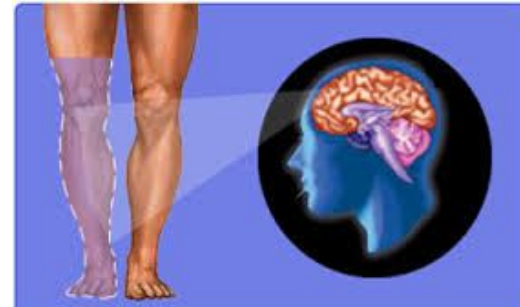


# Phantom Limb Syndrome

**By: Lexi Okurily, Sarah Bade,  
Kevin Watts, Mariah McGarvey**

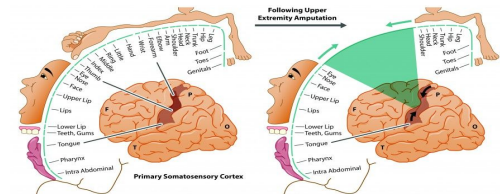
# Phantom Limb Syndrome [PLS]

- **What is it?** Perceived sensation in a limb that has been amputated
- 1st described by a French military surgeon in the 16th century
- Poorly understood and difficult to treat
- 2005: 1.6 million people with limb loss
- 2050: estimated 3.6 million people with limb loss
- Incidence of PLS: 42%-78% of patients with an amputation



# Etiology / Mechanism

- Peripheral
  - Severed peripheral nerves results in a disruption of afferent input to the spinal cord
  - The proximal portion of the severed nerve sprouts to form neuromas.
  - Increased number of molecules enhances expression of Na<sup>+</sup> channels, producing hyperexcitability
- Changes at the spinal cord
  - Neurons not responsible for pain transmission sprout into the Lamina II of the dorsal horn of the spinal cord
  - Increased neuronal activity, expansion of neuronal receptive fields, and hyperexcitability
  - Reduced intersegmental inhibitory mechanisms, resulting in spinal disinhibition. **As a result**, nociceptive inputs are able to reach supraspinal centers.
- Cortical reorganization
  - Areas of homunculus representing amputated extremity are replaced by surrounding zones
- Psychogenic
  - Stress, anxiety, exhaustion, and depression
  - Persons with passive coping styles & catastrophizing behavior.



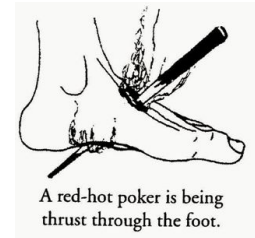
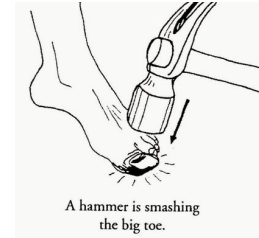
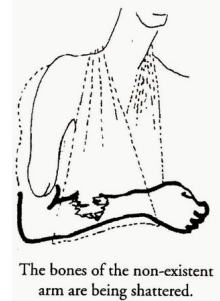
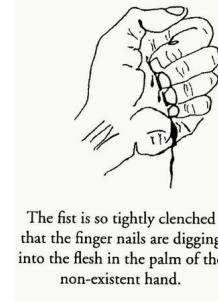
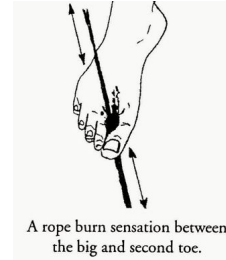
# Risk Factors

- Traumatic amputation
- Blood clot in amputated limb
- Pain present before amputation
- Adults are at greater risk than children
- History of spinal cord or peripheral nerve damage
- Presence of infection pre-amputation
- Significant association between residual limb pain and phantom limb syndrome
- Same rate of PLS development for bilateral or unilateral amputation



# Signs and Symptoms

- Perceived sensations:
  - Shooting, burning, stabbing, piercing pain
  - Numbness, tickling, cramping
  - Pleasure
  - Presence of clothing or jewelry (touch or pressure)
- Peak periods of onset:
  - Within 1 month of amputation
  - 1 year post-amputation



# Complications

- Neuromas may develop on amputated nerves, increasing pain.
- Emotional depression or anxiety (complication & exacerbation)
- Sleep disorders
- Decreased quality of life

# Case Study: Meet Cheryl

- Patient information
  - 49 year old female
  - Underwent right arm amputation distal to elbow after sustaining injuries in a MVA
  - Wears cosmetic prosthesis daily and a myoelectric prosthesis for particular tasks
  - Able to generate voluntary movements in phantom and finger movement is felt in tandem with movement of prosthetic



# Relevant Impairments and Limitations

- Experienced phantom sensation immediately after amputation
- Aware of phantom hand but not ordinarily aware of sensation in missing forearm
- Phantom fingers felt as a unit, not individually
- Experiences shooting and stabbing pain and changes in pressure along with a nonpainful tingling sensation
  - Phantom hand felt in a clenched fist with nails digging into the palm
  - Often times triggered by emotional stress
  - Pain rating: 7/10
- Suffers from depression

# Treatment Week 1

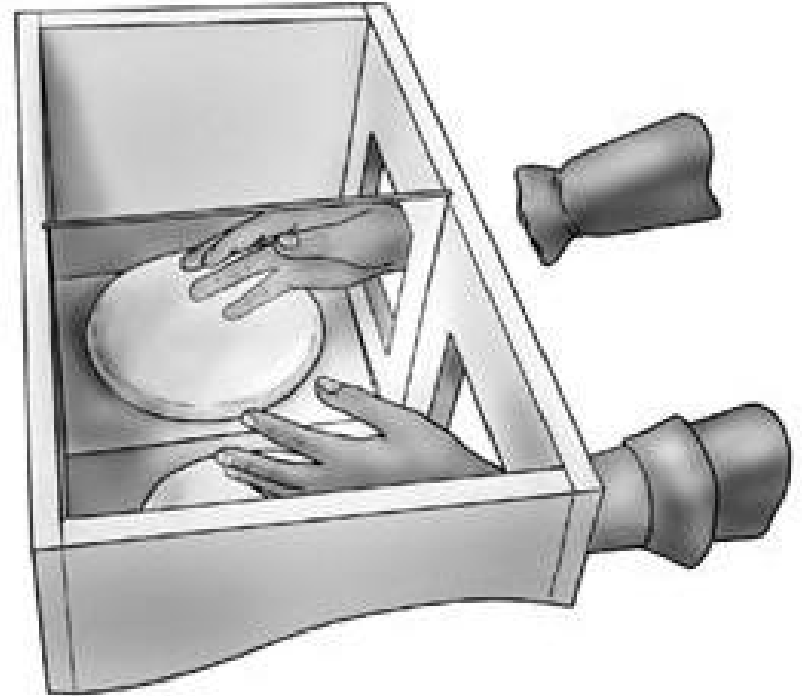
- 1) Goal: pain relief
- 2) Treatment
  - a) Administration of DAS 21 - scored a 10 (moderate depression)
  - b) TENS L elbow
    - i) Low frequency, high intensity
  - c) Mirror therapy - 15 minute session
    - i) Works by stimulating mirror neurons in the brain, which override somatosensory input
    - ii) Demonstration
  - d) Visualization
    - i) Tapping exercise





# Treatment Weeks 2-3

- 1) Goal: pain relief and phantom limb mobility
- 2) Treatment
  - a) Meditation and Body Scan
  - b) Visualization
  - c) Progression of mirror therapy
    - i) 3D Mirror Box
    - ii) Tapping exercise



# Home Exercise Program

- 1) Mirror therapy - 15 min/day
- 2) Visualization - 40 min CD or 10 min individual exercises



# Results for Cheryl

- Standard mirror therapy and 3D mirror box intensified and extended the phantom experience
  - Helped facilitate movement of her digits as independent units
- Pt reported she experienced pain relief throughout treatment
- DASS-21 score decreased to a 4
- Phantom limb pain has decreased in frequency and intensity overall



# Integration

## Review of Literature

**Table 3:** Treatments for phantom limb pain.

Pharmacotherapy	Surgical/invasive procedures	Adjuvant therapy
Opioids	Stump revision	Transcutaneous nerve stimulation
Morphine	Nerve block	Mirror therapy
Tramadol	Neurectomy	Biofeedback
Tricyclic Antidepressants	Rhizotomy	Temperature biofeedback
Amitriptyline	Cordotomy	Electro myographic biofeedback
Nortriptyline	Lobectomy	Massage
Imipramine	Sympathectomy	Ultrasound
Desipramine	CNS stimulation	Physiotherapy
AntiConvulsants	Spinal cord stimulation	Sensory discrimination training
Carbamazepine	Deep brain/thalamus stimulation	Prosthesis training
Oxcarbazepine	Cortical stimulation	Cognitive behavioral pain management
Gabapentin		Electroconvulsive therapy
Pregabalin		
Sodium channel blockers		
Lidocaine		
Bupivacaine		
Mexiletine		
NMDA receptor antagonist		
Memantine		
Ketamine		



Looking to the future: Virtual Reality

Augmented Reality and Myoelectric Pattern Recognition  
(*Frontiers in Neuroscience*, 2014)

<https://www.youtube.com/watch?v=fDIFZeArfGM>

# Take Home Messages

1. Phantom limb pain is very common in amputees
  - Incidence reported to range from 42.2 - 78.8%
2. The best treatments for PT include mirror therapy and visualization
3. Treat the patient as a whole



# Experts on Social Media?

Steve Mycoe

<https://www.facebook.com/Phantom-Limb-Pain-172125679512163/>

<https://twitter.com/PhantomLimbPain>



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