2023 MID-ATLANTIC CONFERENCE

11th ANNUAL CURRENT CONCEPTS IN

VASCULAR THERAPIES

2023

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VASCULAR THERAPIES

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MY PATIENT IS ABOUT TO BECOME AN AMPUTEE

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Physical Medicine and Rehabilitation Perspectives

Objectives:

1. Review Pain Management Issues
2. Identify Energy Expenditures in Amputee Gait
3. Review Strategies for Improved Functioning

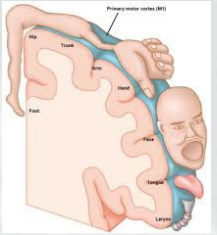
Pain Management In Amputations

Residual vs Phantom

Residual Limb Pain

- Nocturnal
- Mechanical
- Ischemic
- Infection
- Neuropathic

Phantom Limb Phenomenon



- 90 - 98% of amputee patients suffer from phantom limb
- caused by changes occurring in the sensorimotor cortex of the brain; rewiring itself and rearranging sensory information to adjust to the change after amputation increased neuronal activity leads to a central sensitization or 'Wind-up phenomenon'. The final factor is cortical reorganization. Baron R. Mechanisms of disease: neuropathic pain – a clinical perspective. *Nat Clin Pract Neurol* 2006; 2(2): 95–106
- Phantom limb (PLP) pain is the perception of pain or discomfort in a limb that is no longer there. (Bishnu Subedi, George T. Grossberg Department of Neurology & Psychiatry, Saint Louis University School of Medicine, July 2011) . Silas Weir Mitchell, a famous Civil War surgeon in the nineteenth century, coined the term "phantom limb pain
- Phantom limb sensation (PLS) is feeling of a lost body part after traumatic injuries In the 1990s, Tim Pons, at the National Institutes of Health (NIH), showed that the brain can reorganize if sensory input is cut off

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Risk Factors

- Pain or infection prior to amputation
- Presence of blood clots in the amputated limb
- Traumatic amputation
- Type of anesthesia used during the removal of limb (General Anesthesia)
- There may be cortical reorganization in the brain that causes phantom limb pain (sensorimotor cortex)
- Intravenous Ketamine can be used or epidurals and spinal anesthesia to decrease pain
- Psychological factors play an important role in other types of chronic pain in the amputee (I no clear research on predictors of who will experience phantom limb pain)

Phantom Limb Sensation/Pain

- Cramps
- Tickling
- Shooting, piercing, or stabbing pain
- Numbness/Burning
- Cold
- Warmth
- Tightness
- Itchiness

Other Triggers of PLP

- Pressure on the remaining part of the limb from objects (clothing)
- Emotional stress
- Forgetting the limb's absence and attempting to use it
- A poorly fitting prosthesis of brace
- Residual Limb pain

Treatment of Phantom Limb Pain(PLP)

Non-pharmacologic

Electrical stimulation- This can include the use of:

- TENS (transcutaneous electrical nerve stimulation) Spinal cord stimulation (SCS) can be effective treatment for phantom pain. An electrical stimulator is implanted under the skin, and an electrode is placed next to the spinal cord. The nerve pathways in the spinal cord are stimulated by an electric current.
- Electromyofeedback
- EMG biofeedback

Manual therapy- Physical/Occupational therapists use hands-on (manual) therapy including:

- Massage, Vibration , Acupuncture ,Manipulation (gentle limb movements performed by the physical therapist)

Technology- Mobile applications, the Recognise™ app, "retrain" and "remap" how the brain sends pain to a body region

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Therapies

- The less investigated strategies for the management of PLP is phantom motor execution (PME) or phantom exercises. PME involves the imaginary movement of phantom limb in the brain along with the performance of certain actual physical movements developed by Vilayanur Ramachandran and colleagues
- **Mirror visual feedback/mirror box therapy.** This treatment uses a mirror or mirror box to "trick" your brain into believing the reflection of your non amputated limb is actually your opposite limb. The brain adapts how it processes perception and sensation of the amputated limb, which can help reduce phantom sensations.
- Virtual reality has been used. Scientists from the University of Manchester have shown that PLP was relieved by attaching the sufferer's real limb to an interface that allows them to see two limbs moving in a computer-generated

Pharmacological Treatments

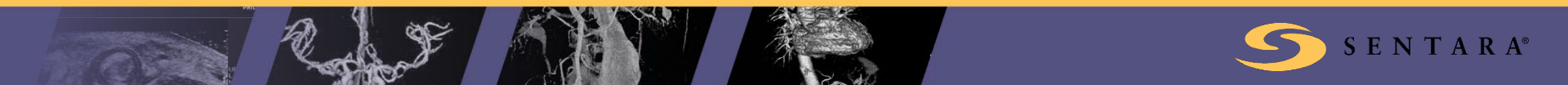
Single pharmacological therapy:

Most commonly used medications for the treatment of PLP are **tricyclic antidepressant (TCA)**

- Venlafaxine is an **SNRI (serotonin–norepinephrine reuptake inhibitor).** It is important to note that venlafaxine is not recommended to date under the NICE or the Scottish SIGN guidelines as an option for neuropathic pain in non-specialist settings

- Gabapentin, **anticonvulsant** commonly used. The action of gabapentin is complex and may inhibit the release of excitatory neurotransmitters and targets NMDA and non-NMDA receptors

N-methyl-D-aspartate (NMDA) receptor antagonist class demonstrated consistent positive results. (Hall & Eldabe, Phantom limb pain: a review of pharmacological management Br J Pain. 2018 Nov; 12(4): 202–207



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Pharmacological Treatments

- Topiramate **(GABA) agonist**, anticonvulsant, sodium channel blocker and kainite antagonist

- Calcitonin therapy in PLP have produced mixed results. Calcitonin (200 IE) was examined in chronic PLP against and in combination with ketamine (0.4 mg/kg) infusion in a 20 participant randomized, double-blind trial. **Ketamine, but not calcitonin, reduced PLP.** (Ketamine increased pressure pain thresholds significantly. Wind-up like pain was also reduced)

- **Memantine/Namenda** 20–30 mg daily, **NMDA receptor antagonists** was used against placebo and demonstrated a reduction in PLP intensity at 1 month, 6 months but not at 12 months (no long-term effect on established PLP was evident) others **Amantadine**

- **Dextromethorphan**, **NMDA** effectively reduced post amputation phantom limb pain. (A pilot double-blind trial RB Abraham · 2002 of cancer amputation pain showed oral dextromethorphan 120–270 mg daily effectively reduced PLP)

- **Combination therapy** has demonstrated effectiveness in previous studies for neuropathic pain but this has never been tested . Combination treatment of agents with proven efficacy in PLP such as **opioid and gabapentin** deserves additional research

Energy Conservation and GAIT

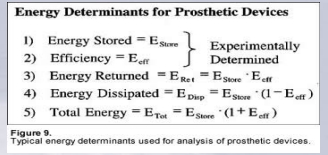

Figure 9.
Typical energy determinants used for analysis of prosthetic devices.

Energy Cost for Vascular Amputees vs Traumatic Amputees

- Preservation of function is the chief concern, amputation should be performed at the lowest possible level Waters, RL; Perry, J; Antonelli, D; Hislop, H
  The Journal of Bone & Joint Surgery 58(1):p 42-46, Jan. 1976

- Transtibial amputation, 10–40% more energy to walk at the same speed as able-bodied peers normal expenditure (Ee) of walking is 0.063 kcal/min/kg and 0.00764 kcal/meter/kg.

- Oxygen consumption (ml O_2/kg/min) and heart rate (beats/min) increased with higher walking speed and a more proximal amputation

- The capacity to walk short or long distances is greatly impaired in PVI patients Pinzur,Gold, Schwartz, Gross, Orthopedics, 2013;15(9):1033–1037

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Energy Conservation and GAIT

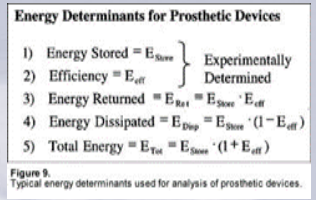
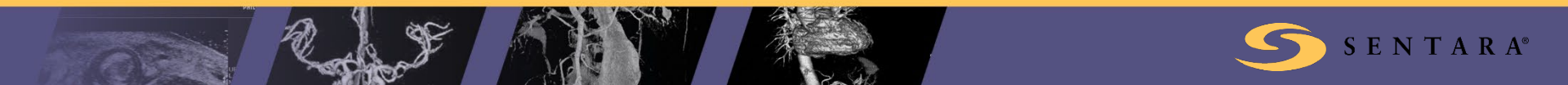


Figure 9.
Typical energy determinants used for analysis of prosthetic devices.

- The higher the level of amputation and the greater number of lower-limbs amputated is associated with a higher metabolic cost of walking and reduced ambulatory physical activity

- Lower-limb amputation have significantly higher Energy cost of walking (Ecw) compared to people without an amputation. Vascular transfemoral amputations showed the greatest difference (+102%) in ECw. The smallest difference (+12%) was found for people with nonvascular transtibial amputations. Slower self-selected walking speed was associated with substantial increases in ECw. General estimates of the energy cost of walking in people with different levels and causes of lower-limb amputation Ettema, Sanne; Kal, Elmar; Houdijk, Han, Prosthetics and orthotics international, 2021



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Prosthesis and Energy Expenditure

- Prosthetic devices can store and return energy during gait enhance to improve mobility

- Rehabilitation, a comprehensive process of obtaining an optimum socket design, alignment, and choice of prosthetic componentry

- Complete physiological replacement of an amputated foot and ankle with a prosthetic device is ambitious, an unattained aim
- The musculoskeletal complex of the foot and ankle not only absorbs energy but also generates more energy than it absorbs,

- Commercial prostheses contain passive materials which partially replaces the missing physiological system, leads to asymmetries in the temporal kinetic and gait parameters between each limb of an amputee during walking gait.

- Osseous Integration vs Traditional designs and energy expenditures: STAY TUNED

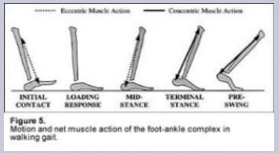
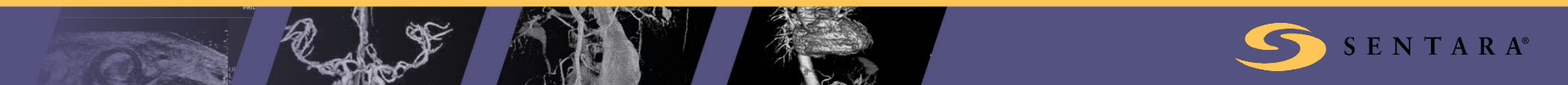


Figure 5.
Motion and net muscle action of the foot-ankle complex in walking gait.

THANK YOU!!!



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