Neuroplasticity & Motor Relearning: Application in Robotics & Rehabilitation

There is emerging evidence that the brain and spinal cord are plastic and capable of recovery. As a result, rehabilitation strategies and technologies have emerged that enable clinicians to enhance functional recovery.

What Is Neuroplasticity?
Neuroplasticity is the capacity for continuous alteration of the neural pathways and synapses of the central nervous system (CNS) in response to injury or repetitive experience. The CNS may respond to this stimulus by reorganizing its structure, function and/or neural connections. New neural connections may form in order to compensate for injury or loss of function, or in response to changes in one's environment.

Why Use Robotics in Rehabilitation?
Robotic devices are appealing for delivering well-defined repetitive exercise in a consistent and prescriptive fashion. Training must be:
- Task specific
- Meaningful and challenging
- Repetitive and intensive
- Provided in an enriched environment
- Performed in a relatively normal biomechanical position and manner

Compensation vs. Recovery
Traditional physical therapy tends to focus on rehabilitation techniques to compensate for the effects of injuries/neural damage. Functional recovery focuses on rehabilitation strategies that enhance functional outcomes and promote functional reorganization of the damaged nervous system.
Upper Extremity Robotics
Upper extremity robotics give some type of immediate biofeedback to errors in coordination, strength and velocity, allowing for patient correction and refinement of movement.

Lower Limb Robotics
Lower limb robotics allow patients to walk in a repetitive, symmetrical manner and enable patients to avoid compensatory walking habits.

Vision Therapy
Vision is a dominant sense that the brain uses to collect and process information, and it plays a significant role in the process of neuroplasticity. Vision deficits affect concentration, balance, memory and depth perception.

Vision therapy involves the use of technology to provide a sequence of activities to strengthen the eyes individually and then together to develop efficient visual-motor and visual perceptual cognitive processing skills. Vision therapy enhances the brain's ability to control:

- Eye alignment
- Eye teaming
- Eye focusing abilities
- Eye motor accuracy
- Visual processing speed and integration