



Merging the Human Body and Technology

The New Frontier for Neurological Diseases and Disorders

Medical technology has made rapid advancements in recent years; components have shrunk, electronics improved, and we, as a society, have become more accepting of placing technology into our bodies. The implanted pacemaker has been around since the late 1950's. Within the medical technology arena, there is an emerging field of neurotechnology. Many therapies and devices are available commercially in such areas as pain management, spasticity control, breathing assistance and new rehabilitation techniques. There are also many new technologies being investigated in research centers across the globe. These devices and technologies are not attempting to "cure" a neurological disease or disorder. Instead, they are tools that can be used, for instance, to combat secondary conditions, provide further independence or to aid in the rehabilitation process. Since the human nervous system is complex, not all devices and therapies apply to every neurological condition. Although there are a variety of applications, consultation with a trained and knowledgeable medical professional is encouraged.

Neurotechnology is a broad term used to refer to medical electronics that interact with the human nervous system. The basis of neurotechnology is the electrical signals the body uses to send messages. Technology may be used to monitor electrical signals, block those signals or use the electrical signals for functional gain. For instance, electrical stimulation is the feature that and may be used on a paralyzed muscle. Even though a muscle is paralyzed, it does not mean that the muscle cannot be stimulated. For those with mobility impairments that do not have peripheral nerve damage, electrical stimulation may be used in ways to enhance exercise, aid in rehabilitation or provide functional daily living.

In the 1950's, the first attempt was made to apply electrical stimulation to the phrenic nerve allowing a person to breathe without a ventilator. During this same decade, the first auditory implant was performed which was the precursor to the cochlear implant for those who are deaf or hard of hearing. This evolved into a field of science called FES (Functional Electrical Stimulation). FES encompasses a variety of therapeutic techniques and treatments used to activate muscles that may not be functioning properly due to injury, disease or a physical abnormality. Over the decades, this field of science that combines medicine, biomedical engineering and technology evolved to what is now termed as neurotechnology.



Areas of Neurotechnology

Neurotechnology can be divided into four areas: Neuromodulation, Neural Prosthesis, Neural Rehabilitation and NeuroSensing and Diagnostics. Each area has a distinct definition however some devices may be applicable to more than one area.

- Neuromodulation therapy uses electrical stimulation to improve control of an existing part of the nervous system. Some examples include the spinal cord stimulation system used for chronic pain management; it blocks pain signals to the brain, while the gastric stimulation system is used to block the signals of hunger.
- Neural Prosthesis, however, is used to replace or improve function of an impaired limb or organ. For instance, an FES system may restore gross hand function for persons with quadriplegia while drop foot stimulators may aid walking and reduce falls for persons with drop foot syndrome often as a result of a stroke, partial paralysis or cerebral palsy.
- Neural Rehabilitation consists of therapies applied to the body to provide healing or encourage natural restoration of an impaired body function. Robotics may be used for repetitive motion therapy or suspension treadmill training systems may improve function of voluntary movement in the legs.
- NeuroSensing and Diagnostics are tools to improve monitoring of activity in the nervous system or improve diagnosis of a condition. Peripheral nerve sensing may be used to diagnose carpal tunnel system, for example. Other examples are the brain computer interfaces to monitor activity in the brain and pressure monitoring devices applied to help prevent the onset of pressure sores.

These four segments make up the innovative field of neurotechnology. Within these segments there are a variety of applications. These applications may be for a specific condition such as depression, epilepsy or sleep apnea. Applications may also be for symptoms of a condition, such as urinary incontinence due to paralysis or tremors due to Parkinson's disease. Just as there are a variety of applications, there are also different conceptions to the human body. Some systems are implanted, external or a combination (hybrid) of both. Implanted systems tend to be more "invasive" and therefore require a surgical or other procedure to install the system into the body of a potential user. In this case, the entire system operates inside the human body. On the other hand, external systems are applied entirely outside the body or on the surface of the skin. Finally, hybrid systems have components that are both implanted and external.

In this emerging field of medical technology, it is essential that the consumer carefully consider each device, therapy or treatment protocol before choosing to participate.

Resources to learn more about neurotechnology are available free from Neurotech Network. Visit www.NeurotechNetwork.org to review educational fact sheets, meet other people who use the technology and search the only neurotechnology database.

Neurotech Network is a non-profit organization focusing on education and information dissemination about neurotechnology for person with impairments. Jennifer French is a quadriplegic due to a spinal cord injury and is a user of the implanted stand and transfer system developed by the Cleveland FES Center. She is the co-founder of a non-profit organization, Neurotech Network