Learning Objectives

- Attendees will have a greater understanding of the application of a graded motor imagery approach and mobile app technology to the management of CRPS.
- Attendees will identify the role of psychological strategies and family-based interventions in supporting recovery among children with CRPS.
- Attendees will have a greater understanding of the current best evidence for multimodal approaches to analgesia in CRPS including physical, psychological and integrative, and pharmacological.

CRPS… some advice from the grave
What is it?

• causalgia

“In our early experience of nerve wounds, we met with a small number of men who were suffering from a pain which they described as a “burning,” or as “mustard red hot,” or as “a red-hot file rasping the skin.” In all of these patients, and in many later cases, this pain was an associate of the glossy skin previously described.”

Mitchell et al (1864). Gunshot Wounds and Other Injuries of Nerves

What is it?

• 80 different names for it reflecting
  • the precipitating event
  • the predominant symptoms
  • the specialty and country of origin of the treating physician
  • or the presumed pathogenetic mechanism

• most widely accepted term was reflex sympathetic dystrophy (RSD) coined by Evans in 1946

Borchers, AT and Gershwin, ME. Autoimmunity Reviews 13 (2014) 242–265

What is it?

• Complex Regional Pain Syndrome is now the accepted terminology, and is divided into two subtypes
  • CRPS type I occurs without nerve injury
  • CRPS II in which significant nerve injury can be demonstrated
Who gets it?

- CRPS 1 has an annual incidence rate of 27 cases per 100,000
  - typically begins in adolescence
  - rare before 6 years or age
  - marked female to male preponderance
  - lower extremities more frequently affected in children

What do we know about it?

- pediatric CRPS ~28% (range 4–60%) of patients are unable to identify an inciting injury or trauma
  - most of the precipitating injuries are minor and fractures or surgery are rarely involved

What do we see?

- sensory
  - pain that is 'out of proportion' in both intensity and duration to the original injury or trauma and not limited to a single nerve territory
- autonomic
  - adults - a warm, red, swollen extremity
  - pediatrics - more often cold and blue at the onset
  - swelling or edema less frequent in children compared to adults
  - sudomotor disturbances (hyperhidrosis or hypohidrosis)
  - trophic changes
- motor
  - weakness or limited active range of motion (ROM)
What is really going on?

- theories on pathophysiology
  - arises from inflammatory process?
  - sympathetically mediated condition?
  - facilitated by central sensitization?
  - ischemia-reperfusion injury?
  - small fiber neuropathy?
  - sensitivity to neuropeptides?
  - autoimmune disorder?
  - genetics?

- a peripheral problem?

---

"We have again and again been urged by patients to amputate the suffering limb…

…it would be in vain to amputate a member while the scar lies beyond it in a part which could not be attacked by the knife of the surgeon."

Mitchell et al (1864). Gunshot Wounds and Other Injuries of Nerves

---

23 years after 'Reflex Sympathetic Dystrophy' Advances in the understanding & management of complex regional pain syndrome (CRPS) in children and teenagers

Stefan J. Friedrichsdorf, MD, FAAP
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Assistant Professor of Pediatrics, University of Minnesota Medical School

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Diagnosis

Complex Regional Pain Syndrome (CRPS) - Pediatrics

- **NO consensus-based pediatric diagnostic criteria for CRPS** (such as those published for adult)
- **Budapest Clinical Diagnostic Criteria**: 100% sensitivity and 70–80% specificity in the adult population
- **Pediatrics**: 95% specificity; 56% sensitivity

Son JS, Wong C, Sethna N, Sieberg CB: Exploring Pediatric Chronic Regional Pain Syndrome (CRPS) Diagnostic Criteria and Determining the Efficacy of Multidisciplinary Treatment in Managing Pediatric CRPS. (Poster) 11th ISPP, Kuala Lumpur, Malaysia, July 6-9, 2017

- In comparison to adults, triple-phase bone scan less reliable diagnostic method


- **Review of prior diagnostics important**
  - e.g. Kacho et al, who reported 5 patients with alternative diagnoses among 19 patients referred for CRPS


- **erythromelalgia**
- ankle sprain
- angiomatosis of the lower extremity with osteoporosis due to disuse
- conversion reaction

Budapest Clinical Diagnostic Criteria for CRPS

(1) Continuing pain, which is disproportionate to any inciting event
(2) Must report at least one symptom in 3 of 4 following categories
  - Sensory: Reports of hyperesthesia and/or allodynia
  - Vasomotor: Reports of temperature asymmetry and/or skin color changes and/or skin color asymmetry
  - Sudomotor/Edema: Reports of edema and/or sweating changes and/or sweating asymmetry
  - Motor/Trophic: Reports of decreased range of motion and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin)
(3) Must display at least one sign* at time of evaluation in 2 or more of the following categories:
  - Sensory: Evidence of hyperalgesia (to pinprick) and/or allodynia (to light touch and/or deep somatic pressure and/or joint movement)
  - Vasomotor: Evidence of temperature asymmetry and/or skin color changes and/or asymmetry
  - Sudomotor/Edema: Evidence of edema and/or sweating changes and/or sweating asymmetry
  - Motor/Trophic: Evidence of decreased range of motion and/or motor dysfunction (weakness, tremor, dystonia) and/or trophic changes (hair, nail, skin)
(4) There is no other diagnosis that better explains the signs and symptoms

Differential diagnoses of complex regional pain syndrome

| Orthopaedic disorders | Fracture, sprains, bone contusion, bursitis, apophyseal, ligamentous injury, muscle injury |
| Neurologic disorders | Peripheral neuropathy, cocaine- and amphetamine-induced psychosis, diabetic neuropathy, nevus, nerve entrapment, complex regional pain syndrome, postherpetic pain, Gullain–Barré syndrome |
| Rheumatologic disorders | Rheumatoid arthritis, pauciarticular arthritis, osteoporosis, sarcoidosis |
| Infectious disorders | Syphilis, herpes simplex, viral infections, osteomyelitis, Lyme disease |
| Vascular disorders | Vasculitis, aortic insufficiency, Reiter's syndrome |
| Miscellaneous | Toxic exposure to heavy metals (lead), or chemotherapeutic agents (e.g., cisplatin), porphyria, vitamin B12 deficiency, thalassemia, familial disease, somatoform disorder |


What are we measuring...?

(1) Nociceptive Pain: arises from the activation of peripheral nerve endings (nociceptors) that respond to noxious stimulation [e.g. localized, sharp, squeezing, stabbing, or throbbing]
  - Somatic (for example, muscles, joints)
  - Chronic somatic pain typically well localized & often results from degenerative processes (such as arthritis)

(2) Visceral (internal organs) [poorly localized, dull, crampy, or achy]

(3) Neuropathic Pain: resulting from injury to, or dysfunction of, the somatosensory system. [burning, shooting, electric, or tingling]
  - Central pain: caused by a lesion or disease of the central somatosensory nervous system

(4) Psycho-social-spiritual-emotional Pain / Total Pain

(5) Persistent (Chronic) Pain
  - Pain beyond expected time of healing

Epidemiology
Complex Regional Pain Syndrome (CRPS) - Adults

- Incidence in Western countries about 26 per 100,000 person-years
- 80,000 Americans are diagnosed with CRPS annually
- Most common adult trigger in prevalent cases is wrist fracture
- 1,549 patients presenting with wrist fracture

CRPS - Pediatrics

- Type I typically arises from minor injury (sprain/fracture)
- develops more commonly in girls of white ethnicity, with incidence rising around puberty
- often arises after minor trauma
- more common in the lower extremities (versus upper extremity in adults)

- Type II indicates likelihood of specific nerve injury causing the symptoms
- occurs in equal numbers in boys and girls

Pediatric CRPS

- Peak age of onset is around 12–13 years of age
- Usually minor trauma is inciting event such as minor sprain or twist
- Fractures account for 5–14% of the inciting events
- CRPS develops postsurgically in 10–15% of cases

- Clinical characteristics
  - Male:Female = 1:6
  - Lower:Upper extremity = 5:1
  - Often highly stressed adolescent
  - Competitive sport, often from early age
Pediatric CRPS


Pediatric versus adult CRPS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pediatric</th>
<th>Adult</th>
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<tbody>
<tr>
<td>Gender</td>
<td>Female&gt;&gt;male</td>
<td>Female&gt;&gt;male</td>
</tr>
<tr>
<td>Median age, y</td>
<td>13</td>
<td>43</td>
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<tr>
<td>Limbs</td>
<td>LE&gt;UE, some diffuse</td>
<td>UE&gt;LE</td>
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<tr>
<td>Preceding trauma</td>
<td>Mild&gt;Severe</td>
<td>Severe&gt;Mild</td>
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<tr>
<td>Edema</td>
<td>40%</td>
<td>40% cooler</td>
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<tr>
<td>Affected limb temperature</td>
<td>70% cooler</td>
<td>40% cooler</td>
</tr>
<tr>
<td>Spasms/tremor</td>
<td>20%/20%</td>
<td>20%/40%</td>
</tr>
<tr>
<td>Prognosis</td>
<td>Favorable</td>
<td>Less favorable</td>
</tr>
<tr>
<td>Relapse rate</td>
<td>30%</td>
<td>10%</td>
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CRPS = complex regional pain syndrome; LE = lower extremity; UE = upper extremity.


Pathophysiology
Complex Regional Pain Syndrome

Several pathological mechanisms

- Oxidative stress
- Classic inflammation
- Neurogenic inflammation
- Autonomic & sensory nerve system alterations
- In animal model NFκB involved in development of allostynia after physical injury (ischemia and reperfusion) without direct nerve trauma
- CRPS with fixed dystonia associated with HLA system (HLA-B62 and HLA-DQ8) in animal model
- Some CRPS patients had functionally active autoantibodies against muscarinic-2 and beta-2 adrenergic receptors
- CRPS pathogenesis: Cytokine imbalance/activity [pro-inflammatory vs anti-inflammatory] in CRPS (local, but not systemic TNF-α increase)

Pediatric CRPS

- Pathophysiology is poorly understood
- many features, particularly neurologic abnormalities, suggest both peripheral and central nervous system involvement
- Peripheral small fiber neuropathy as etiology and inflammation involving small nerve fibers (neurogenic inflammatory pain) has been suggested.
- Tissue inflammatory etiology has been investigated; however, these inflammatory aspects differ from those seen in other conditions involving tissue inflammation

nociceptive pathways & Primary sites of action of analgesics

- Thalamus
- Acetaminophen (Paracetamol)
- Injury
- NSAIDs

Injury

Nociceptive Pathways & Primary Sites of Action of Analgesics

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Nociceptive Pathways & Primary Sites of Action of Analgesics

Injury

Thalamus

NSAIDs

Opioids

Acetaminophen (Paracetamol)

Peripheral Sensitization:
- Response to Tissue Injury

Central Sensitization:
- Activities in C-Fibers drives changes in 2nd neuron
  - Glial activation & cytokine release
  - Also involved?
  - Result: 

  - Reduced inhibition in Dorsal Horn
  - GABAAergic neuron (GABA/Gly interneurons)

  - Altered Synaptic Transmission: Ca-channel (\(\alpha-2-\delta\) dysfunction?)

  - Injury induced accumulation of Na-channels
  => ectopic firing

Integrative
(non-pharmacological)
therapies

Periaqueductal grey (endorphins)

2nd Neuron

NSAIDs

Opioids

Acetaminophen (Paracetamol)

INJURY:
- Stress
- Anxiety
- Catastrophizing
- Depression
- perceived injustice
- disturbed Sleep

Neuropathic Pain Mechanisms

Thalamus

Peripheral Sensitization:
- Response to Tissue Injury

Central Sensitization:
- Activities in C-Fibers drives changes in 2nd neuron
  - Glial activation & cytokine release
  - Also involved?
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Integrative
(non-pharmacological)
therapies

Periaqueductal grey (endorphins)

2nd Neuron

NSAIDs

Opioids

Acetaminophen (Paracetamol)
Interaction between autonomic and somatosensory systems

- Sympathetically maintained pain most commonly linked to CRPS, but same principles apply to other pain conditions, such as postherpetic neuralgia. Cohen, S.P., S.G. Kapoor, and J.P. Rathmell. Intravenous infusion tests have limited utility for selecting long-term drug therapy in patients with chronic pain: a systematic review. Anesthesiology. 2009. 111(2): p. 416-31.
- Expression of α-adrenoceptors on primary afferent sensory fibers
- Sympathetic sprouting into dorsal root ganglia
- Impaired oxygenation and nutrition in response to sympathetically mediated vasoconstriction.
- Clinically, sympathetically maintained pain may manifest as temperature or color changes (or both) in an affected extremity, swelling or atrophy, and pain worsened by cold weather or stress, which enhances sympathetic outflow Cohen, S.P. and J. Mao. Neuropathic pain: mechanisms and their clinical implications. BMJ, 2014. 348: p. f7656
- Compared to controls, pediatric CRPS patients have reduced gray matter in the primary motor cortex, premotor cortex, supplementary motor area, midcingulate cortex, orbitofrontal cortex, dorsolateral prefrontal cortex (dIPFC), posterior cingulate cortex, precuneus, basal ganglia, thalamus, and hippocampus.

Brain Changes in Pediatric CRPS

- Reorganizational changes occur, including changes in:
  - Dorsal horn of the spinal cord
  - Dorsal root ganglion cells
  - Structural changes in afferents and sympathetic nerves
  - Leading to neural plasticity
  - Producing a state of heightened reactivity within the CNS
- This process accounts for why patients continue to report neuropathic pain even after the initial injury or damage has healed.
Central Sensitization

- fMRI in patients aged 9–18 years with CRPS


- After stimulation of affected and nonaffected limbs, patients had abnormal activation of sensory cortex, motor regions, emotional processing centers and pain sensory regions.

- These abnormal activation patterns persisted and were present even when a nonaffected limb was stimulated and even after recovery from a painful stimulus suggesting that the brain perceives normal stimuli differently in patients with CRPS.

- Brain network alterations in networks associated with pain processing (salience, default mode, central executive, sensorimotor networks) normalize with treatment in pediatric CRPS


Central Sensitization

“…amplification of neural signaling within the CNS that elicits pain hypersensitivity”

In other words...

- Pediatric CRPS is a disorder of the peripheral and central nervous system.
- Clinical Model: blood pressure cuff on upper limb
  - absence of large fibers = touch, mechanical etc. = only burning sensation
  - shaking hands = large fiber stimulation

Treatment

Complex Regional Pain Syndrome

- Despite treatments incl. physical / occupational therapy, sympathetic nerve block, spinal cord stimulation, systemic analgesics, and cognitive-behavioral pain management.
CRPS Treatments

SHOW ME THE EVIDENCE!

Medications

Adult literature

- **vitamin C** noted to decrease the risk of CRPS after fracture
  

- **Topical ketamine** beneficial in reduction of allodynia
  

- 2 pediatric case reports of management using **gabapentin**, supported in the adult literature
  


  - Low-dose naltrexone?
  - Glucocorticosteroids?
  - Bisphosphonates?
  - Cannabis?

Cannabis

“Charlotte, should we use cannabis in Kids with CRPS?”

[Link](https://www.youtube.com/watch?v=ClYdJpezFIV)
Medications

- **No known large, prospective, randomized clinical trials for pediatric CRPS**

- Large number of children (70%) required amitriptyline or gabapentin to enable participation in physical therapy (Rakowsky AL, Haddad P, Wiener AM) Pediatric complex regional pain syndrome (Pediatr Orthop). 2017;37(3):372.


This is why you shouldn’t believe that exciting new medical study

Critical lack of high quality evidence for the effectiveness of most therapies for CRPS.

Moderate quality evidence:
- Intravenous regional blockade with guanethidine is NOT effective; associated with risk of significant adverse events.

Low quality evidence
- Effective for pain when compared with placebo
- Bisphosphonates
- Calcitonin
- Daily course of IV ketamine
- Effective for pain and function when compared with usual care
- Graded motor imagery
- Mirror therapy may be effective for pain in post-stroke CRPS
- Local anesthetic sympathetic blockade NOT effective
- Physiotherapy or occupational therapy are associated with small positive effects that are unlikely to be clinically important at one year follow up

Which treatments are effective for the treatment of complex regional pain syndrome in adults?

Pediatric CRPS: Integrative Therapies

Acupuncture

Hypnosis
Regional Anesthesia

- Adults: Scarcity of published evidence to support use of local anesthetic sympathetic blockade for CRPS. From existing evidence not possible to draw firm conclusions regarding efficacy or safety of this intervention; but the limited data available do not suggest that LASB is effective for reducing pain in CRPS. Stanton TR, Wand BM, Carr DB, Birklein F, Wasner GL, O’Connell NE. Local anaesthetic sympathetic blockade for complex regional pain syndrome. Cochrane Database Syst Rev 2013(8):CD004598.


Regional Anesthesia

- Continuous regional anesthesia (epidural or peripheral perineural local anesthetic infusions) along with inpatient rehabilitation may be an option to facilitate intensive rehabilitation for selected pediatric patients with CRPS. Donado C, Lobo K, Velarde-Alvarez MF, Kim J, Kenney A, Logan D, Berde CB. Continuous Regional Anesthesia and Inpatient Rehabilitation for Pediatric Complex Regional Pain Syndrome. Reg Anesth Pain Med 2017;42(4):527-534.


- noninvasive neurostimulation include repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation

Other Non-invasive treatment options


- transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation

Rehabilitation

- Physical therapy (PT), occupational therapy (OT), and recreational therapy (RT)
- Aquatic therapy, Graded motor imagery, transcutaneous electrical nerve stimulation (TENS), contrast baths, fluidotherapy, and elastic therapeutic tape (e.g., Kinesio Tape)
- Support for education, desensitization, introduction of weight bearing, and functional use of the affected extremity
- Cognitive-behavioral treatment: Perceived harmfulness of activities contribute to functional limitations

Psychology

- CRPS may represent aberrant protective response to perceived threat of tissue injury
- Anxiety, pain-related fear, and disability are associated with poorer outcomes in CRPS
- Primary goals of psychosocial treatments are to enhance pain management skills and to restore normal activity.
- Behavioral and cognitive-behavioral interventions

Multidisciplinary Management

- The most evidence-based treatment of CRPS in pediatric and adult patients is a multidisciplinary rehabilitation approach that combines physical therapy and biobehavioral treatments.
- A day-hospital interdisciplinary rehabilitation approach seems effective in reducing disability and improving physical and emotional functioning and occupational performance among children and adolescents with CRPS that have failed to improve with outpatient treatment.

Prognosis


Our Approach
Exit Interview:
What is the Hard Work...and non-negotiable...?

- **Physical Therapy**
  - Daily home exercise

- **Integrative Medicine**
  - Self-Hypnosis
  - Biofeedback
  - Progressive Muscle relaxation
  - Daily home exercise
    - Passive: Massage, Acupuncture

- **Psychology**

- **Sports/Exercise**

- **Sleep-hygiene**

- **Social:** Having daily fun

- **School:** Attending full-time (or school-re-entry plan)

- **Family Coaching**

- **Medications**
Exit Interview:
What is the Hard Work...and non-negotiable...?

- **Physical Therapy**
  - Daily home exercise
- **Integrative Medicine**
  - Self-Hypnosis
  - Biofeedback
  - Progressive Muscle relaxation
  - Daily home exercise
  - Passive Massage, Acupuncture
- **Psychology** (...if missing school)
- **Normalize Life**
  - Sports/Exercise
  - Sleep-hygiene
  - Social: Having daily fun
  - School: Attending full-time (or school-re-entry plan)
- **Family Coaching**
- **Medications**...???
CRPS is a complicated entity that is more than a painful sensory condition.

There is evidence for peripheral inflammatory and neurological changes, and reorganization in both sensory and motor cortices.

Successful interdisciplinary treatment involves psychology & physical therapy…

Conclusion
Compared to headache, abdominal pain, and back pain, CRPS:

- greater functional disability,
  however
- less school absences
- no differences in depression, anxiety

Why Psychology?

Meta-analysis by Palermo and colleagues

- Omnibus tests for CBT, relaxation training, and biofeedback: significant positive effect on pain reduction
  - 18 studies: demonstrated 50% reduction in pain compared to controls. Numbers needed to treat:
    - Post-treatment: 2.64 (CI: 2.27 - 3.21)
    - Follow-up: 1.99 (CI: 1.66 - 2.60)

CRPS Intervention

Interdisciplinary day treatment outcomes

- Longitudinal Case Series: 56 patients
  - Median length of stay: 3 weeks
  - Outcomes:
    - Reduced pain intensity
    - Improved functional disability
    - Improved emotional functioning

11 year old, female, CRPS in knee triggering event: cleft palate repair
Patient Perspective

I feel sorta like right before I step- my brain pulls up all the previous records of pain during my steps... It's as if my brain is doing premature file searching as if it knows that it is going on a trip where they [brain] need to bring that file or that importance piece of paper with them.

The memories that my brain pulls up are memories of previous steps that I have taken with CRPS- I know of course these are very painful because CRPS makes it very painful for me to walk of course. A lot of times its not as much the memory as it is the word ow as the memory takes place.
Patient Perspective

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Memory and Pain

"my brain pulls up all the previous records of pain"

Memory and Pain

- The memory (vs actual pain rating) of lab-based pain experience better predicted future pain ratings
- Negative memory of pain vs. Positive/Accurate memory
  - greater anticipated pain
  - increased pain rating

“Find something positive and shine a spotlight on it”

Melanie Noel

Protectiveness and Hypervigilance

"where they [brain] need to bring that file or that importance piece of paper with them"

Protectiveness

Fear of Pain and Perceived Harmfulness of Activities:

- Modulates physical and psychological functioning

- Associated with functional disability

- Perceived harmfulness of activities, related to increased functional disability
  de Jong, JR, Vlaeyen, JWS, de Gelder, JM, Patijn, J. Pain-related fear, perceived harmfulness of activities, and functional limitations in CRPS Type 1. J. Pain, 13(12), 1208-1218.
Protectiveness

Catastrophizing/Awfulizing/Extreme Thinking


Expectancies

“I know of course these are very painful because CRPS makes it very painful for me to walk of course”


“The most dangerous procedure in medicine? Communication.”

Leora Kuttner

Intervention

Memories & Expectancy

Remember, the frontal brain place has LOTS of memories of you walking—something to the tune of 3,285 days of walking comfortably, which is the VAST MAJORITY of walking memories. So, each time you take a step or two—try to remind your mind to look for the memories of walking COMFORTABLY.
Realistic Perspective

Remember, the frontal brain place has LOTS of memories of you walking—something to the tune of 3,285 days of walking comfortably, which is the VAST MAJORITY of walking memories. Each time you take a step or two, try to remind your mind to look for the memories COMFORTABLY.

The Oww, Oww, Oww, Oww, Oww, Oww Song
Attentional Bias

- Patients have attentional bias towards pain and have a harder time distracting away from pain


Intervention

- Musical, bumpy rides
- Silent ow song
- Funny word

Relaxation Training & Biofeedback
Autogenic Relaxation Training

Our Mind, is a Powerful Thing

Physical Therapy

“And you wonder why you wake up with a sore ankle.”

Ballard Street by Jerry van Amerongen
What is PT?

- published articles often recommend 'physiotherapy' as adjuvant treatment without specifying exactly what it is...
- variable approaches to the prescription of physiotherapy
- specific physiotherapy techniques were poorly described and often
- physiotherapy for CRPS-I is likely to have a beneficial impact on the disorder and on how patients cope with the condition

Movement

- pain might be considered a perceptual inference - a “best guess” that protective action is required


- so if the consequence of movement in CRPS is protective action, how then can we move without actually moving?

- we need movement that the patient’s brain does not yet have an opinion of…

What did Mitchell say again?

“We have again and again been urged by patients to amputate the suffering limb…

…it would be in vain to amputate a member while the scar lies beyond it in a part which could not be attacked by the knife of the surgeon.”

Mitchell et al (1864). Gunshot Wounds and Other Injuries of Nerves

A  acute CRPS  after treatment

B  lip/hand

Muhlebar et al Neurology 2004;63:693–701
Cortical change and pain

- patients with CRPS display cortical reorganization and associated changes in somatosensory cortex activity and anatomy
- degree of cortical reorganization is correlated with pain intensity (adults)
- treatments aimed at reversing cortical reorganization should be considered for use in patients with certain types of chronic pain


What about the pediatric brain?

- grey matter abnormalities in pain-related brain regions in pediatric CRPS
- interdisciplinary treatment approaches produce measurable clinical effects that overlap with objective rapid changes in brain structure and function
- children with CRPS typically have higher chances of recovery, likely due to enhanced brain plasticity processes

Erpelding N et al., Brain Struct Funct. 2014 December

Moving without movement?

- graded motor imagery (GMI) is a sequential rehabilitation approach that aims to alter sensory-motor processing in 3 stages
  - implicit motor imagery
  - explicit motor imagery
  - mirror therapy
- allows gradual movement without pain production
- goal of this treatment is to successively activate cortical motor areas without triggering protective pain responses

Left or right?

- implicit motor imagery
  - the patient views images of body parts and makes a laterality judgment
  - restoration of the brain’s concept of left and right
  - thought to activate pre-motor cortices but not the primary motor cortex


Imagine moving

- explicit motor imagery
  - mental representation of the posture shown in the image
  - kinesthetic imagery (first person imagery)
  - activates both pre-motor cortices and the primary motor cortex


Reflecting on movement

- mirror therapy
  - provides a visual illusion of a normal moving limb by using the mirror reflection of the unaffected arm… movement without moving
Meet John…

- 10-year-old male with acute onset right lower extremity CRPS
- pain (10/10) and allodynia over the right lower extremity
- significant mobility and functional limitations, and associated feelings of distress and frustration
- impaired lower extremity left/right discrimination (accuracy left 80%, response time 0.6 s / accuracy right 0%, response time 3.1 s using Recognise app)
- patient stated goal to be able to play baseball

Intervention

- Medicine
  - gabapentin 400 mg tid titrated to 600 mg tid and amitriptyline 10 mg qhs titrated to 20 mg qhs.
- Mind
  - cognitive-behavioural therapy with patient (and mother) focused on teaching pain coping strategies
- Movement
  - pain neurophysiology education
  - progressive weight bearing pool program
  - left-right discrimination training of lower extremity with Recognise app

Recognise data
Outcome

- data from the patient's 185 uses of the Recognise app reveal gradual restoration of left and right discrimination (accuracy left 100%, response time 0.9 s and accuracy right 100%, response time 0.9 s)
- corresponding to significant reductions in pain and full return to baseball
- promise of tickets for PT when patient reaches MLB

What do we know?

- GMI has large effects when compared to usual physiotherapy care
  Bowering et al., The Journal of Pain Vol 14, No 1 (January), 2013 (pp 3-1)
- GMI may yield positive clinical outcomes in terms of pain and functional improvement

What don’t we know?

- a lot…
  - low-volume and poor-to-fair quality evidence on the effect of PT for children with CRPS I
  - paucity of evidence regarding what constitutes PT and the most effective type of treatment in acute and chronic CRPS
  - lack of information regarding how the treatment should be applied
  - GMI along with other techniques (such as graded exposure, sensorimotor treatment, and mirror visual feedback) have not been evaluated in pediatric CRPS populations

- GMI more palatable to children, their parents, and health professionals?
But…

• mirror therapy in children with cancer-related amputations is associated with lower incidence of PLP at 1 year and shorter duration of PLP
  Anghelescu et al. Rehab Oncol 2016;34:104–112

• mirror therapy in children with hemiplegia may improve strength and dynamic function of the paretic arm

• mirror illusion increases the excitability of the primary motor cortex in hemiparetic patients with contralateral corticospinal organization and in typically developing subjects
  Grunt et al. Neurorehabilitation and Neural Repair 2017, Vol. 31(3) 280–288

But…

• VR therapy is safe and feasible for pediatric patients with CRPS and that using a more flexible mapping of movement is an option

Conclusions

• we know less than we think we do

• Mitchell might have been on to something…

• there is a lot going on north of C1

• we might be able to offer patients some movement that the brain doesn’t have an opinion of…

• movement is more than just movement