successive trainings by the neuraxis training apparatus **100**, the trainee would have their neuraxis functionality improved accordingly. After proper and sufficient trainings, the trainee shall experience better motor, sensorial, cognitive, autonomic, behavioural and emotional functionalities. The neuraxis training apparatus is widely applicable in the field of neuroplasticity (i.e., the ability of the neuraxis to change with successive learning). The neuraxis training apparatus of the present invention is capable of locally training and stimulating the neuraxis area and the entirety of the nervous system.

~~[0055]~~ The above description illustrates various embodiments of the present invention along with examples of how aspects of the present invention may be implemented. While specific embodiments have been described and illustrated it is understood that many changes, modifications, variations and combinations thereof could be made to the present invention without departing from the scope of the present invention. The above examples, embodiments, instructions semantics, and drawings should not be deemed to be the only embodiments, and are presented to illustrate the flexibility and advantages of the present invention as defined by the following claims:

Claims

1. A training apparatus for training neuraxis of a trainee comprising:

a base including a plurality of extending legs, wherein each of the plurality of extending legs has a slip-resisting device being disposed at the distal end of the legs;

a frame with a horizontal bottom and two lateral upright sides, wherein the frame is rotatably mounted on the base through the horizontal bottom by a vertical shaft, and wherein the two upright sides defines a vertical axis;

a cabin for receiving the trainee, wherein the cabin has a yaw-axis, a pitch-axis and a roll-axis that are perpendicular to each other, wherein the cabin is pivoted to the two lateral upright sides through a first lateral shaft and a second lateral shaft of the frame, wherein the first and second lateral shafts defines a lateral axis that perpendicular to the vertical axis, and wherein when the cabin is in an upright orientation, the yaw-axis and the pitch axis of the cabin is in line with the vertical axis and lateral axis respectively;

a driving assembly that operatively drives the rotations of the frame and cabin to rotate about the vertical axis and lateral axis respectively, wherein ~~;~~

~~wherein, when~~ the cabin is operationally reclined about the lateral axis into a recumbent orientation, and is rotated about ~~-~~the vertical axis while maintaining the cabin in the recumbent orientation ~~, the cabin rotates about the~~to render a roll-axis rotation in relation to ~~to the trainee in~~ the cabin.

2. The apparatus according to claim 1, wherein the rotation of the frame about the vertical axis is independent of the rotation of the cabin about the lateral axis.

3. The apparatus according to claim 1, wherein the rotation of the frame about the vertical axis the rotation of the cabin about the lateral axis can be provided in any combination of rotations.

4. The apparatus according to claim 1, further comprises a computer system for controlling the operations thereof.

5. The apparatus according to claim 4, wherein the computer system further comprises:

a storage device for storing instructions and training protocols for training neuraxis;

a processor for executing operations of the training apparatus;

a displaying device for displaying operation parameters of the training apparatus to an operator; and

an input device that allows the operator to input personal information of the trainee.

6. The apparatus according to claim 5, wherein the storage device is further configured to operatively store the personal information of the trainee.

7. The apparatus according to claim 5, wherein the training protocols are determined according to the needs of the trainee.

8. The apparatus according to claim 1, wherein the cabin further comprises a seat for the trainee to sit thereon.

9. The apparatus according to claim 8, further comprises a fastening means operable to allow the trainee to be seated securely on the seat.

10. The apparatus according to claim 1, further comprises an alarm that gives a signal about a problem related to the training apparatus.

11. A method for ~~generating rotation about a roll-axis to the trainee~~rendering a roll axis rotation to a cabin of a training apparatus, comprising:

providing ~~a~~ the training apparatus comprising:

a base;

a frame with a horizontal bottom and two lateral upright sides, wherein the frame is rotatably mounted on the base through the horizontal bottom by a vertical shaft, and wherein the two upright sides defines a vertical axis;

~~a~~the cabin for receiving the trainee, wherein the cabin has a yaw-axis, a pitch-axis and a roll-axis that are perpendicular to each other, wherein the cabin is pivoted to the two lateral upright sides through a first lateral shaft and a second lateral shaft of the frame, wherein the first and second lateral shafts defines a lateral axis that perpendicular to the vertical axis, and wherein when the cabin is in an upright orientation, the yaw-axis and the pitch axis of the cabin is in line with the vertical axis and lateral axis respectively;

a driving assembly that operatively drives the rotation of the frame and cabin to rotate about the vertical axis and horizontal axis, respectively;

reclining the cabin to a recumbent orientation relative to the base and maintaining the cabin in the recumbent orientation; and

rotating the frame about the vertical axis_;~~whereby the rotation about the vertical axis gives a~~to render the roll-axis rotation ~~to the trainee in~~ in relation to the cabin.

12. A method of claim 11, wherein the base includes a plurality of extending legs, wherein each of the plurality of extending legs has a slip-resisting device being disposed at the distal end of the legs.