Making Sense of Balance Enhancement

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Balance Training

- Balance Training is often prescribed to rehabilitate a variety of knee, hip, and back impairments.
- A working knowledge of the systems that control balance and how to safely challenge these systems is essential for effective balance training.

Balance Description

- Balance has been described as the ability of an individual to maintain his or her body's center of gravity over the base of support, whether that base of support is stationary or moving.
- While maintaining balance, a person responds to both external forces that can destabilize the body's center of gravity and internal forces that result from the body's movements.

Sensory Systems

- Three sensory systems provide input regarding the body's position in space and movement through the surrounding environment:
  - Visual system
  - Vestibular system
  - Somatosensory system

Visual System

- The visual system provides information about the environment, the body's location within that environment, and the direction and speed of movement within the environment.
- If provides info through the clarity with which it sees and via information that is collected as a person moves through space.

Visual System

- When visual info is reduced in younger adults, postural sway increases.
- Conversely, stance is steadied when the eyes are open and fixed on a point of reference.
- As we age, we tend to lose ability to use visual cues to control static balance.
- This may be a result of declines in the visual field, contrast sensitivity, and depth perception.

Vestibular System

- The vestibular system located in the inner ear and consisting of otoliths in semicircular canals, providing info about head movement independent of visual cues.
- The otoliths are responsible for detecting movement with respect to gravity, such as degree and direction of head tilt.
- The semicircular canals comprise three fluid-filled passages positioned in the frontal, saggital, and horizontal planes.
- As the head moves, movement of fluid in the canals triggers receptors and info regarding head orientation is sent to the brain.

Somatosensory System

- The somatosensory system provides info about the body's position via skin and muscle receptors.
- Skin receptors relay info about temperature, pressure, vibration and tactile sensation.
- Failure of these receptors is demonstrated when, for instance, a foot "falls asleep," when a patient has diabetic peripheral neuropathy.

Muscle Displacement

- Additional info about muscle displacement is provided by muscle receptors.
- When a muscle is lengthened during movement, stretch receptors in the muscle send signals to the central nervous system until the muscle is contracted and the desired length and tension of the muscle is regained.
- The skin and muscle receptors work together to detect the effects of the surrounding environment and to provide feedback regarding muscle contractions that may be required to maintain balance.

Sensory and Motor Integration

- The afferent info sent to the central system by the three sensory systems is processed at the spinal cord, the lower-and midbrain, and the brain cortex.
- Once info is transmitted to and processed by one of these systems, a response is executed by the muscular, or motor, system to maintain balance.
- If any of these systems are impaired, the body's ability to sustain postural balance is diminished.
- It is essential to address both sensory and motor components during balance training.

Training

- Training programs should be customized to target the systems involved in balance control, particularly the muscular, visual, vestibular, and somatosensory systems.
- Balance training should progressively overload physiological systems being trained to encourage adaptation.
- They should become more challenging, while teaching appropriate and safe response strategies.

Training

- Computerized posturography can quantify sensory or motor impairments and can help determine specific interventions for balance impairment.
- Other simple clinical tests can be used t screen patients for balance disorders, for example:
  - Single leg stance test
- Training should start on a solid surface. Once the patient is able to control center of gravity, unstable stable conditions may be introduced.

Exercises

- Begin by helping patients learn to maintain center of gravity under static conditions.
  - Start with the feet side by side on a stable surface such as the floor.
  - Target the somatosensory system by introducing active or passive weight shifts to challenge the center of gravity.
  - Then proceed to reducing the base of support.

Exercises

- Place feet in a series of positions that gradually shrink the base of support, holding each stance for 10-30 seconds.
- Proceeding from a reduced base of support, labile surfaces can be added to increase required somatosensory input and neuro-muscle activity beyond that needed for standing on stable surfaces.

(These exercises are designed to subtly change the posture in ways that are similar to the challenges experienced in everyday life and to allow the body to learn appropriate responses and maintain balance while standing still.)

Maintaining Postural Stability

- Maintaining postural stability when external forces or loads are applied can pose additional challenges.
- However, patients learn to adapt and modify their balance under dynamic conditions.
- A resistance band wrapped around the hips and pulled by the therapist is a simple way to apply an external force that challenges the patient to control their center of gravity.

Progression

- Progressively increasing the amount of movement involved in the training activities will further increase sensorimotor integration and develop balance control strategies that leads to function, specific movement patterns.
- Activities such as leaning and reaching in different directions, standing on a chair, bending down to pick up an object or a variety of stepping and lunging movements may be performed.

Unilateral Weakness

- In patients with unilateral weakness, such as knee injury or hemiparesis, it's important to improve ROM and muscular performance impairments in affected joints while improving balance.
- Strengthening activities incorporating closed kinetic chain movements may be more beneficial than open kinetic chain strengthening activities to improve balance.

Conclusion

- One challenge in developing training programs is identifying safe and effective exercises that target multiple systems.
- Clinicians should gradually alter the amount of sensory info fed to the central nervous system in order to facilitate appropriate motor reactions that allow the patient to maintain balance under a variety of conditions.
- At each level of progression, the training should be gradually increased to present new challenges.
- Be creative to increase rigor
- Be keen to identify substitutions needing to be controlled that compensatory occur