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“Arming” You with Therapies: Evidence Based Techniques for Upper Extremity Motor NeuroRehabilitation

Steve Page, Ph.D., M.S., OTR/L, FAHA, FACRM, FAOTA

Associate Professor, School of Health & Rehab Sciences;
The Ohio State University Medical Center

Outline

• Describe neuroplasticity and its relevance to upper extremity rehabilitation.
• Identify and briefly describe 2 tools for finding evidence for upper extremity rehabilitative therapies.
• Identify and describe two assessment strategies for measuring upper extremity status.
• Briefly describe the Brunnstrom stages.
• Recognize the Brunnstrom stages with choices for upper extremity treatment strategies.
• Identify four strategies for increasing affected arm use and function.
What is Evidence-based practice?

Evidence-based practice (EBP) stresses "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence-based medicine... means integrating individual clinical expertise with the best available external clinical evidence from systematic research“

(Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996, p. 71).

Where can I find evidence fast??

<table>
<thead>
<tr>
<th>What you are looking for</th>
<th>Where to find it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generalized search for Peer-reviewed articles, books, abstracts and articles.</td>
<td>scholar.google.com</td>
</tr>
<tr>
<td>Stroke rehabilitation meta-analysis</td>
<td>ebrsr.com</td>
</tr>
<tr>
<td>All peer reviewed studies</td>
<td>pubmed.com</td>
</tr>
<tr>
<td>A breakdown of all peer reviewed literature into subcategories including “Therapy”</td>
<td><a href="http://www.tripdatabase.com">www.tripdatabase.com</a></td>
</tr>
<tr>
<td>Rehabilitation research</td>
<td>naric.com/research</td>
</tr>
</tbody>
</table>
Managing Evidence: 
“Push” and “Pull” methods

• “Pull” – access information when needed
  – Traditional Method - “Just in Time” learning

• “Push” - alerts us to new information
  – “Just in Case” learning

Using Medline...
When you click on "my library…"
Use open access resources

- Directory of Open Access Journals
  - www.doaj.org
- BiomedCentral
  - www.biomedcentral.com
- Google
  - Google Scholar
- PubMed
  - The NIH Mandate (see next slides on PubMed)
- Examples:
  - Physical Therapy Journal
  - Journal of Rehabilitation Research & Development
    - www.research.va.gov/programs/rrd.cfm
  - Stroke. (Free one year after publication)
    - http://stroke.ahajournals.org
Stroke Edge: Recommendations for outcome measures in different environments

http://www.neuropt.org/professional-resources/neurology-section-outcome-measures-recommendations/stroke
Upper Extremity Neurological Assessment

• Swedish Fulbright Scholar
• William Fulbright - Former U.S. Senator and SS.
• Brunnstrom authored several books and dozens of journal articles about human movement and the treatment of patients with hemiplegia.
The Brunnström stages simplified for assessment

What do the Brunnstrum stages and “recovery” represent neurophysiologically??

What are we saying when someone is “recovering?”
Some of the processes include:

**Reduction of swelling**
- restore blood flow to intact synapses
- reduces physical pressure
- action potentials resume

“The prenumbra” – some believe that’s all there is!!

---

**Denervation hypersensitivity**
- new receptor sites develop on postsynaptic membrane.
- WHY? Less neurotransmitter → development of additional receptor sites
- Receipt of neurotransmitters from adjacent sites
Unmasking of silent synapses

Synapses are unused until injury occurs; Injuries to other pathways causes their activation.

HOW DO WE ASSESS THESE BRAIN PROCESSES (OR LACK THEREOF)?
Neuroimaging let’s us see change that we may not see if the patient has the above and we use the below.

How is current status and response to therapy measured?

• Most common methods:
  – Transcranial Magnetic Stimulation (TMS)
  – Functional Magnetic Reasonance Imaging (fMRI)
    • Functional areas *should* light up according to use
    • DTI can be added
Reflex Testing

REFLEX SCALE

0 : Absent - No visible or palpable muscle contraction even with reinforcement

1+ : Hyporeflexia - Slight or sluggish muscle contraction with little or no joint movement. Reinforcement may be required to elicit a reflex response.

2+ : Normal - Slight muscle contraction with slight joint movement

3+ : Hyperreflexia - Clearly visible, brisk muscle contraction with moderate joint movement.

4+ : Abnormal - Strong muscle contraction with one to three beats of clonus. Reflex spread to contralateral side may be noted.

5+ : Abnormal - Strong muscle contraction with sustained clonus. Reflex spread to contralateral side may be noted.
UE Spasticity Testing

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>No movement</th>
<th>Stage 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>synergies dominate movement</td>
<td>Isolated joint movements visible</td>
</tr>
<tr>
<td></td>
<td>deviations become available</td>
<td></td>
</tr>
</tbody>
</table>

0  No increase in muscle tone
1  Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of range of motion
1+ Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the range of motion
2  More marked increase in muscle tone through most of the range of motion, but the affected part is easily moved
3  Considerable increase in muscle tone, passive movement is difficult
4  Affected part is rigid in flexion or extension (abduction or adduction, etc.)
**Ashworth: General considerations**

- Should be done in supine.

- Passively move the joint rapidly and repeatedly through the available PROM and grade the resistance using the definitions.

- Ask the patient if there is any pain in the arc

- Ashworth prior to goniometric measurements

---

**Elbow**

1. 1\textsuperscript{st} = Most spasticity brachioradials, 2\textsuperscript{nd} = biceps, 3\textsuperscript{rd} = brachialis

- With the patient’s elbow fully flexed.
- Palm of the hand facing inward (neutral sup/pro)
- Extend the patient’s forearm from maximum possible flexion to maximum possible extension

---

**What mm causes the most tone ?**

**Note:** not more than three consecutive times and rate the muscle tone.
Wrist (wrist flexors)

- Elbow as straight as possible and the forearm pronated so that the palm of the hand is facing downward

- Move the wrist from max possible flexion to max possible extension

Finger Flexors:

- Elbow as straight as possible

- Palm of the hand facing inward (neutral supination)

- Wrist in neutral

- Open and close the fingers

- Not more than three consecutive times and rate the muscle tone.
Thumb: Adductor Pollicis

- Elbow as straight as possible
- Palm of the hand facing inward (neutral supination)
- Raise and lower the thumb form max possible flexion to max possible extension not

Not more than three consecutive times and rate the muscle tone

The Box & Block

No movement

synergies dominate movement
deviations become available
isolated joint movements visible

Stage 1

Stage 6

Captures Gross Proximal and Distal Movement

CONTINUED
Box and Block

The ARAT

Captures Distal Mvemnt
The Action Research Arm Test

- Nuray Yozbatiran, Lucy Der-Yeghiaian and Steven C. Cramer

- A Standardized Approach to Performing the Action Research Arm Test

- *Neurorehabil Neural Repair* 2008; 22; 78

Figure 1. The complete ARAT kit is displayed.
<table>
<thead>
<tr>
<th>Task Material</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table</td>
<td>Height, 75 cm; width, 76 cm; depth, 49 cm</td>
</tr>
<tr>
<td>Chair</td>
<td>Height of seat 46 cm from floor; no arm rests</td>
</tr>
<tr>
<td>Shelf (or box on the table)</td>
<td>37 cm above level of table</td>
</tr>
<tr>
<td>Four wooden blocks</td>
<td>10.0, 7.5, 5, and 2.5 cm³, respectively</td>
</tr>
<tr>
<td>Large alloy tube</td>
<td>Diameter, 2.5 cm; length, 11.5 cm</td>
</tr>
<tr>
<td>Small alloy tube</td>
<td>Diameter, 1 cm; length, 16 cm</td>
</tr>
<tr>
<td>Cricket ball</td>
<td>Diameter, 7.1 cm</td>
</tr>
<tr>
<td>Marble</td>
<td>Diameter, 1.6 cm</td>
</tr>
<tr>
<td>Sharpening stone</td>
<td>10.0 × 2.5 × 1 cm</td>
</tr>
<tr>
<td>Ball bearing</td>
<td>6-mm diameter</td>
</tr>
<tr>
<td>Two plastic tumblers</td>
<td>Upper diameter, 7 to 8 cm; lower diameter,</td>
</tr>
<tr>
<td></td>
<td>6 to 7 cm; height, 12 to 15 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Task Material</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washer</td>
<td>Outer diameter, 3.5 cm; inner diameter, 1.5 cm</td>
</tr>
<tr>
<td>Plank for the tubes</td>
<td></td>
</tr>
<tr>
<td>Starting point</td>
<td>1.5 × 8.5 × 8.5 cm</td>
</tr>
<tr>
<td>Target point</td>
<td>3.5 × 8.5 × 34 cm</td>
</tr>
<tr>
<td>Bolt for the large alloy tube</td>
<td></td>
</tr>
<tr>
<td>Starting position</td>
<td>Round wooden peg; diameter, 2.0 cm; height, 13.5 cm</td>
</tr>
<tr>
<td>Target position</td>
<td>Round wooden peg; diameter, 2.0 cm; height, 8.0 cm</td>
</tr>
<tr>
<td>Bolt for the small alloy tube</td>
<td></td>
</tr>
<tr>
<td>Starting position</td>
<td>Round wooden peg; diameter, 0.8 cm; height, 6.0 cm</td>
</tr>
<tr>
<td>Target position</td>
<td>Round wooden peg; diameter, 0.8 cm; height, 6.0 cm</td>
</tr>
<tr>
<td>Plank for the washer</td>
<td>1.5 × 8.5 × 8.5 cm</td>
</tr>
<tr>
<td>Bolt for the washer</td>
<td>Round wooden peg; diameter, 0.8 cm; height, 8.5 cm</td>
</tr>
<tr>
<td>Tin lid</td>
<td>Diameter, 9 cm; rim height, 1 cm</td>
</tr>
</tbody>
</table>
Treatments ideally occur with K.I.S.S.

- Keep It Simple Stupid
- "...Therapies That Your Mom (and Ours) Can Use"

Most survivors will not be at a rich IRF or academic medical center – There are more clinics and community hospitals – IRFs are on the decline in # (ACA, economics of running an IRF)
The P.R.A.C.T.I.C.E. Principles:
Common Ingredients for Efficacious Neurorehabilitation

- Part whole practice
- Repetitive, task specific, and goal focused
- Activities should be meaningful to client
- Client driven – goals and content of practice
- Train in a practical way
- Emphasize accomplishments and awareness – copious, diverse feedback, self efficacy, home programs

Page & Peters, Stroke, 2014

<table>
<thead>
<tr>
<th>Part-whole practice</th>
<th>Break the desired task down into its smallest components, and practice those that are deficient. Do not break down tasks that are discrete or not normally performed segmentally.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetitive and goal focused</td>
<td>Focused on a particular task or task component and should allow opportunities for repetition</td>
</tr>
<tr>
<td>Activities should be salient</td>
<td>Meaningful to pt.</td>
</tr>
<tr>
<td>Client driven</td>
<td>Pt attempts as much as possible, pt designs regimen</td>
</tr>
<tr>
<td>Train practically</td>
<td>Easy to access, normal schedule &amp; gear</td>
</tr>
<tr>
<td>Impairments addressed</td>
<td>Impairments addressed</td>
</tr>
<tr>
<td>Challenge regularly</td>
<td>Grade and re-grade regularly</td>
</tr>
<tr>
<td>Emphasize accomplishments</td>
<td>Multi-modal feedback that instills carryover, insight Copious amounts feedback</td>
</tr>
</tbody>
</table>
A review of *some* approaches

A way to think about measurement
A way to think about therapies that are layered at different stages (instead of “one size fits all”)
This is a clinical talk with research stuff; not a research talk with clinical stuff

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A review of *some* approaches

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mCIT
If you are a stroke patient...

• And I asked you to reach for something, with which hand would you be more likely to perform the task; the affected or unaffected hand?

• Unaffected

• Why?
  – Learned Nonuse – a *behavioral* suppression of movement (not biologically based)
  – Operant conditioning
    • Success/punishment-operant conditioning
    • therapy/compensation

**Constraint-induced movement therapy (CIT)**

• Components to induce repeated practice with the affected UE include:
  – 6 hour training sessions on 10 consecutive weekdays
  – Mitt 90% of all waking hours during same 2 weeks
  – Behavioral strategies (log; shaping; behavioral contract)

• Increases more affected UE use & function in subacute & chronic CVA pts.
Time for a little restraint?

- Couldn't do at Kessler
- Can't do in OH
- Page et al., 2002
  - >60% of stroke patients would not want to participate
  - >60% concerned about adherence
  - Lose in independence, mobility, time
- Confirmed in a more recent population-based study (as opposed to perspectives from subjects enrolled in a clinical or research program)
- Other thoughts:
  - Reimbursement
  - Conditioning?
  - Compliance?
  - Taub et al., 1993, van der Lee et al., 1999 — burns, muscle soreness resulting in stiffness, and discomfort in the affected UE.
  - Ploughman and Corbett (2004) — non-significant increase in pain for four of the five patients in the constraint group

Modified constraint-induced therapy: Translating “preclinical research” to care

- Therapy 3 times/week for ½ an hour
- Practice with the more affected arm for 5 hours/day 5 days/week
- Behavioral techniques (log, shaping)
  - Reimbursement (acute and OP)
  - Enough time (acute – 4 units of OT; OP – 2-3 units)
  - Conditioning/no overtraining
  - Compliance
  - More UE reps → more opportunity for operant conditioning
  - Distributed practice schedule
There are many different (and delicious) CIT/mCIT “flavors”
(and I don’t care which one you use)

- 6 hours/day (Taub, Wolf, others)
- 3 hours/day (Sterr et al)
- 1.5 hours/day (Taub’s clinic)
- Ours (1/2 hour/day)
- Bottom line (again): dosing work needed, but it may just be that more than one version works

There is strong (Level 1a) evidence of benefit of CIMT and mCIMT in comparison to traditional therapies in the chronic stage of stroke. Benefits

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**mCIT: Before The First Day of Treatment**

- Time before and after
- Video before and after
- Activity monitors
  - Objectively, quantitatively determine amount of use.
  - Patient takes home and wears for one week.
  - Easy to use – put into tray and tables come out (right).
  - Can be used as an outcome measure for therapy
    - www.theactigraph.com/
Picking the Tasks...

*Tasks should be one or more of the following:*

- Important to the patient (motivating)
- Challenging Fun, interesting, engaging
- Necessary (feeding)
- We use the COPM & MAL
- Pt is regularly assessed; progressed in task difficulty when he/she can perform deficient component 70-80% of time

**Scenario: R Hemi**
1. Shooting Pool
2. Writing
**Task Oriented Approach**

- Based on systems model of motor control and theories of motor learning
- Therapist is a teacher of motor skills
  - Select contextually appropriate functional tasks
  - Vary tasks to increase transfer of learning
  - Structure the environment the conditions of the task are present
  - Provide feedback
  (Carr and Shepherd, 2003, and Gentile, 2000)
Things you can grade

- Distance to reach or step
- Timed/untimed
- Speed
- Duration
- Qualities of object
- Environment
- Contextual interference
- Several tasks learned and practiced together
- Demands (standing/sitting)
- Number of repetitions

- Object placement
- Complexity: amount of steps
- Amount of cues or assistance given
- Number and kinds of distractions during tasks
- Gravity factor
  - With gravity → gravity
  - Eliminated → gravity

Case Study

Video from personal collection of Christine Griffin. Used with permission.
mCIT/CIT is *not* sliced bread

- It is the “final blow”;
- Thus, as a team, you need to:
  - Have tools in your box that address the myriad of impairments that will *precede* mCIT (figure)
  - Look & see if you even have patients who fall in that 20% (mCIT prgm might be a waste of time)
  - Implement regular measurement techniques to gauge progress & mCIT readiness (other than the FIM) (NFL combine approach - FM, MAS, ARAT, video, timing)

Only 20% of all pts!!

So what do we do with the other 80%

How do we “PRACTICE” with them?
A review of *some* approaches

- No movement
- Synergies dominate movement
- Deviations become available
- Isolated joint movements visible

Stage 1 ↔ Stage 6

MP

Inactive and alone: Physical Activity Within the First 14 Days of Acute Stroke Unit Care

- 58 patients < 14 days after stroke from 5 metropolitan stroke units
- Observed them for 2 consecutive days at 10-minute intervals between 8 AM and 5 PM
- At each observation, they ascertained physical activity, location, and other person(s) present.
Mental practice and stroke

- “MP,” “Motor Imagery,” “MI w Mental Practice”
- Same musculature activated during MP as during PP
- Parts of brain are activated during imagery as if actually performing movement
- Repeated practice => brain reorganization => improved motor function
- So, over time, repeated MP use should have a practice effect
Home-based motor imagery training for gait rehabilitation of people with chronic poststroke hemiparesis.

Daniela A. Dickstein H. Marcus E. Levi S. Deutsch JE

- 3 times a week for a total period of 6 weeks, with each session lasting 15 to 20 minutes
- In each patient's home
- Measures:
  - Tinetti Performance-Oriented Mobility Assessment;
  - Patient’s self selected cadence, assessed using a metronome
  - 6m walk

- first 4 weeks: push-off performance by the UE and on prolongation of the loading phase of that leg.
- last 2 weeks, subjects were directed to increase their imagined speed and symmetry of walking
  - cadence for imagery training was set through a metronome to coincide with the participant's natural cadence, as determined during assessments
Mental Practice Intervention

Therapy for the affected arm:

- Administered by the same therapists in the same environment (although not at the same time)
- Therapists undergo extensive inservicing (videos, testing, literature review) to assure consistency
- Tasks can be progressed, are B/L, and not necessarily specific to hand dominance

<table>
<thead>
<tr>
<th>Tape/CD Number</th>
<th>Functional Task Described</th>
<th>When Administered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reaching for and grasping/drinking from a cup</td>
<td>Weeks 1,2</td>
</tr>
<tr>
<td>2</td>
<td>Using a push button telephone</td>
<td>Weeks 3,4</td>
</tr>
<tr>
<td>3</td>
<td>Eating finger foods</td>
<td>Weeks 5,6</td>
</tr>
<tr>
<td>4</td>
<td>Turning pages</td>
<td>Weeks 7,8</td>
</tr>
<tr>
<td>5</td>
<td>Playing checkers</td>
<td>Weeks 9,10</td>
</tr>
</tbody>
</table>
Typical mental practice therapy session structure

- 15 minutes – Other activities
  - Will assist with performance of designated functional task
- 15 minutes – Performance of designated functional task with challenge
- 15 minutes – Listening to mental practice recording of designated functional task

WHEN?
Maximize times when you could administer MP, thereby increasing practice attempts

- Home/homework
  - As an alternative to HEP
  - Shortage of clinical practice attempts
  - Develop a library of ADLs
- Internet
- When patient is waiting for tx
- In acute hospital (in bed)
Multi-modal mental practice (MMMP)

Mirror neurons-learning by imitation

- Rizzolatti studying monkey brain systems that regulate intentional hand movements.

- Team member reaches for piece of fruit and monkey brain activated.

- The premotor neurons didn’t activate at the mere observation of a hand or mouth—only when it was carrying out a goal directed action.
• May help with unilateral neglect
• More attention to the affected arm.
• The reflection superimposes normal sensory signals on the affected side.
• This “accurate” information may cause neuroplasticity.


Mirror therapy
Once daily at least 10 minutes (30 minutes is optimal)

<table>
<thead>
<tr>
<th>Motor exercises without an object</th>
<th>Motor exercises with an object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilateral movements of the non-affected arm only</td>
<td>Unilateral movements of the non-affected arm with an object</td>
</tr>
<tr>
<td>Bilateral movements (&quot;as good as possible&quot;)</td>
<td>Bilateral movements with an object only in the non-affected side</td>
</tr>
<tr>
<td>Guiding of the affected arm by the therapist</td>
<td>Bilateral movements without objects on both sides (imagining the objects)</td>
</tr>
<tr>
<td>Guiding of both arms by the therapist</td>
<td>Bilateral movements with guidance of the affected arm by the therapist (with or without an object at the affected side)</td>
</tr>
</tbody>
</table>

A review of some approaches

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>No movement</td>
<td>Repetitive transcranial magnetic stimulation: Touching their brains</td>
</tr>
</tbody>
</table>

TMS/tDCS

Repetitive transcranial magnetic stimulation:
Touching their brains
transcranial direct current stimulation (tDCS)

- Constant, low current delivered to brain
- Alters resting membrane potential and subsequent neuronal firing
- Expensive
- Big
- Side effects

Device

- 1-2mA for 20 minutes
- Dose: 40 mA/min
- Chattanooga Ionto™
- $400-500
Functional Brain Stimulation™

- Single dose studies
  - Transient
- Multiple dose
  - Longer term
- Multiple dose + physical practice component
  - Longer term, greater gains
- tDCS overlaid onto task-oriented therapy
- CPT codes:
  - ADL training
  - Neuromuscular Re-ed
  - Gait training

UE
Hemiparesis - Primary Motor Cortex (M1)
Anodal tDCS

- Increases neuronal excitability & communication of affected area being stimulated
- Long-term potentiation

What is the impact?

Findings meta-analysis of seven studies that examined the effects of anodal tDCS vs. sham stimulation on motor function in stroke survivors

<table>
<thead>
<tr>
<th>Included studies</th>
<th>Outcome measure</th>
<th>Sham</th>
<th>tDCS</th>
<th>Weight (%)</th>
<th>Standard mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boggio et al.1</td>
<td>JTT</td>
<td>7</td>
<td>7</td>
<td>0.35 (-0.43, 1.12)</td>
<td></td>
</tr>
<tr>
<td>Fregni et al.10</td>
<td>JTT</td>
<td>9</td>
<td>9</td>
<td>0.35 (-0.43, 1.12)</td>
<td></td>
</tr>
<tr>
<td>Hummel, 2005</td>
<td>JTT</td>
<td>7</td>
<td>7</td>
<td>0.35 (-0.43, 1.12)</td>
<td></td>
</tr>
<tr>
<td>Hummel et al.11</td>
<td>JTT</td>
<td>9</td>
<td>9</td>
<td>0.35 (-0.43, 1.12)</td>
<td></td>
</tr>
<tr>
<td>Hummel et al.13</td>
<td>JTT</td>
<td>7</td>
<td>7</td>
<td>0.35 (-0.43, 1.12)</td>
<td></td>
</tr>
<tr>
<td>Kim et al.13</td>
<td>PS</td>
<td>9</td>
<td>9</td>
<td>0.35 (-0.43, 1.12)</td>
<td></td>
</tr>
<tr>
<td>Mahmoudi et al.22</td>
<td>JTT</td>
<td>8</td>
<td>8</td>
<td>0.35 (-0.43, 1.12)</td>
<td></td>
</tr>
<tr>
<td>Stagg et al.14</td>
<td>BET</td>
<td>8</td>
<td>8</td>
<td>0.35 (-0.43, 1.12)</td>
<td></td>
</tr>
<tr>
<td>Stagg et al.14</td>
<td>CS</td>
<td>1.66</td>
<td>1.68</td>
<td>1.47</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Level of evidence: Level 1a

Butler et al., 2013; J Hand Ther
A review of some approaches

The majority of patients are moderately to severely impaired; This group commonly exhibits:
- little to no active distal movement;
- min-mod spasticity, co-contraction, reciprocal inhibition
- difficulty w active practice paradigms

So what do we do with the UE?

- Facilitate *assisted* repetition

  **Rationale:** Functional repetition $\rightarrow$ Neuroplasticity $\rightarrow$ Movement

  **Benefits:** Spasticity reduction; Motor relearning; Can be done at home by pt and care partners

  **Disadvantages:** Requires equipment. But it can be inexpensive equipment.
How might automated or semi-automated approaches be helpful to this group?

MIT Manus

ARM Guide (assisted rehabilitation and measurement)

Are any of these using functional activities?

The problems:

• Not portable
  – Use in clinics and homes
  – Homes – 70% of therapies do not transfer to homes

• EXPENSIVE

• Negative evidence (in some cases)
Myopro-based training

- Portable
- Inexpensive
- Incorporates several, evidence-based strategies in rehab, including:
  - Shaping
  - Repetitive task specific practice for spasticity
  - Repetitive task specific training for learning & Plasticity
  - “Upstream” training
  - Compensation for those who need it

Specifications

- Weight: 2.75 pounds (1.25 kilograms)
- 7Nm of torque
- 0° to 130°
- Rechargeable Battery
Phase 1: Volitional Relaxation
Bicep Mode During a Very Basic ADL

Phase 4: Dual Mode

- Increased reciprocal inhibition. Timing may be slow but controlled.
- Biceps and Triceps are starting to work as a team again
- Some people aren’t going to get better, so compensation
Movies

• As a prosthetic

Types of Devices

• Cyclic
• “Thought” triggered
• EMG-triggered
• Neuroprosthesis
• Implants
Estim

- Cyclic (Empi et al)
  - Can be integrated into ADLs
  - Trigger switch
    - $$$ High tens to very low hundreds
- EMG Triggered – not evidence based (EBRSR) but may work on individual pts
  - $$$low hundreds
- Bioness
  - Positive evidence for spas reduction
  - $$$mid thousands
- Agonist retraining versus Antagonist retraining?

E-stim Can Be Graded:

Begin repetitive practice paradigms

Get a few degrees of AROM

EMG-based estim/functional estim

Get trace movement

Cyclic estim

- What can be done for survivors with spastic paralysis or flaccid paralysis? Estim may be the “missing link.”
EMG-Triggered ES

How does it work?
- Set stim intensity and EMG threshold
- Electrodes sense trace contraction/muscular attempt
- Device rewards patient with stimulation
- Begin sequence again...

Take home points
- A variety of neuro-specific search engines are available
  - All free!
  - Pull as needed
  - Use push regularly (well, actually once)
- Measurement:
  - Communication (pt and team)
  - Reimbursement
  - Efficacy
  - Consider a multi-tiered approach
    - Not all measures will be sensitive to the same deficits and domains
  - We discussed motor in this webinar, BUT motor is affected by:
    - Perceptual
    - Sensory
    - Psychosocial
    - Mobility
    - Pain
    - Other
Take home points

• We considered approaches, tiered by impairment level.
  – Don’t be a “one trick pony;” a single approach does not work with everyone

• Many of the slides had stroke examples, but that’s because:
  – More stroke trials out there
  – Higher prevalence disease

• Also applies to ABI, SCI, and, in some cases, neurodegenerative disorders (e.g., MS; Parkinson’s)

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Seats are filling quickly!!!
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