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Physicaltherapy.com Chronic Stroke week 2016

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Elevating the Intensity in Stroke Rehabilitation:

LOCOMOTOR, FUNCTIONAL MOBILITY AND EXERCISE APPLICATIONS

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POST –COURSE CONTACT

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OBJECTIVES

Upon completion of this course, you will be able to:

1) Identify physiologic changes that occur in many individuals months and years post CVA.
2) Apply recent evidence in motor learning and motivation to maximize the recovery for clients in chronic stroke rehabilitation

OBJECTIVES

Upon completion, you will be able to:

3) Apply recent evidence in practice structure and feedback to maximize the recovery for clients in chronic stroke rehabilitation

4) Debunk rehabilitation myths about recovery dependence on timing and technology in effective rehabilitative outcomes in chronic stroke

OUTLINE

Physiologic and morphologic changes after stroke

Evidence in chronic stroke rehabilitation to date

Practice structure and feedback advances

Novel clinical applications: motivational + exercise

Case studies in chronic stroke recovery

Questions

PHYSIOLOGIC CHANGES IN CHRONIC STROKE: BRAIN AND BEYOND

Neuroplasticity changes: Positive

Neuroplasticity changes: Negative

LEARNED NON USE AND DYSFUNCTIONAL NEUROPLASTICITY

Overcoming "the bad habits" with intensity and a forced-use approach

One of the MAIN reasons why YOU can help ANY stroke patient improve

Learned non use occurs in motor AND sensory impairment

NEUROPLASTICITY IS NOT ONLY MOTOR

Sensory neuroplasticity – establish relevance and a supportive environment

Balance – forced use for protection

Extremity function in ADLs and MRADLs

Vestibular integration

Vision

Video: Sensorimotor applications

MOTOR CONTROL NEUROPLASTICITY

Requires that the brain SEE a need to make a change

Task specific overtraining

Forced-use

Weight, speed, accuracy, endurance

PHYSIOLOGIC CHANGES IN CHRONIC STROKE due to disuse

Learned non-use changes the brain:
-Contralateral “takeover”
-Hypoactive in and around lesion site
-Regression in vasculature in/around lesion
-Structures dependent on the lesioned site suffer
(Diaschisis phenomenon)

Neuroplasticity: The laws of DEMAND and SUPPLY

Consider the brain changeable under any condition and any time frame until proven otherwise.

The brain has potential to change at any stage in life and recovery. Attention to new information stimulates neuronal branching.

YOU can change a patient's brain in 10 min!

The brain must see a need to…

Survive, protect, compete, improve…

If there is no challenge
If there is no chance
If there is no expectation
If there is no success

There is no stimulus to continue to improve…

Evidence in chronic stroke rehabilitation

Evidence in chronic stroke rehabilitation

Neuroplasticity studies

Evidence in chronic stroke rehabilitation

Outcome studies: LEAPS, et al

Upper Extremity Interventions: VECTORS

Acute Inpatient Rehabilitation – phase II Clinical Trial

9.65 (4.5) days post stroke; Treatment 5 days x 2 wk

- Standard care: compensatory techniques, ROM, strengthening. Massed practice, shaping, and constraint were prohibited. 1 hr ADL, 1 hr bilateral activities daily
- Standard CIMT: 2 hours of shaping / constraint 6 hours daily
- High Intensity CIMT: 3 hours of shaping / constraint 90% of waking hours

(Dromerick et al, 2009)

Upper Extremity Interventions: VECTORS

All groups improved on ARAT

High intensity group had significantly less improvement at 90 days

No significant differences were found between the dose-matched CIMT and control groups at day 90.

MRI of a subsample showed no evidence of activity-dependent lesion enlargement.

Upper Extremity Interventions: Modified CIMT

Subjects < 14 days post-stroke (n=10); 4 – 6 months post-stroke (n=14); 28 months post (n=1)

- **F**requency: 3x/wk x 5 days restraint x 10 wks
- **I**ntensity: Not described
- **T**ime: 30 min of OT + 5 hours of restraint
- **T**ype: Task-specific training – 3 ADL tasks practiced using shaping

(Page et al, 2005; Page et al, 2002; Page et al, 2002)

Upper Extremity Interventions: Modified CIMT

- Outcomes:
  - Fugl-Meyer: Mean improvement of 11.4 (acute), 18.7 (subacute), 9.5 (chronic)
  - Action Research Arm Test (ARAT): Mean improvement of 11.5 (acute), 21.7 (subacute), 13.5 chronic

(Page et al, 2005; Page et al, 2002; Page et al, 2002)

Sub-acute and Chronic Injury

Mechanisms of Recovery and Clinical Interventions in Stroke

Sub-acute and Chronic care:

- What is happening to the Nervous System?
- Human and animal research studies
  - ***Sub-acute***
    - 4 to 20 days post stroke (inpatient rehab)
    - **20 days to 6 months post stroke (outpatient rehab)**
  - Chronic setting (late effects)
- Impact of research outcomes on clinical practice

Upper Extremity Interventions: CIMT

Participants:

- **<u>Able to actively extend at least 10 degrees at the MCP and ICP and 20 degrees at the wrist</u>**
- Adequate balance while wearing restraint and transferring to/from toilet; able to stand 2 minutes without UE support
- **EXCITe trial:** 3 to 9 months post-stroke
- (Wolf et al 2006)

Upper Extremity Interventions: CIMT

Outcomes:

- Wolf Motor Function Test: Decrease from 19.3 to 9.3 seconds in performance time
- Motor Activity Log: Increase from 1.21 to 2.13 in the amount of use; Increase from 1.26 to 2.23 in Quality of Movement

Upper Extremity Interventions: CIMT

Frequency: Daily for 14 days (10 days of 6-hr practice)

Intensity: Modified shaping parameters (number of repetitions per unit time, time to carry out specific number of reps)

Time: 6 hours of task-training; wearing constraint for 90% of waking hours

Type: Task-specific training of 10 – 15 tasks using shaping to incrementally extend motor capacity beyond previous performances

Upper Extremity Interventions: CIMT (Sawaki, 2008)

Participants
- 30 patients post-stroke (> 3 months and < 9 months)

FITT (as above)
- 10 days, 6 hr/day; constraint worn for 90% of waking hours

Outcomes
- Treatment group:
  - Increase in motor map for extensor digitorum
  - Greater increase in grip strength

LEAPS Trial

(Duncan, 2011)

LEAPS (locomotor experience applied post-stroke)

"To determine the effectiveness of locomotor intervention"-1 year post walking

Inclusion Criteria:

Sit unsupported 30 sec

Fugl-Meyer Lower Extremity score < 34

Walk 10 feet with max 1 person assist

LEAPS Trial

(Duncan, 2011)

Early or Late Locomotor Training (LT)

- 2 months or 6 months post stroke
- 90 minute sessions, 3X week for 36 sessions
- LT - treadmill stepping with BWS (20-30 min), overground at 4^{th} week for 15 min, speed up to 3.2 mph
- Provided in addition to standard care (PT)

Home Exercise Group (HEx)

- 2 months
- "Designed as a active control, not a high-intensity, task-specific walking program", balance and strength
- Participants encouraged to walk daily
- Provided in addition to standard care (PT)

LEAPS Trial

6 months

- Early LT and HEx had similar gains (.25 m/s vs. .23 m/s)
- Late LT gains were less (.13 m/s) – only had standard care up until 6 months

1 year

- Early LT and HEx maintained gains
- Late LT "caught up" with other groups (gained mean .24 m/s)

LEAPS Trial

No differences in primary or secondary outcomes at 1 year

- Walking speed
- 6 minute walk distance
- Number of steps taken in the community
- SIS improvements: ADLs, physical mobility, social participation
- Motor recovery
- Berg Balance Scale and Balance Confidence

57.6% reported falls

- No significant differences between 3 groups
- Percentage multiples falls higher in early LT (52%) vs. late LT (36%) or HEP (30%)

Dizziness or faintness

- 7.9% in early LT vs. 5.6% in late LT
- 0% in HEx

LEAPS Trial – Potential Limitations

- Additional PT at same time as interventions
  - How much did patients walk in other therapies?
  - Was there a relation between amount/types of additional therapies and improvements post-stroke?
- Intensity of Locomotor training
  - Average mid-training HR per session was 90 beats a min, RPE < 13

Subacute Walking Training Outcomes

- Gait speed (generally 3x/week, for couple of months)
  - 0.3 m/s in subacute stroke (Hidler et al, 2009)
  - ~ .24 m/s in LEAPS trial
  - 1.01 m/s in fastest possible velocity (Pohl et al, 2002; ~16 wks post)
- Walking distance (6 minute walk):
  - 60 m (Hidler et al, 2009)
  - 73 – 85 m in LEAPS trial

Sub-acute and Chronic Injury

Mechanisms of Recovery and Clinical Interventions in Stroke

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Upper Extremity Interventions: High Intensity UE Training

(Birkenmeier et al, 2010)

- **F**requency: 3 x week for 6 weeks

Intensity: ≥ 300 repetitions per session

Time: 60 minutes

Type: supervised, massed practice of functional daily tasks

- graded and progressed for each participant
- included 4 components: reaching for, grasping, moving/manipulating, and then releasing an object

Video: High intensity everyday UE

Upper Extremity Interventions: High Intensity UE Training

- Outcomes:
  - Primary: ARAT average improvement of 8 points
  - No significant change in grip strength
- Patients: Chronic UE paresis post-stroke

(Birkenmeier et al, 2010)

Chronic Walking Training Outcomes

Gait speed: 0.13-0.18 m/s (Sullivan et al, 2002, Ada et al, 2003-4 wks of training)

Walking distance (6 minute walk): 30 - 80m (Macko et al 2005, Ada et al 2003)

Gait Efficiency or Peak VO_2 (Macko et al 2005, Moore et al 2008)

Gait coordination/symmetry
- Improved consistency of walking pattern in CVA
- Improved paretic limb stance time CVA (Hornby et al, 2008)

Application Parameters Across Walking Studies

- When studies compared walking interventions vs "control" or "conventional" physical therapy , walking usually results in improved outcomes
  - Stroke - Hesse et al 1995, Pohl et al 2002, Macko et al 2005, Moore et al 2010
- When studies compare walking interventions on a treadmill vs overground or using "conventional" gait approaches, there is little difference
  - Stroke – Kosak and Reding 2000

Application Parameters Across Walking Studies

Application Parameters

Faster may be better for some patient populations

- Pohl et al 2002, (CVA) Sullivan et al 2002 (CVA)
- Faster or higher intensity or more practice??

Higher intensity may be better

- Hornby et al 2008 (CVA) – same speed, distance in robotic vs therapist assisted training, although intensity was different (Israel et al 2006)

More practice may be better

- Most locomotor studies appear to provide large amounts of practice (Moore et al 2010)

Use of body weight support

- 40% BWS early or with substantial impairments (i.e., speeds < 0.2 m/s)
- No difference at higher speeds (> 0.2 m/s – Kosak and Reding, 2000; Barbeau and Visintin, 2003)

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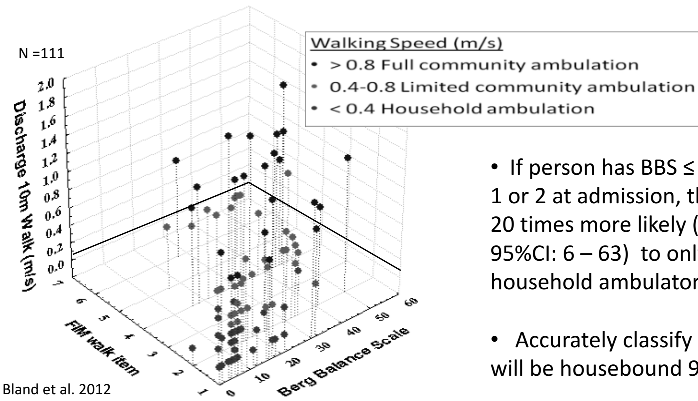
Prognosis

Clinical question: how do the IRF admission assessments help me determine how well my patient will be walking by the time of discharge?

N =111



Bland et al. 2012

- If person has BBS ≤ 20 and FIM-L = 1 or 2 at admission, then they are 20 times more likely (OR = 20, 95%CI: 6 – 63) to only achieve household ambulatory status by d/c
- Accurately classify persons who will be housebound 92% of the time

Bland, 2012

Translation to Clinical Practice

Maximize practice

- Increase the number of repetitions
- Practice the movements you want to improve (it is not always all about gait)

Make sure the evidence and the patient match

Individualized patient care

Practice structure and feedback advances

Individualizing the need for feedback and success

Gradually decreasing frequency and structure

Increasing time betweem exposure to "test"

Manipulation of (4) key practice variables appears to be critical for evoking neural plasticity and behavioral recovery

Task Complexity
- *Jones et al., 1998*

Task Difficulty
- *Plautz, Milliken, and Nudo, 2000*

Task Specificity
- *Nudo et al., 1997*

Task Intensity
- *Sullivan et al., 2002*
- *Van Pragg et al., 1999*

Therapist

Task specificity

Task complexity

Task difficulty

Task intensity

Patient

I want to be able to do this

I trust my therapist

I will be able to do this

This is worth the struggle

Making a MATCH

Demand

And

Supply

A balance of allowing the patient to struggle enough during safe practice that the nervous system sees a need to make a change. This takes into consideration patient awareness, personality and their current levels of physical abilities.

Case Studies: Make a MATCH

Meaning – for the learner, not the therapist

Active – learner driven and evaluated

Task specific – real world, not contrived

Challenge – demanding more from the system

Hope – within reach

Stroke rehabilitation

ANY patient can improve ANYTIME

Measurement priority

Requires consistency and intensity

RIPE

Stroke rehabilitation: RIPE

Repetitions

Intensity

Promise

Error

Stroke rehabilitation: RIPE

Repetitions: The nervous system requires a consistent and frequent opportunity to see what changes can and should be made

Exposure incentivizes the system to improve so that the same error is not repeated again

Stroke rehabilitation: RIPE

Intensity: Requiring an individual to push and explore their limits of performance in the form of speed, balance, resistance, accuracy/skill, or cognition.

MAY NOT require an increase in heart rate or extended practice without rest.

Stroke rehabilitation: RIPE

Promise: Task-specific practice revealing the possibility of a higher level of function than the learner currently operates.

(Adjusting task difficulty enough to provide the learner with some level of success)

Tasks that are too hard give no hope for improvement and no reason for change

Stroke rehabilitation: RIPE

Error: Revealing a fundamental need for change.

Loss of balance, need for assistance, speech fluency, missed button in dressing, etc.

Tasks that are too easy do not require change.

RIPE: preparing the nervous system

Providing frequent reality-based and challenging practice in a safe situation where the learner can make and see errors without consequence of injury or complete failure

Applications to mobility, ADL, communication,

Intensity: task specific circuit training

Sit to stand and sit to supine repetitions

Standing without UE support or vision - compliant

Ascending stairs with the affected LE

High speed or weighted LE efforts BWSTT

More…

HIIT: Chronic Stroke application

Chronic stroke patients > 6 months post

Maximum tolerated speed in BWSTT

Rest periods of :30 Work periods of :60

Superior aerobic capacity and gait outcomes

Boyne P, Dunning K 2015 Med Sci Sport Ex

Novel clinical applications: motivational and exercise attributes

Stroke Inpatient Rehabilitation With Reinforcement of Walking Speed (SIRROWS)

Informing inpatients of their gait speed 1x/day

Self-directed competition

No other changes in interventions

Lasting gait speed change, statistically significant

Dobkin et al. 2010

SIRROWS: Application video

Novel clinical applications: motivational and exercise attributes

Self controlled learning – patients determine the frequency of feedback (Chiviacowsky, Wulf, Lewthwaite 2010)

Self determined learning – practice structure and feedback advisement from patients (Sanli, Lee 2012)

Short Term Approaches to Maximize Treatment Efficacy

Maximize motivation to fully participate in the rehabilitation process

Our single best theory and approach in psychology
- Increase self efficacy
- Increase perceived outcome expectations.
- Reducing perceived failure with pre-task cues

Self Efficacy

Self efficacy is the belief that one has the capability to manage the demands of a challenging situation in such a way as to attain a desired outcome (Bandura, 1977).

Patients who have a higher self efficacy will be more likely to fully participate in the rehabilitation process.

Could it even predict no shows?

General Self-Efficacy Scale

I can always manage to solve difficult problems if I try hard enough.
If someone opposes me, I can find the ways and means to get what I want.
It is easy for me to stick to my aims and accomplish my goals.
I am confident that I could deal efficiently with unexpected events.
Thanks to my resourcefulness, I know how to handle unforeseen situations.
I can solve most problems if I invest the necessary effort.
I can remain calm when facing difficulties because I can rely on my coping abilities.
When I am confronted with a problem, I can usually find several solutions.
If I am in trouble, I can usually think of a solution.
10. I can usually handle whatever comes my way.

Self Efficacy

Increase self efficacy through practice
Use objective measures to relay success
Cheerleading does not work
Use video to document improvement
Start and end with a successful experience
Individualize frequency of success

STROKE REHABILITATION POTENTIAL

Muscular strength
Muscular endurance
Cardiovascular endurance
Somatosensory neuroplasticity
Motor control neuroplasticity
P S Y C H O L O G I C A L concepts

Need for ***and*** role of intensity…

Muscular strength
Muscular endurance
Cardiovascular endurance
Somatosensory neuroplasticity: balance and extremity
Motor control neuroplasticity
P S Y C H O L O G I C A L concepts
Brain-derived neurotrophic factor (BDNF)

Point by point…how you intervene

STRENGTH

- Function and falls
- Resistance tolerated 8-12 reps
- 2-3 sets
- 3-4 days/week
- Expect soreness
- Perceived exertion drives intensity

Point by point…how you intervene

Muscular endurance

Resistance 15-20 repetitions

- Multiple sets
- 3-4 days/week
- The art of cumulative effects
- Consecutive order for sets?
- Perceived exertion drives intensity

Point by point…how you intervene

Cardiovascular endurance:

- Sustained activity, whole body as able
- 30 minutes
- 10 minutes, 3 +/day acceptable (cumulative)
- 4-7 days/week
- The art of cumulative effects
- Perceived exertion drives intensity

Point by point…how you intervene

Sensory neuroplasticity: Extremity and balance

Remove sensory strengths
Vision
Somatosensation
Daily +

Unique balance considerations after stroke

Unique attributes of balance after CVA

Asymmetry is persistent in static and dynamic function

Persistently displaced center of mass due to asymmetry

Learned nonuse in balance strategies

Learned nonuse leads to more impairment

Sensory and motor control impairment WITH visual, cognitive, and resting muscle tone changes

Balance activities must be lifelong and challenging

Point by point…how you intervene

Motor control neuroplasticity

Demand and supply
Task specific
Repetition-based
MUST be challenged…and see progress

PSYCHOLOGICAL

Understand that the brain can change

Understand that I can improve

SEE that I have improved

Know that challenge = opportunity to improve

Use MEASUREMENTS to prove potential

Self controlled/determined (as noted above)

STROKE REHABILITATION POTENTIAL

P S Y C H O L O G I C A L

Using measurements
Read personalities
USE patient preferences/ICF – tap into interest

Maximize outcome with intensity: Capture attention through…

Interest

TEST

Challenge

Patient predictions

Error estimation

Intensity = Challenge

Consider patient personality

Confidence

Self efficacy

Patients may be competing against themselves, you, another patient or an issued “challenge”

Intensity: Patient Predictions

Patients estimate their abilities, become invested in the outcome: Ask them to predict:

“How much help will you need?”
“How much time will it take you?”
“How many times will you lose your balance?”

Intensity: Patient Predictions

Reinforcing learning from previous efforts
Advancing patient awareness
Fewer cues or "logic" from therapists

Pre task delivery with post task review
"HOW will I do next time?"

P S Y C H O L O G I C A L

Above **ALL**...what ***NOT*** to do:

Cheerleading
Using high intensity and high expectations
Mismatch of challenge to patient personality
Error rate exceeding patient tolerance
Lecturing

WARNING/disclaimer

This course includes case studies are to be viewed at your own discretion. Some footage may be contrary to your current approach to practice and may involve patients being challenged – intensively: loss of balance, errors, incomplete repetitions.

If you are averse to watching a patient struggle – please do not open your eyes.

Case studies in chronic stroke recovery

Questions

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