Stroke Rehabilitation Strategies

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Rehabilitation Focus

- Traditional / Conventional :primarily on instruction in compensatory techniques such as ambulating with a cane and AFO or use of one-handed dressing techniques
- New interventions based on plasticity/ goal of rehabilitation should be to maximize neurologic recovery and then teach compensatory approaches to residual deficits

Major Theories of Rehabilitation Training

Traditional/Conventional Therapy

- A traditional therapeutic exercise program consists of positioning, ROM exercises, strengthening, mobilization, compensatory techniques, and endurance training
- Traditional approaches for improving motor control and coordination emphasize the need of repetition of specific movements for learning the importance of sensation to the control of movement, and the need to develop basic movements and postures

Proprioceptive (Peripheral) Neuromuscular Facilitation (PNF)

- (Knott & Voss, 1968)
- Uses spiral and diagonal components of movement rather than the traditional movements in cardinal planes of motion with the goal of facilitating movement patterns that will have more functional relevance than the traditional technique of strengthening individual group muscles.
- Theory of spiral and diagonal movement patterns arose from observations that the body will use muscle groups synergistically related (e.g., extensors versus flexors) when performing a maximal physical activity.
- Stimulation of nerve/muscle/sensory receptors to evoke responses through manual stimuli to increase ease of movement-promotion function.

- Resistance is used during the spiral and diagonal movement patterns with the goal of facilitating “irradiation” of impulses to other parts of the body associated with the primary movement (through increased membrane potentials of surrounding alpha motoneurons, rendering them more excitable to additional stimuli and thus affecting the weaker components of a given part).
- Mass-movement patterns keep Beevor’s axiom: The brain knows nothing of individual muscle action but only movement.

Bobath Approach / Neurodevelopmental Technique (Ndt) *(Bobath, 1978)*

- The goal of NDT is to normalize tone, to inhibit primitive patterns of movement, and to facilitate automatic, voluntary reactions as well as subsequent normal movement patterns.
- Probably the most commonly used approach.
- Based on the concept that pathologic movement patterns (limb synergies and primitive reflexes) must not be used for training, because continuous use of the pathologic pathways may make it too readily available to use at the expense of the normal pathways.
- Suppress abnormal muscle patterns before normal patterns are introduced.
- Mass synergies are avoided, although they may strengthen weak, unresponsive muscles, because these reinforce abnormally increased tonic reflexes and spasticity.
- Abnormal patterns are modified at proximal key points of control (e.g., shoulder and pelvic girdle).
- Opposite to the Brunnstrom approach, which encourages the use of abnormal movements;

Brunnstrom Approach / Movement Therapy *(Sawner & Lavigne, 1992)*

- Uses primitive synergistic patterns in training in an attempt to improve motor control through central facilitation.
- Based on the concept that damaged CNS regressed to phylogenetically older patterns of movements (limb synergies and primitive reflexes). Thus, synergies, primitive reflexes, and other abnormal movements are considered normal processes of recovery before normal patterns of movements are attained.
- Patients are taught to use and voluntarily control the motor patterns available to them at a particular point during their recovery process (e.g., limb synergies).
- Enhances specific synergies through use of cutaneous/proprioceptive stimuli, central facilitation using Twitchell's recovery.
- Opposite to the Bobath approach, in which the goal is to inhibit abnormal patterns of movement

Sensorimotor Approach / Rood Approach *(Schultz-Krohn, 2013)*

- Modification of muscle tone and voluntary motor activity using cutaneous sensorimotor stimulation.
- Facilitatory or inhibitory inputs through the use of sensorimotor stimuli, including quick stretch, icing, fast brushing, slow stroking, tendon tapping, vibration, and joint compression to promote contraction of proximal muscles.

Motor Relearning Program / Carr And Shepherd Approach *(Carr et al., 1985)*

- Based on cognitive motor relearning theory and influenced by the Bobath approach.
- Goal is for the patient to relearn how to move functionally and how to problem solve during attempts at new tasks.
- Instead of emphasizing repetitive performance of a specific movement for improving skill, it teaches general strategies for solving motor problems
- Emphasizes functional training of specific tasks, such as standing and walking, and carryover of those tasks.

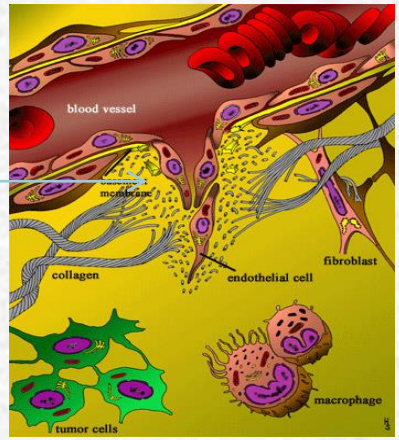
Neuroplasticity/Brain Plasticity

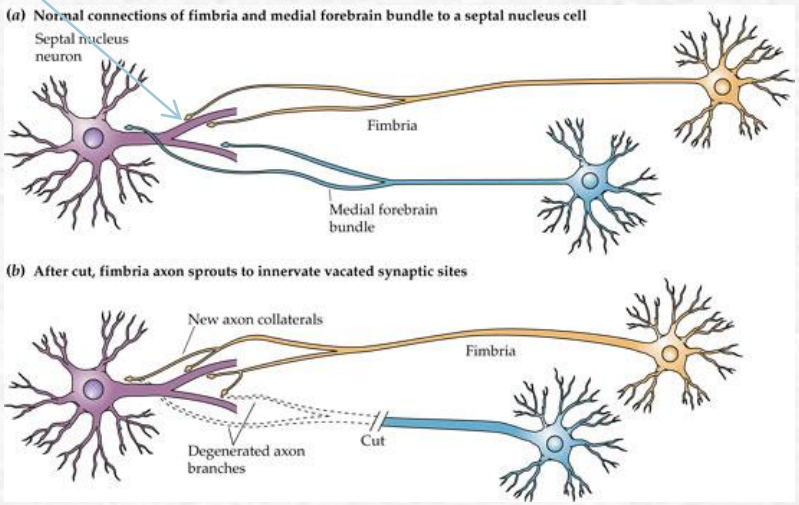
Definition:

- The capability of the brain (or the CNS) to reorganize by forming new neural connections throughout life.
- It allows the neurons in the brain to compensate for injury and disease and to adjust their activities in response to new situations or to changes in the environment.

Mechanism of Neuroplasticity

- angiogenesis
- Axonal sprouting (neurogenesis)
- Unmasking of latent synapses (synaptogenesis)
- Regeneration from neural stem cells in the subventricular regions migrating to the periinfarct area.



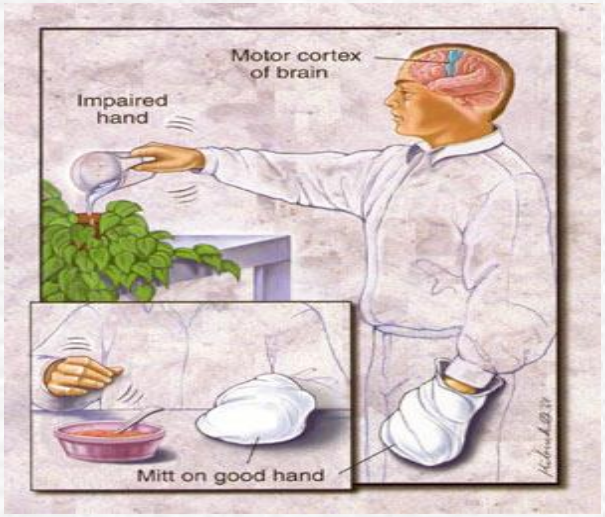


New Rehabilitation Interventions

- Constraint-Induced Muscle Training (CIMT)
- Partial Body Weight-Supported Treadmill Training
- Functional Electrical stimulation
- Biofeedback
- Robotic Devices
- Motor Imagery
- Mirror Therapy
- Transcranial Magnetic Stimulation
- Virtual Reality (VR)

CONSTRAINT INDUCED MOVEMENT THERAPY (CIMT)

- The unimpaired upper extremity is restrained, forcing the patient to use the affected extremity
- Reinforcement of using affected limb and restraint of unaffected limb reduces learned nonuse behavior
- Repetition of functional tasks leads to cortical re-organization



Constraint-induced movement therapy (CIMT)

- statistically shown to produce clinically significant improvements in arm motor function that persist >1 year
- CIMT requires that patients be able to extend their wrists and actively move their digits.
- participants were required to have at least 10° of active wrist extension, at least 10° of thumb abduction/extension, and at least 10° of extension in at least two additional digits.

Body-weight-support treadmill training

- was not shown to be superior to progressive exercise at home managed by a physical therapist
- Subjects who received body-weight-support treadmill training within 2 months after stroke were at higher risk to fall than those in other groups.

Partial Body Weight-Supported Treadmill Training

- Repetitive task oriented practice

Functional electrical stimulation (FES)

- may improve the ability to voluntarily move the affected limb and/or use the affected limb in everyday activities
- The available evidence suggests there might be a small effect on some aspects of function in favor of electrical stimulation compared to no treatment.
- Currently, there are insufficient data to support or refute the clinical use of FES for neuromuscular retraining.

Functional Electrical stimulation:

- The most promising technique for hemiparetic arm!
- Neuroprostheses

Electromyographic biofeedback (EMG-BF)

- makes patient aware of muscle activity or lack of it by using external representation (e.g., auditory or visual cues) of internal activity as a way to assist in the modification of voluntary control.
- In addition to trying to modify autonomic function, EMG-BF also attempts to modify pain and motor disturbances by using volitional control and auditory, visual, and sensory clues.
- Electrodes are placed over agonists/antagonists for facilitation/inhibition.
- There is insufficient evidence to support or refute use in stroke rehabilitation

EMG biofeedback

Robotic devices

- are being developed to improve the rehabilitation of extremities by providing passive and active range of motion and measurement of improvements in mobility and strength.
- AUTO ambulator and the treadmill supported orthosis.
- There is insufficient evidence to support or refute use in stroke rehabilitation.

Robotic-Assisted Therapeutic Exercise

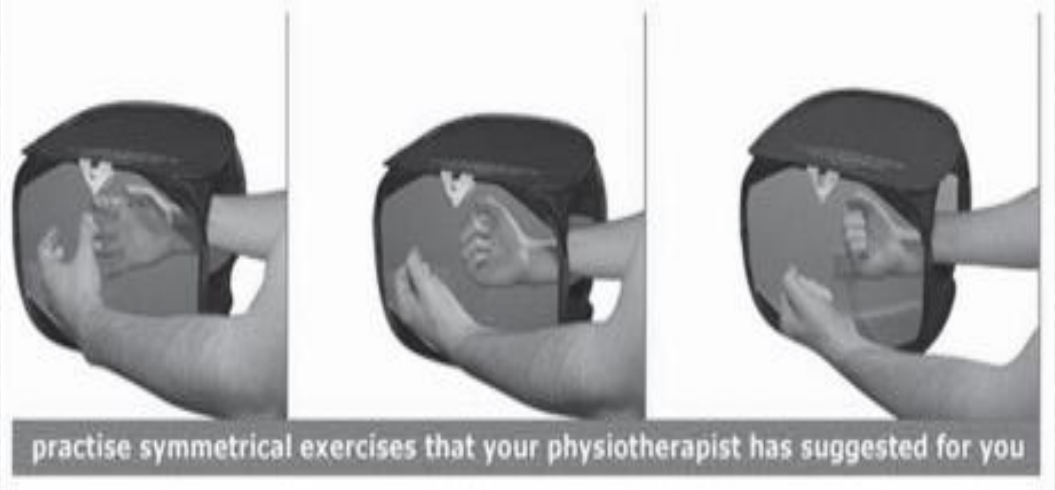
- Provides consistently delivered therapy
- Suitable for highly repetitive exercises

Motor imagery

- is a mental process during which an individual rehearses or simulates a given action before it is actually performed.
- There is insufficient evidence to support or refute use in stroke rehabilitation.

Mirror Therapy

- Placing the affected limb(hand or foot) in the mirror box and unaffected limb in front of the mirror .Then using both limbs to do the gentle symmetrical exercises.
- The underlying Principle is that movement of the affected limb can be stimulated via visual cues originating from the opposite side of the body
- Visual Stimuli enhances neuroplastic changes within the brain.



Mirror Therapy

- Mirror Therapy (Mirror Visual Feedback)
  - form of motor imagery in which a mirror is used to convey visual stimuli to the brain through observation of one's unaffected body part as it carries out a set of movements.

Mirror therapy

- Mirror therapy is effective for improving upper extremity motor function, activities of daily living (ADL), and pain, at least as an adjunct to normal rehabilitation for patients after stroke.

Mirror Therapy


move BOTH your limbs into a comfortable position


CNN

Noninvasive brain stimulation includes transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS)

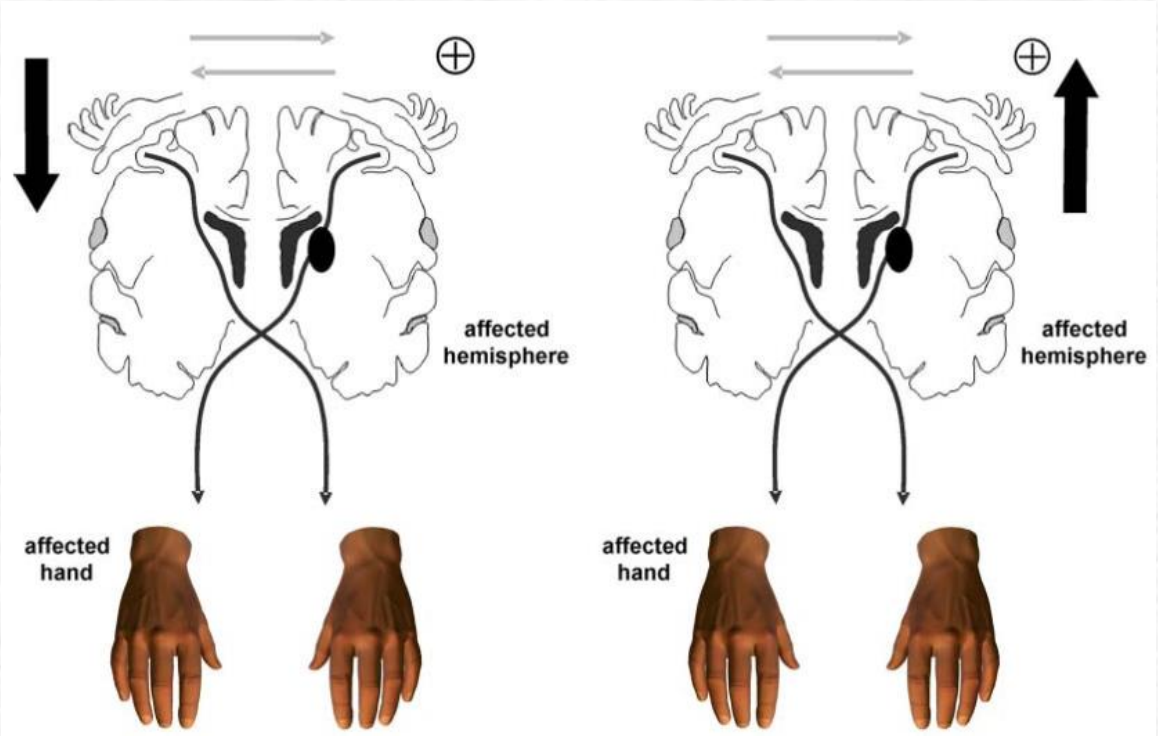
- Can be used to modulate cortical excitability during and for several minutes after the end of the stimulation period.
- Cortical excitability can be reduced (inhibition) or enhanced (facilitation) depending upon parameters.
- May induce plastic changes within neural networks active during functional recovery, but still being studied.

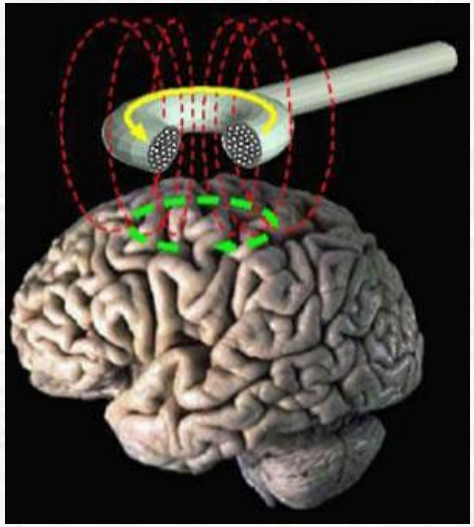
Transcranial Magnetic Stimulation

- In stroke, cortical excitability is reduced in the affected parts of the motor cortex. Increased excitability is seen in unaffected motor cortex
- It is possible to use TMS to modulate cortical excitation, thus improving motor function.

Repetitive TMS

- For Inhibition • Slow (1Hz) rTMS
- For Excitation • Fast (>3Hz) rTMS





Virtual reality

- utilizes computer-simulated environment and interactive video gaming to provide patients with engaging activities to improve motor or cognitive function.
- Limited evidence that the use of virtual reality may be beneficial in improving arm function and ADL function when compared with the same dose of conventional therapy.
- Unclear which characteristics of virtual reality are most important, and unknown whether effects are sustained.