Impacting patient Outcomes
Through Strategic Motor Learning
Interventions: Case-Based
Approaches for Both PT & OT

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Course Objectives

1. Define motor learning and basic motor learning principles.

1. Compare and contrast different motor learning strategies to improve function.

1. Integrate motor learning into everyday clinical interventions.

Motor Learning Rehabilitation

For 25 years the area of motor learning has been working on translating the science for rehabilitation (Fisher, 2014 JNPT)

There has been an exponential rise in the articles that you can find on Pubmed incorporating the terms “motor control” and “rehabilitation”

Bridging the Gap

Understanding the basic theory and definitions is important but then the knowledge has to be translated to bridge the research/clinician gap.

- How can a task be structured to optimize a movement strategy?
- When teaching a motor skill what types of cueing can be given to provide the best learning environment?

Motor Learning Strategies

- We already talked about task specificity, repetition, intensity, part/whole and random/blocked practice.

- I am going to focus on Self-control cueing, External focus of attention, Extrinsic feedback, and Motor adaptation strategies.

- We will look at ways in the case of how to combine some of these concepts.

DON’T FORGET - MOTIVATION IS KEY

If the activity doesn’t mean anything to them and is not functional (tapping dots on floor, being given perturbations in sitting, sitting marching, etc). How do those things challenge and motivate them to be functional?
Learning

Goal-oriented
Skill acquisition is shaped by the specific tasks that are used to challenge the patient

Goals of the therapist
- Choose appropriate task
- Structure the environment
- Progressively increase complexity
- Vary the task and try new tasks

James Gordon, 2004

Learning-Performance Distinction

- The goal is to accomplish a relatively permanent change in the capability of learning versus a short term temporary change.

- The distinction is noted between the observed behavior during practice (motor performance) and sustaining the activity over time due to practice (motor learning)

**Intensity**

Significant relationship between:

**Dose and Response**

Stepping practice during therapy/training

Improvements in daily stepping following therapy/training


“"If it is intense enough, specific enough, and goal oriented, then you do not need fancy equipment.”

- Carol Richards PhD, DU, PT

**Are Current Intensities Enough?**

- Study of patients of PT and OT between 2-14 weeks post stroke
- HR monitored to assess amount of time spent training cardiorespiratory system
- Found if it was present the aerobic component of typical physiotherapy session lasted **less than 3 minutes.**
- Study suggests physiotherapy is not intensive or targeted enough to have a training effect
  
Considerations for Challenges

- Joints included
- Task speed
- Plane of motion
- Environment
- Lever arm
- Sensory input
- Muscle contraction
- Error
- Resistance direction & intensity

Where Do We Start?

Start with understanding the underlying impairments so you choose the best strategies

THEREFORE understand normal movement first!

Normal Movement First

APTA VISION
Transforming society by optimizing movement to improve the human experience.

What do you remember as the movements for sit to stand to be successful??
What ranges do you need??
When do you need strength to kick in??
Sit to Stand

Pre-Extension Phase

This phase requires active proximal control but is about movement.

Need trunk to stay neutral with slight thoracic extension, neutral pelvis progressing to anterior tilt, and hip flexion.

These motions shift the weight forward and provide weight bearing through LEs.

Tibias need to be able to translate forward with knees flexed until hips lift off the mat.

What Can Limit Forward Progression of the Tibia?
Extension Phase

Need symmetrical firing of extensor muscles to provide the extension moment of hip/trunk and knee

May have enough strength but if not properly aligned can see compensations like
  - Leaning onto good side
  - Rotating in trunk
  - Pushing up heavily with UE

Potential Impairments

So.... What are some potential impairments (things you would find during your examination) that would limit sit to stand??

WHAT WOULD YOU DO??
Interventions

✓ Facilitate Movement – NDT Facilitation
✓ Facilitate Error
✓ Adjust cues
✓ Increase motivation
✓ Increase Challenges and Intensity
  ✓ Somatosensory
  ✓ Vestibular
  ✓ Weightbearing
  ✓ Speed

Cueing

Internal Focus
Directed toward components of the body movement where the learner will be consciously aware of how they are performing

External Focus
Directed toward the effect of the movement on the environment, or the end goal
  - Count how many steps it takes to walk 25ft – have them count out loud, then ask to do in 22 steps, then 18.

Retrain isolation of knee flexion with hip extension

Right side impaired: 2 lb weight on right ankle, ball behind for external cue to kick

Self Control

Providing the patient some aspect of control during an intervention enhances motor learning.

When possible limit externally imposed conditions and have the patient adjust the situation parameter

   Let them determine the distance, the repetitions, how to increase challenge


Self Controlled Practice

Suggest a deeper processing of relevant information when allowed to adjust training parameters and take charge of their own learning process resulting in more active involvement and increased effort invested


Increased Autonomy

In addition, allowing increased opportunities for self-control may allow increased autonomy.

Increased autonomy has resulted in increased intrinsic motivation and engagement with an improved perception of competence.

Overall self-control group participants demonstrate more effective learning.

Extrinsic (Augmented) Feedback

This type of feedback is given in addition to intrinsic feedback by an outside artificial means.

KP (Knowledge of Performance) is externally provided feedback that is focused on the quality of the movement.

KR (Knowledge of Results) is also externally provided and is focused on the outcome or goal of a skill.

Reinforcement of Walking Speed

Providing specific outcome measure results to patients can result in improved outcomes.

For instance, the SIRROWS trial found that a single daily bout of feedback about performance for that day’s walking speed led to significantly faster speeds (.19m/s difference) at discharge compared to well matched controls who did not receive feedback.


Think Basic

Use an outcome measure that targets a specific behavior and a chart to communicate the changes to the patient.

- GAIT SPEED
- TIMED SIT TO STAND
- TIMED SUPINE TO SIT

ERROR

- How do you get a patient to correct abnormal movement patterns that the nervous system may not perceive as erroneous or requiring correction?
  - Need to perturb the system (theraband, weights on ankle, split belt treadmill, size of objects)

- “...if one can develop a capability to detect one’s own errors, then the learner can practice without a teacher or a coach.”


Motor Adaptation

- Significant errors seen in the beginning because the CNS does not correctly predict the new situation
- Once the CNS has adjusted and the challenge is withdrawn, error will occur in the opposite direction
  - Looking for the after effects

Video Summary

Resistance of the TheraBand was placed to exaggerate the gait deviation. Since he is externally rotating and abducted then he theraband pulls his leg into that motion making him overcompensate to get the leg neutral. They must have some strength to be successful.

Need to increase recruitment, so we challenge them for motor adaptation.
Segment I – Patient Case

Patient is a 69-year-old man who was having complaints of left upper extremity weakness and facial numbness. He was admitted to the hospital with increased weakness throughout the left side.

He lives with his wife in a two story house and the bathroom on the second floor. He was an engineer before retirement.

Impairments

1. **Poor posture**: presents with thoracic flexion and posterior pelvic tilt in sitting, weak core strength

2. **General aerobic deconditioning**: was in the hospital for over a two weeks

3. **Decreased sensory input** on left resulting in decreased weightbearing and asymmetrical step length left>right

4. **Hip weakness**: frontal and sagittal plane – *hip extensors** most common in many dx and abductors

Considerations Based on Impairments

1. Utilize environment for prolonged stretch into an anterior pelvic tilt and thoracic extension

2. Utilize circuit training to facilitate improved aerobic conditioning with functional activities

3. Utilize motor adaptation techniques to increase right sided stepping sensory input on left

4. High challenge stepping to increase activation of hip abductors and extensors and sensory progress to resisted sit to stand.
Segment 2

Motor Learning Considerations
Task Specific
Motivating
Self Control Cueing
External Focus of Attention
Adjustment of Feedback
Challenge Options

Knowledge of Results
Make a chart to show improvement. Choose outcome measures based on key impairments.

What outcome measures would you choose for this patient?

Make sure to make a chart for each of your patients.
Chart

<table>
<thead>
<tr>
<th>DATE</th>
<th>Standing eyes closed in sec</th>
<th>Sit to Stands in 30 seconds</th>
<th>Gait Speed in m/s</th>
<th>6MWT in feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/24</td>
<td>10 seconds then put foot down</td>
<td>3 with assist of bilateral upper extremities</td>
<td>.2m/s with RW</td>
<td>50 feet with SOB</td>
</tr>
<tr>
<td>9/25</td>
<td>18 seconds</td>
<td>3 but with use of one hand only</td>
<td>.2m/s with RW</td>
<td>NT today due to fatigue</td>
</tr>
<tr>
<td>D/C to SNF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Self- Control Cueing**

Why can't you stay standing? What do you need to do?

Do you want to use the device while you are walking or not?

Do you want to perform this in the parallel bars or outside?

How long do you think you can perform this activity?

What do you want to include in your circuit today?

**Intervention Options**
Poor Posture

- This should be the first place we ALL start if someone has alignment issues.
- Basic activities of lying flat with knees supported to facilitate thoracic extension and hip flexors stretch
- Recommend Sara Meeks webinar
  - http://www.sarameekspt.com/
  - She has a pdf on her website as well:

Sitting Backwards in Chair
General Aerobic Deconditioning

Circuit Training

**Possible impairments addressed:** cardiovascular

**Self control cueing:** Which items do you want to include in your circuit out of the following four: sit to stand, supine to sit, rowing, bike, resisted walking? How long do you want to do each activity?

**Adjustments to activity:** Resisted walking and sit to stand (add weighted vest)
**Circuit Chart**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
<th>Total reps or distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sit to stand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resisted walking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rowing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decreased Sensory Input on Left**

Position allows increased sensory input on left but the activity is a motor adaptation technique.

- Left side impaired with short step on right to decrease time/weightbearing on left.
- To increase step length on right and increase time on left the impaired leg is put on side of treadmill.
- Good leg should be cued for BIG steps and have them do it fast.
**Hip weakness**

- Most common weakness you will see in many of your patients is hip extensors. Common limitations leading to gait deviations decreased functional activities.

- All of us should be cueing tightening the gluts during standing activities whether it is walking, sit to stand, and dressing.

**Stepping Up w/ Assist**

- When they need more facilitation and assist start with this in stairs, parallel bars, or on single step

**Sit to Stand**

Possible impairments addressed: decreased force production on impaired side, hip weakness, control of quads/hamstrings

Self control cueing: how many repetitions do you think you can do this activity?

Adjustments to activity:

- Use a spinning rolling chair when doing sit to stand - have them focus on keeping the chair from rolling
- Resisted sit to stand
Challenges

Eyes closed, Speed change (Slow/fast), Add transverse plane motion, Incorporate a variety of muscle contractions, Visual distracters, Circuit training, Adjust resistance to appropriately address priority impairment

Dual task training with challenges – cognitive, visual, manual, auditory (singing, words start with K, reading, dialing a phone, etc). Vestibular stimulation (head turns, VOR), somatosensory reweighting