

THE VESTIBULAR SYSTEM

The vestibular system in the brain does more than just allow us to stand upright, maintain balance and move through space. It coordinates information from the vestibular organs in the inner ear, the eyes, muscles and joints, fingertips and palms of the hands, pressors on the soles of the feet, jaw, and gravity receptors on the skin and adjusts heart rate and blood pressure, muscle tone, limb position, immune responses, arousal and balance.

Dysfunctions in the vestibular system can cause anxiety or panic attacks, a need for self-stimulation, abnormalities in muscle tone, difficulty defecating, teeth grinding and chin tapping, hand flapping, academic problems, drooling, etc. Exercises that activate a wide range of inputs to the vestibular system have been found to be effective in reducing or eliminating vestibular problems.

Vision is an important component of the vestibular system. About twenty percent of visual neurons respond to vestibular stimulation (e.g. when spinning, head shaking, or rocking). Adults who have suffered damage to the vestibular organs of the inner ear can learn to depend on visual information to maintain their balance. However, If that visual information is removed or distorted (e.g. in the dark or when there is conflicting visual information about the horizon as when standing on a balcony), the individual will feel as if they are drifting or falling.

The auditory system is also highly involved in vestibular functions. The vestibular and auditory nerves join in the auditory canal and become the eighth cranial nerve of the brain. Anything that disrupts auditory information can also affect vestibular functioning. Blocked eustachian tubes in the inner ear, for example, create mild balance problems.

There are also other systems that provide sensory information to the vestibular system. The hands and fingers, for example, send information to the brain about the relationship between the body and stationary surfaces in the environment. If the brain loses information from the vestibular organs of the inner ear (e.g. when there is fluid in the eustachian tubes) balance can be maintained by simply touching a vertical or horizontal surface with the fingertips.

The pressors on the soles of the feet provide important information to the vestibular areas of the brain about the texture of the ground. This information is used to calculate weight and posture adjustments that will allow upright balance and movement.

The facial or trigeminal nerve (which lies along surface of the face and eyes) and the masseter muscle of the jaw also respond to vestibular information. Chin tapping, for example, provides vestibular stimulation and vestibular stimulation innervates the masseter.

(for more information see Brain Training: New Hope for Children With Delayed Development, MacAlpine, 2004).

VESTIBULAR REHABILITATION EXERCISES

The following exercises have been taken from our own experience in the clinic and from the following sources: Abatzides, G.J. and Kitsios, A., "The role of rehabilitation in the treatment of balance disorders: *Journal of Back and Musculoskeletal Rehabilitation* 12:101-112 (1999); Herdman, S.J. *Vestibular Rehabilitation*, 2nd ed. Contemporary Perspectives in Rehabilitation, Philadelphia: F.A Davis Co. (2000).

The child should choose the activities and should have absolute control over how long they are performed. Offer, but do not force, these activities on a child as the vestibular system is constantly adapting and what works one day may be aversive on another. In general, moving the head or the body in space or watching moving targets are the most effective.

1.

Swinging, rocking, jumping

2.

Rotating chair: The child sits in an office chair or other chair that can spin easily and is rotated up to 20 times, changing direction frequently. Stop immediately if the child appears uncertain or if they want to get down from the chair. Children who are unstable can be placed in an adult's lap and rocked side to side (slowly) rather than spun.

3.

Visual Pursuit: Hold an object at eye level, a comfortable distance away from the child's face and then move the object smoothly from the left to the right slowly while the child follows the object with the eyes alone. Change direction and move the target in all directions, increasing speed over time.

4.

Balance: The child walks up and down a low ramp while holding an adult's hand. Increase the slope (rake) of the incline as the child improves. Sitting on balance balls can also be used to help improve balance, or standing on boards with a rounded bottom.

5.

Obstacle Course.

6.

Gaze Stabilization: The child stands on an uneven, soft, or movable surface (e.g. foam, trampoline or tilt board) and focuses on a toy or interesting object that is moving either diagonally, horizontally, or vertically in front of them. Change the trajectory, direction, and speed of the object movement as the child watches.

7.

Targets and Optic Flow: Play catch with balls of varying diameters and textures, increasing the distance between players over time. If the child has difficulty catching a

ball, use a balloon rather than a ball. Increase difficulty by using smaller and harder balls to increase the speed and challenge of the game.

8.

Steps, Curbs and Parking Blocks: Practice walking smoothly up steps, curbs and parking blocks.