


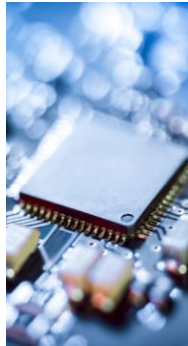
# Fundamentals of Electrical Stimulation

Steve Page, OTR/L, PhD, MS, MOT  
SPage@neurorecovery.net

 www.StevePRehab.com

 @StevePRehab

 StevePRehab



---

---

---

---

---

---

---

---

1

## Lesson Objectives

- 1** List relevant estim parameters that can be modified by therapists
- 2** Differentiate between different types of electrical stimulation
- 3** Identify purposes of different estim types

---

---

---

---

---

---

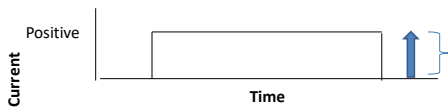
---

---

2

## Amplitude (Intensity)

- How “big” (intense) the stimulation is compared to baseline
- Measured in amperes (milliamps) or volts (millivolts)
- With increasing amplitude, more, deeper, and smaller fibers are reached → **stronger contraction**



---

---

---

---

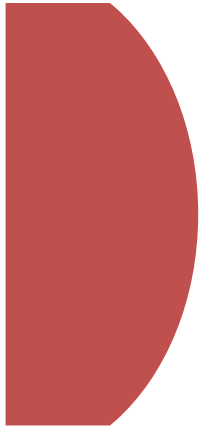
---

---

---

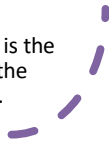
---

3



Increasing the amplitude will:

- Increase the depth of penetration
- Amplitude should be adjusted to produce the desired physiologic response
- Physiologic response is the key, do not focus on the number of milliamps.




---

---

---

---

---

---

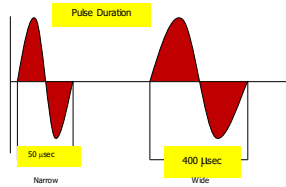
---

---

4

### Amplitude and Pulse Duration

- **Amplitude**
  - How much?
- **Pulse Duration**
  - The length of time that the specified amplitude is flowing during a given pulse usually stated in milliseconds (msec), microseconds ( $\mu\text{sec}$ ),
  - It can be also called **pulse width**.




---

---

---

---

---

---

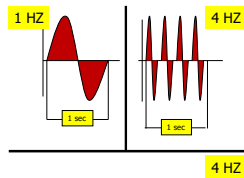
---

---

5

### Frequency

- Hertz-**
- Pulses per second (pps)
    - The number of pulses occurring in 1 second
  - Cycles per second (cps)
    - the number of time AC switches direction in 1 second
  - Both used to describe the frequency of pulsed current




---

---

---

---

---

---

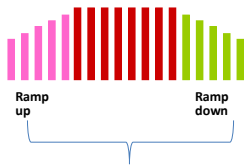
---

---

6

### Ramp-Time

- Indicates how long it will take to get to preset amplitude.
- Individual pulses *gradually* increase/decrease in intensity



Duty cycle – on/off time or stimulation versus rest time

7

---

---

---

---

---

---

---

---

---

---

### How Do I Know Where the “Best” Motor Point is Located?



8

---

---

---

---

---

---

---

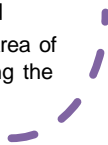
---

---

---

Smoke over  
fire?  
Not  
necessarily!

- Black electrode – cathode/negative lead
  - placed over the area that you want to activate using the stimulator.
- Red electrode – anode/positive lead
  - placed over the area of the nerve supplying the specific muscle



9

---

---

---

---

---

---

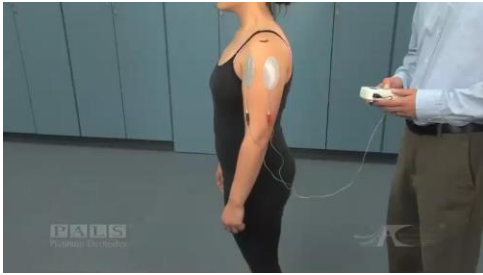
---

---

---

---

## Shoulder Flexion and Abduction



10

---

---

---

---

---

---

---

---



11

---

---

---

---

---

---

---

---

### TENS/Sensory Stimulation (sub-threshold)

- Low voltage, "subthreshold" stimulation
- Delivers electricity across the intact surface of the skin to activate underlying nerves
- Applications:
  - Pain - acute, chronic, non-malignant
  - Sensory restitution



12

---

---

---

---

---

---

---

---

## NMES (neuromuscular electrical stimulation)

Causes repeated limb use...

*...but does not require active participation by the patient!*

Goals:

- Decrease spasticity
- Muscle strengthening
- Reduce edema
- Muscle reeducation
- Prevent atrophy
- Preserve/increase range of motion

13

---

---

---

---

---

---

---

---

## EMG-Triggered NMES

How does it work?

- Set stim intensity and EMG threshold
- Electrodes sense trace contraction/muscular attempt
- Device rewards patient with stimulation ONLY when patient hits threshold



Saebo MyoTrac Infinity



\$4740

<https://www.saebo.com>

Goal:

- Increase AROM in people w. trace/minimal movement

14

---

---

---

---

---

---

---

---

## Functional Electrical Stimulation (FES)

Cyclic e-stim during **functional movements and task specific activities**

Facilitation for functional performance

Goals:

- Improve hand function and voluntary movement
- Facilitate neuromuscular reeducation
- Regulate muscle tone (decrease spasticity)
- Prevent atrophy- muscle strengthening
- Initiate and regain voluntary motor functions (muscle reeducation)

15

---

---

---

---






---

---

---

---

E-stim Can (and should) Be Graded:

-  Begin repetitive practice paradigms
-  Get a few degrees of AROM
-  EMG-based estim/functional estim
-  Get trace movement
-  Cyclic estim

---

---

---

---

---

---

---

---

16

Billing/Documentation Examples

See Files Located in This Lesson




---

---

---

---

---

---

---

---

17

Chattanooga Continuum Empi

- “2 channel stimulator to provide electrical stimulation treatments in pain management (TENS) and neuromuscular stimulation (EMS/NMES)”



- 399.00
- <https://www.chattanoogarehab.com/us/continuum-kit-2600-kit>

---

---

---

---

---

---

---

---

18



19

---

---

---

---

---

---

---

---



## Electrical Stimulation Units and Equipment Available Elsewhere on This Lesson

Article  
Devices  
Trigger switches  
Contraindications

20

---

---

---

---

---

---

---

---

Units from DJO

<b>Primer TENS &amp; NMES</b> 77615 Intensity: 0 - 80 mA Frequency: 0 - 100 Hz Pulse Width: 0 - 200 µs Programs: 8 TENS and 6 NMES	<b>Intellect TENS</b> 77710 77715 77500 Intensity: 0 - 80 mA Frequency: 0 - 100 Hz Pulse Width: 0 - 200 µs Programs: Adjustable	<b>Intellect NMES</b> 77715 77717 Intensity: 0 - 80 mA Frequency: 0 - 100 Hz Pulse Width: 0 - 200 µs Programs: Adjustable	
 <b>Primer Tens/Nmes With Gold Medical S.</b> \$147.78	 <b>Primer TENS/NMES 3B Scientific</b> \$152.50	 <b>Primer TENS/NMES SOURCE Ortho...</b> \$93.95	 <b>Chattanooga Primera Better Braces</b> \$99.99
 <b>Intellect TENS 77615</b> \$149.99	 <b>Chattanooga Intellect TENS 77710</b> \$149.99	 <b>Intellect NMES 77715</b> \$149.99	 <b>Intellect NMES 77717</b> \$149.99

21

---

---

---

---

---

---

---

---





There is Level 1a evidence that neuromuscular electrical stimulation in combination with gait/balance training improves gait/balance when compared to stimulation or training alone.

---

---

---

---

---

---

---

---

There is Level 1a and Level 2 evidence that functional electrical stimulation during conventional rehabilitation improves gait, balance, and independence when compared to rehabilitation alone

---

---

---

---

---

---

---

---

25

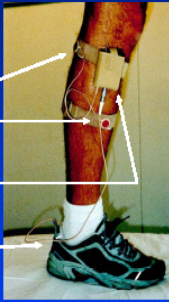
**Treatment**

- Ankle foot orthosis (AFO)
- Peroneal nerve stimulation (1961 Liberson)

Surface electrodes

Stimulator

Heelswitch



26

---

---

---

---

---

---

---

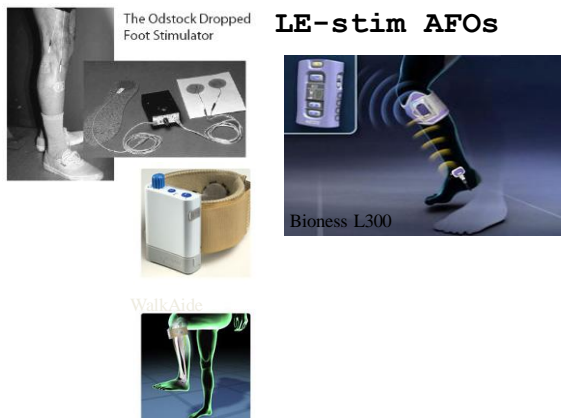
---

The Odstock Dropped Foot Stimulator

**LE-stim AFOs**

Bioness L300

WalkAide



27



28

---

---

---

---

---

---

---

---

### transcranial Direct Current Stimulation (tDCS)



Constant, low current delivered to brain through electrodes placed on scalp



Non-invasive brain stimulation



Inexpensive, portable, safe



29

---

---

---

---

---

---

---

---

### Functional Brain Stimulation™

- tDCS overlaid onto task-oriented therapy
- CPT codes:
  - ADL training (97530)
  - Neuromuscular Re-ed (97112)
  - Gait training (97116)



30

---

---

---

---

---

---

---

---

### Device

- 1-2mA for 20 minutes
- Dose: 40 mA/min
- Chattanooga Ionto™
  - ≈\$300.00
  - Others
- Small, portable, automatic ramp up and shut off
- Alerts (e.g., sponges not sufficiently soaked, not secured tightly enough to head)




---

---

---

---

---

---

---

---

31

### Take Home Messages & “Nuggets”

- Adjust amplitude and other parameters depending on patient specs & response
- Incorporate different types of estim with/without practice depending on patient specs
- Estim can also be used for stretching, maintaining muscle bulk, maintaining joint ROM, edema

---

---

---

---

---

---

---

---

32



Thank-you!

Spage@Neurorecovery.net

---

---

---

---

---

---

---

---

33