Managing the Hemiparetic Upper Extremity

Treatment Interventions for Upper Extremity Hemiplegia

Comparing Evidence Based Treatment Approaches and How They Apply to Client Centered Rehabilitation

“A brain left to its own devices, without facilitation and structure, does not move to its highest level.”

Chris Hagen

“Based on the strengths and limitations of decades of research, clinicians need clarity on the difference between evidence-based practice and experimental practice. Many models have stood the test of time and vigorous tiers of research. Others are new and intoxicating in their novelty, but the depths of their testing is still up for debate. ”

- Steve Childress

Arm and Hand Function: What do we need it for?

- Support and Balance
- Pushing and Pulling
- Holding and Carrying
- Manipulating
- Reaching
- Sensing
- Throwing
- Tool use
- Communicating and Gesturing
- Intimacy

"Do the treatment strategies I use with my client(s) empower them to regain these functions?"

"Do the treatment strategies I use allow my client (s) to achieve as many of these skills as possible?"

"Can the movements / skills I address be carried over to other functions, activities, roles, demands, etc?"

Support and Balance

Pushing

Pulling

The Neuro Plasticity Bus

Are you driving it or are you riding along?

"Just Right Challenge"

Functional Context

Task Complexity

Integration of affected extremity (ies)

Task Specificity

Cognitive Engagement

Intensity of Practice

Activity Dependent Cortical Reorganization

Sensorimotor Experience

Neuroplasticity
How to get it, How to drive it

- Remediation (where possible)-
  - Guiding individual toward ***efficient*** motor movement strategies for task performance.
  - Goal: The largest repertoire of movement possible.
    - More motor skills = more options

- Assessment and Treatment are constantly integrated
  - Are they ready for more complexity , less complexity? Just right as it is?

- Assessment is always ongoing!!!
  - Task selection
  - Use your eyes, use your hands.
  - Watch it, feel it, grade it!

- Facilitate & Inhibit Simultaneously-
  - Encourage- efficient motor strategies
  - Discourage- maladaptive movements
  - Use your words, use your hands (feet, hips, knees, forearms, etc)
  - Get creative with "biofeedback".

Roby-Brami et al, 2003

Neuroplasticity
How to get it, how to drive it.

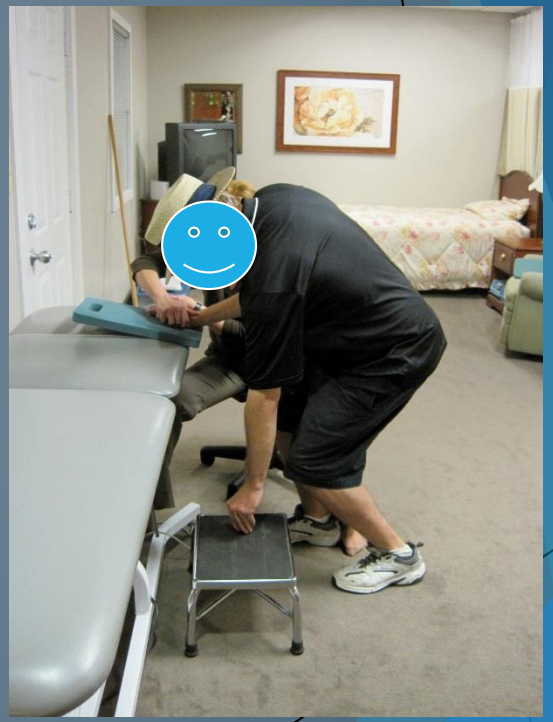
- Maintain optimal Level of Difficulty
  - "Just Right Challenge"
- Integration of Affected Extremities in Functional Tasks
- Activity Dependent Plasticity
  - Skillful manipulation of motor practice variables.
-
- Characteristics that maximize motor learning
  - Task complexity
    - Cognitive engagement vs. exercise- active problem solving
  - Task difficulty/intensity
    - New skill acquisition vs. repetition of current abilities
  - Characteristics that maximize motor learning
    - Task specificity
    - Sensory experience influence

Bayona, Bitenski, Salter, Teasell (2005)

Utilizing Principles of NDT to accomplish graded improved use of hemiparetic UE into daily life tasks

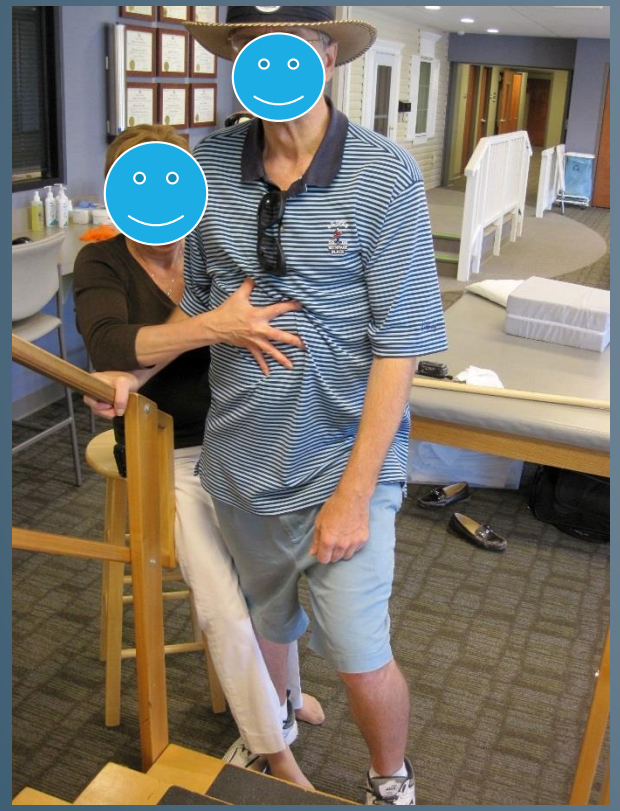
The arm bone is attached to the trunk bones! The trunk bone is attached to the leg bones! They are all driven by the head bone!

Arm/Hand on Stationary Surface: Low



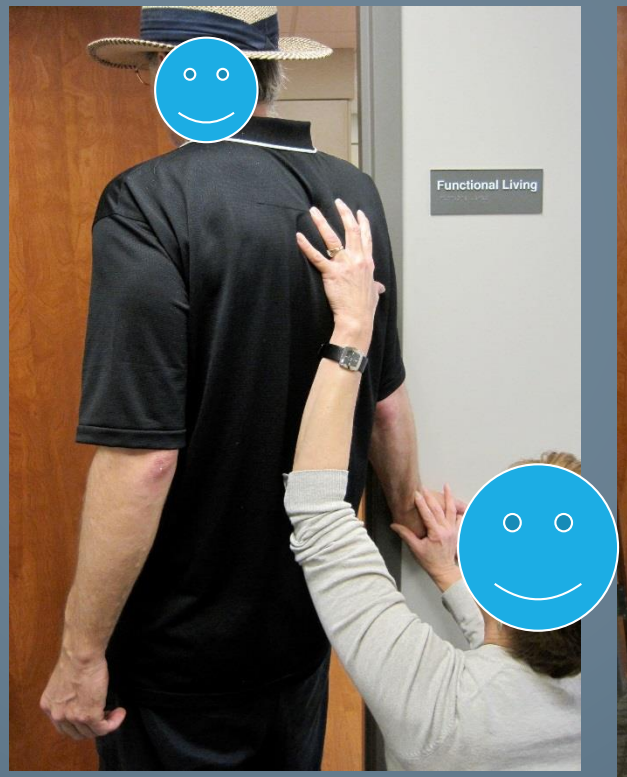
Goal: UE use in Balance and Support

Arm on Stationary Surface: Moving Body away from Arm/Hand (Arm on Body)



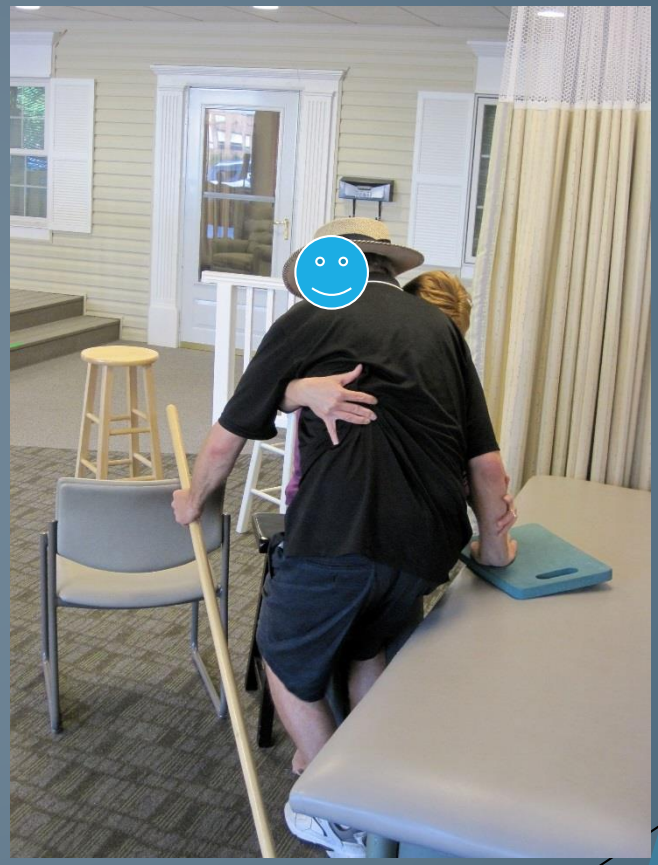
Goal: Precursor to active reach. Active recruitment of movements opposite of maladaptive synergy patterns and spasticity bias.

Developing Range in Active Support
Body away from arm/hand (Body on Arm)



Goal: Developing Range of motion to move through various planes of motion at multiple joints.

Transitional Movements

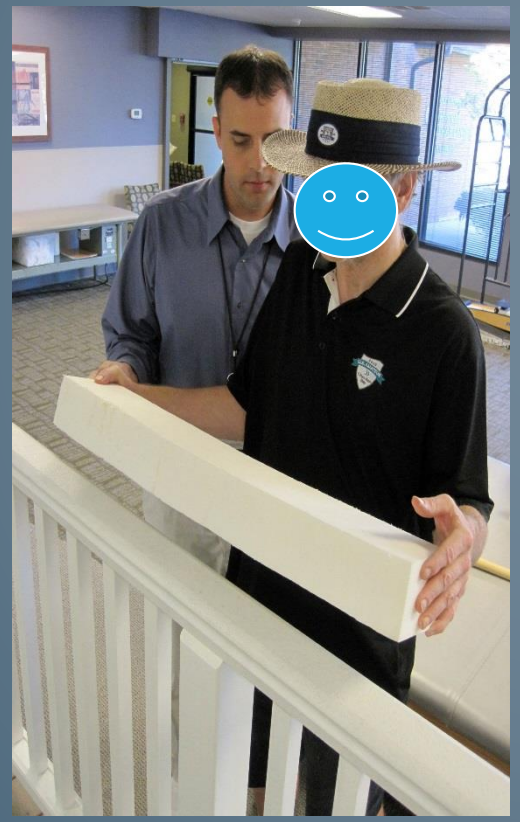


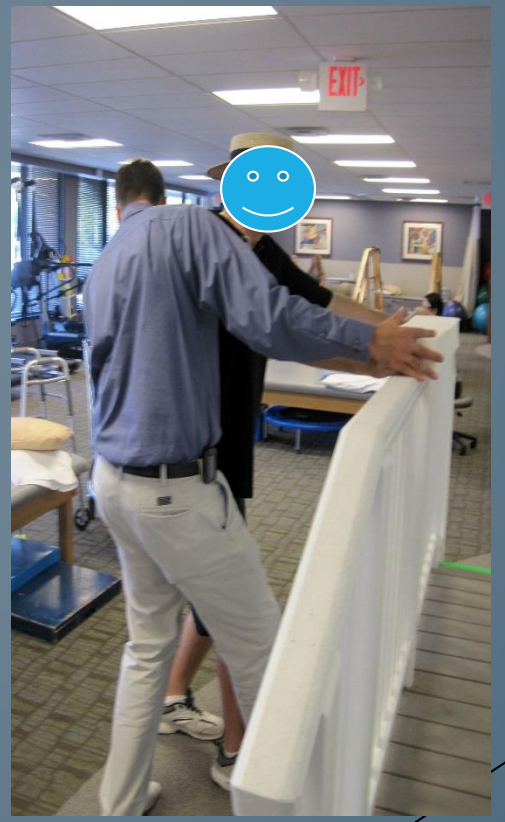
Goal: Use of UE to assist with transitions of body positions while integrating LE and trunk movements. (Whole body task- not just UE specific)

Isometric Activities

Goal: Isometric strength required for carrying objects. Bilateral in this scenario

Dynamic transitions of isometric, to concentric to eccentric movements for carrying and transporting.



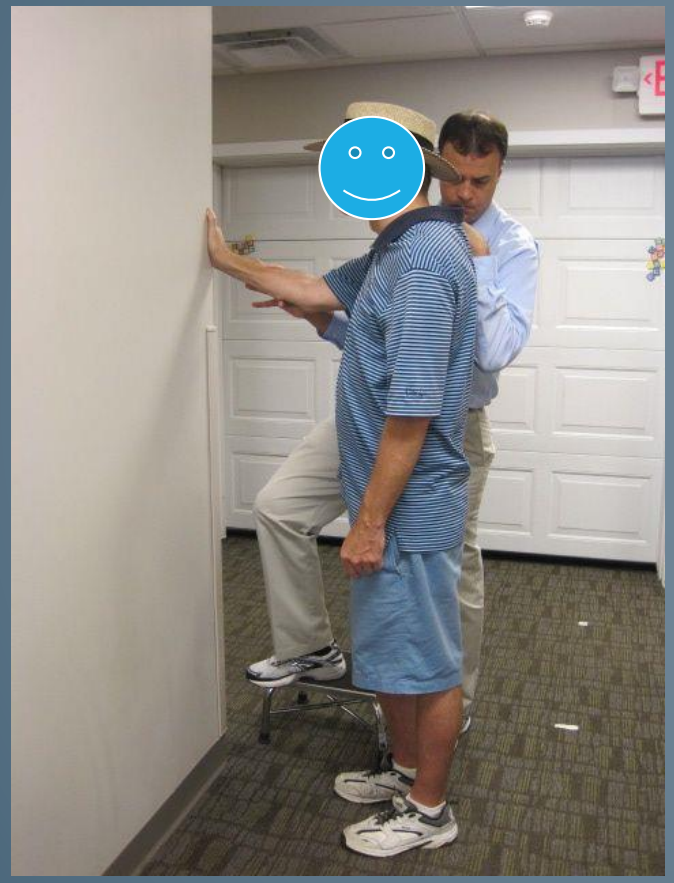


Goal: Replicating real life transitions of muscle control to move objects through functional ranges of motion

Bimanual- Carrying with Transitions

Goal: Performing carrying and transporting motor functions integrated with walking/gait. Whole body function.

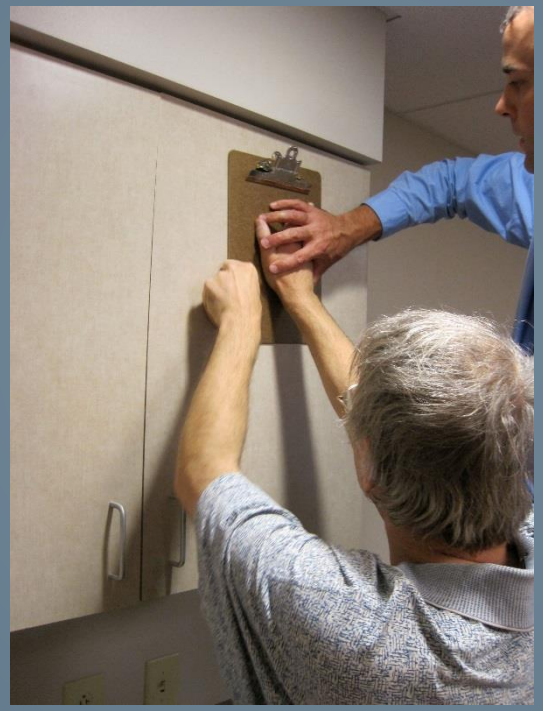
Let’s Get Vertical- Partial Weight Bearing

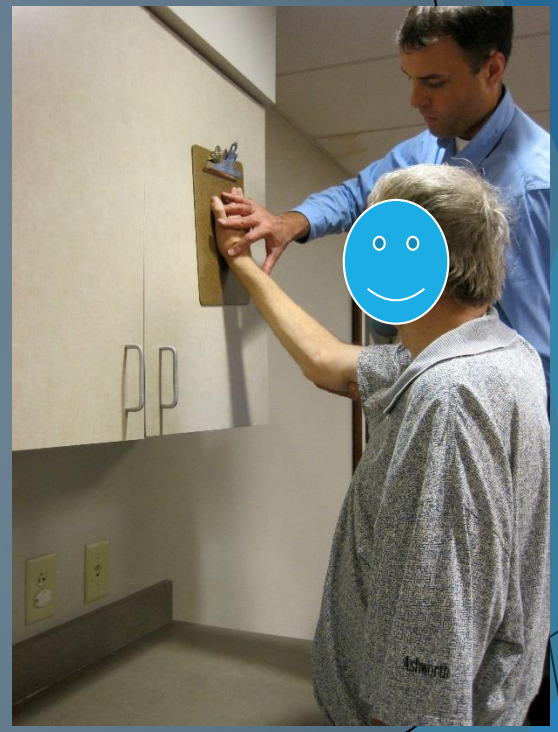


Goal: Developing active control in higher ranges opposite of maladaptive synergies.

Pre-cursor for anti-gravity open chain reach in higher ranges and pushing objects in higher ranges.

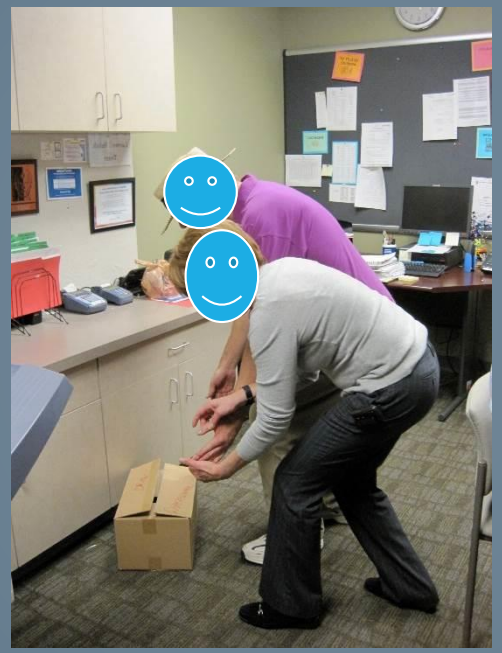
Let’s Get Mobile

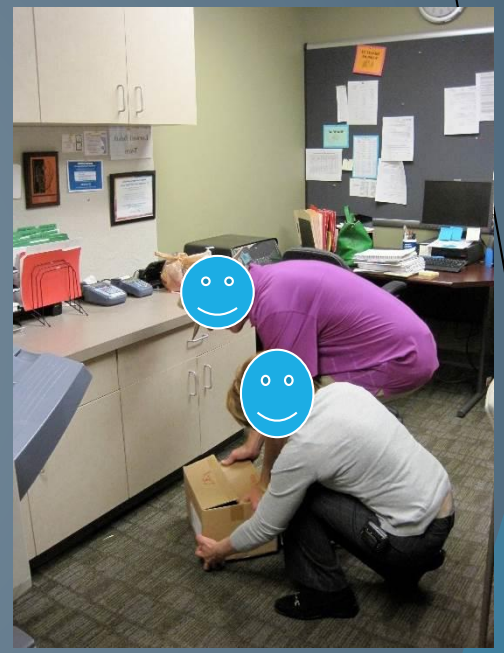




Goal: Concentric and eccentric control of reaching motions opposite of maladaptive synergies/compensations.

BOS With Reach





Goal: Integrating base of support demands with active reaching to functional objects.

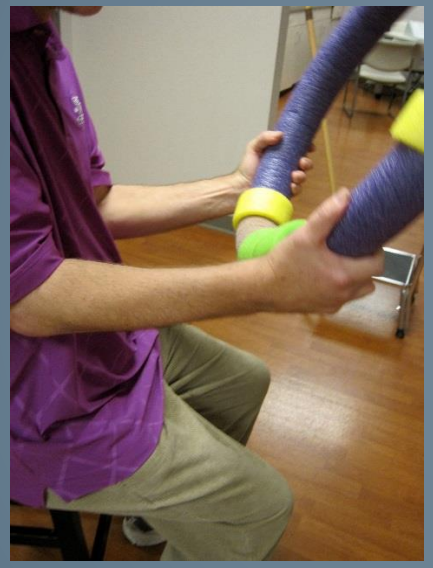
Active reaching isn't always upward.

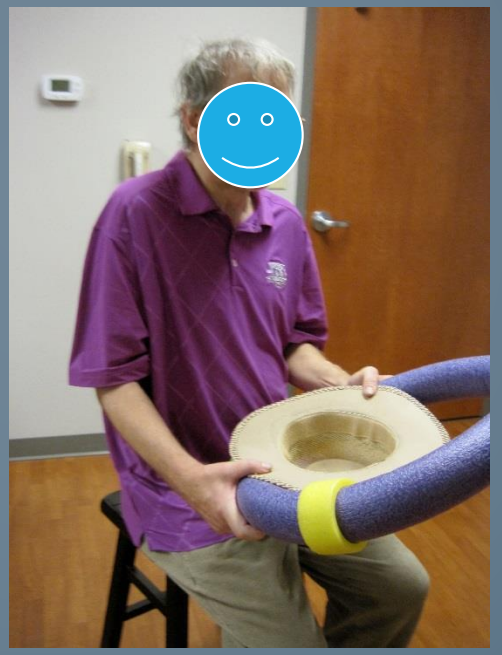
Active reaching requires more than just a shoulder and an elbow.

Arm with Body- Vertical

Goal: Active pushing with increasing resistance / force requirements in vertical ranges of motion.
Integration of base of support and trunk requirements to perform task.

Adding Complexity- Multiple Joint Coordination

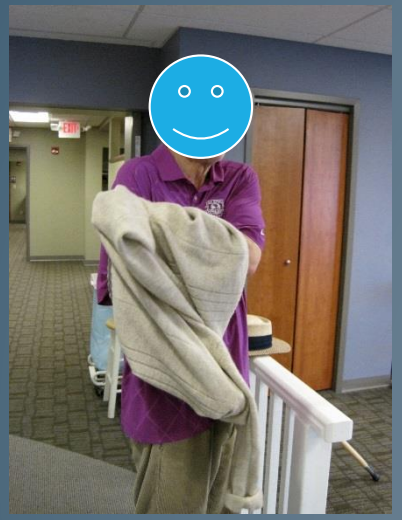




Goal: Multi joint coordination needed to don and doff hat.

Bilateral object used to reduce weight of arm in closed chain. Realistic sequence of several joints moving through the functional task (timing, goal directed, sequences of movement)

Let’s Get Functional



Goal: Increase complexity of movements in more complex functional scenarios as patient gains the ability.

Bilateral task: Both arms are performing different movements.

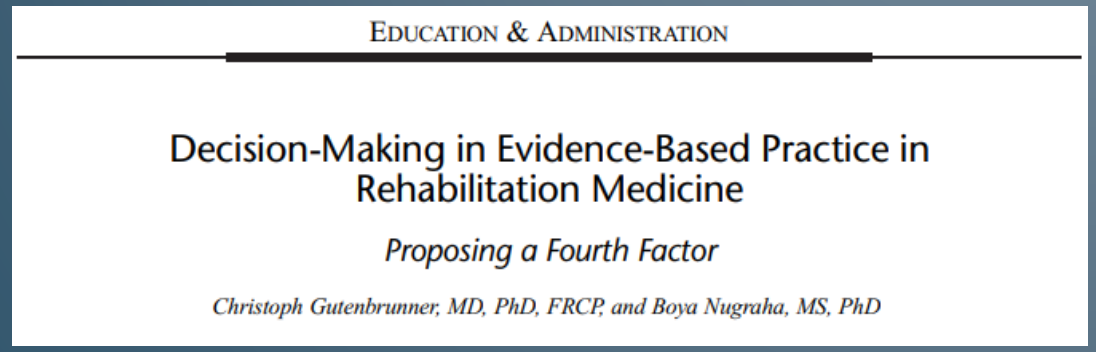
Evidence Based Treatment Interventions for UE Recovery

"MAY"

“The current literature fails to account for the complexity of factors including personal and environmental ones that influence the individuals’ state of functioning and the outcomes of rehabilitation interventions.”

Gutenbrunner & Nugraha, 2020

Decision Making in Evidence Based Medicine- Proposing a Forth Factor.


EDUCATION & ADMINISTRATION

Decision-Making in Evidence-Based Practice in Rehabilitation Medicine

Proposing a Fourth Factor

Christoph Gutenbrunner, MD, PhD, FRCP, and Boya Nugraha, MS, PhD


Perspectives on evidence based practice in ABI rehabilitation. “Relevant Research”: Who decides?

Catherine Wiseman-Hakes[a,*], Sheila MacDonald[b] and Michelle Keightley[c]

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[b]Sheila MacDonald & Associates, Toronto, Canada

[c]Graduate Department of Rehabilitation Science, & Department of Psychology, University of Toronto, Canada


Article

What factors affect clinical decision-making about access to stroke rehabilitation? A systematic review

Verity Longley, Sarah Peters, Caroline Swarbrick and Audrey Bowen

Client Centered Practice Model

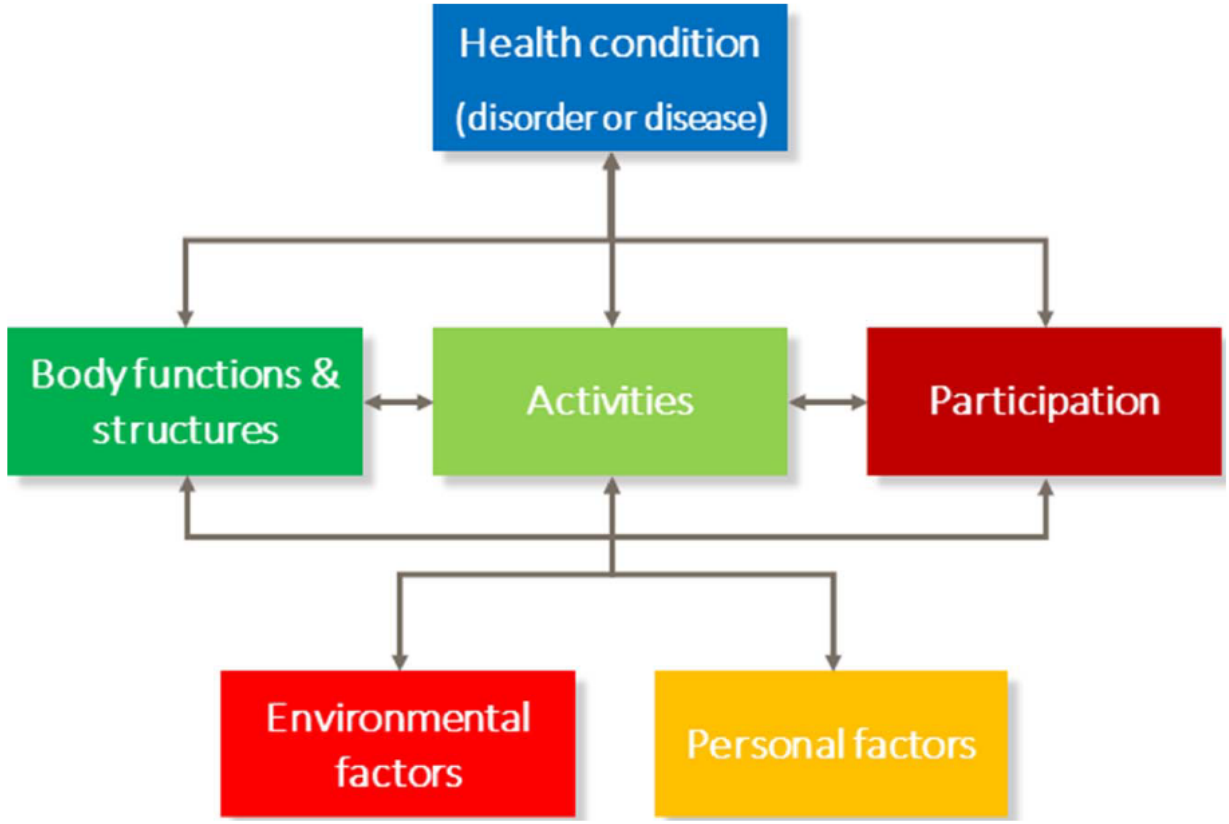


FIGURE 2. The model of functioning, disability, and health (WHO 2001, with permission).

- Patient's status of well being and rehabilitation outcomes are heavily influenced by their individual circumstances (social determinants of health, personal beliefs, motivations, education, emotional status, etc).

Influencers of Clinical Decision Making

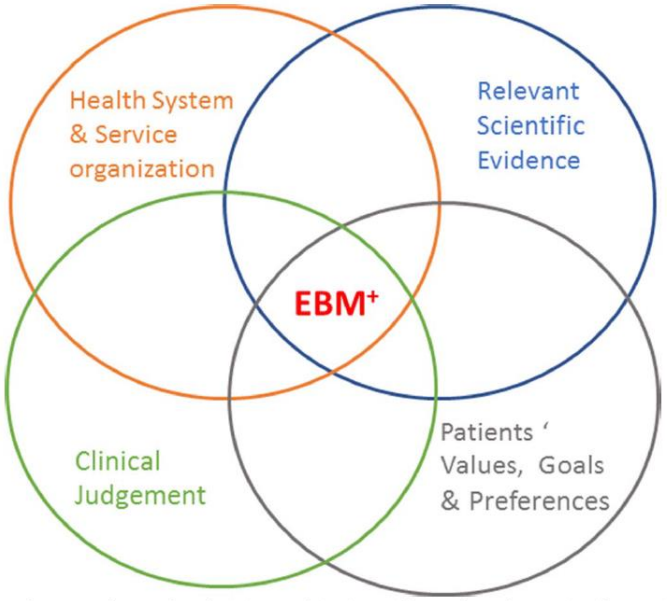


FIGURE 3. Schematic figure of the four factors relevant for decision-making in evidence-based practice (factors in blue, green, and gray from Sackett et al.,[3] 1996, modified).

Health System: Insurance, staffing, equipment, economy, access to evidence-based literature, time constraints of staff, productivity expectations, quality of training, rules and regulations, etc…

Clinical Judgement:
- Fills in the gaps (does literature explain it all?)
- Which intervention is best for this client?
    - This situation?

Patient's Values, Goals, & Preferences:
- Which intervention is most likely to fit with this individual ?

Relevant Scientific Evidence:
- Understanding it
- Critiquing it
- Applying it

Evidence Based Practice in Neuro-rehabilitation

- Goal of EBP- Use the scientific knowledge gained in research in clinical practice.
  - Cannot be done without clinicians
  - "Clinicians have a moral responsibility to know about the strength of available evidence and to consider this when making decisions about clinical management."
  - Example- Treating a Child with CP has a dauting number of considerations
    - Child's age, type of CP, Motor ability, cognitive ability, behavior and motivation, family involvement and support, home environment, and education placement.
  - Results from RCT's are not directly applicable to an individual patient.
    - Clinicians are left with the need to make "interpretive leaps"
      - What evidence best supports each individual patient?
  - Hierarchy of Clinical Trials- How does this fit into Neuro-Rehabilitation clinical practice?
    - Hierarchy is derived from medicine and pharmacological research– point blank and straight forward.
    - Neuro-Rehabilitation is behavioral in nature
      - Highly dependent on therapist – patient interactions.
      - Highly dependent on the individual factors surrounding the individual client.

Evidence Based Practice

- Lack of Core UE Outcomes
  - Quality of Evidence is directly impacted by the Quality of Outcome Measures
    - As movement science has evolved, have our outcome measures evolved/improved at the same rate?
    - Fugl Meyer: Developed in 1975
    - ARAT: 1981
    - FIM- Developed in 1983
  - Miller et al – suggesting an implementation of Core UE Outcomes that all UE studies would adopt.
    - Reduce variability in assessments leading to lack of apples-to-apples comparisons.
- Does better UE impairment outcomes directly affect functional outcomes?
  - FIM , Barthel – ceiling affects, biased toward learned non-use (increased function through compensation).
  - Lack of quality outcome measures for IADL.

Evidence Based Review: Critiquing how studies apply to your patients

Wiseman-Hakes et al (2005)

- Client centered practice:
  - My patient is an individual with:
    - Unique goals, interests, motivations, SES, support systems, education, cognitive status, physical status, etc.
- Treatment interventions should reflect your patient's unique factors
- Does EBP support this?

Table 3
Critical appraisal of evidence: A brief guide for clinicians

Factors for consideration	Additional questions for clinicians
– Inclusion exclusion criteria provided – Representative of the population	Do the participants match the patients/clients in my practice?
– Population samples described according to demographics, length of time post injury, severity of injury & impairment, – Sample size – Attrition (who dropped out and why?)	Are those who dropped out the more vulnerable 'in need', harder to treat group?
– Were efforts made to create contrasting treatment conditions, and to equate samples and decrease bias (i.e. randomization, blind raters, monitoring of treatment provision, analysis of attrition)	Are these individual or group interventions relevant to the individual I'm treating?
– Outcomes; were they standardized, do they measure at the level of impairment, activity or participation	What outcome is my patient/client aiming for
– Were the findings statistically significant?	Does this equate with functionally and or clinically significant for my patient/client?
– Is the description of the intervention sufficient to replicate	Do I have the means to carry out this treatment in my practice
– Was there follow-up to ensure maintenance and generalization of gains	Will the gains be maintained?
– Are there SSD data available for the intervention of choice?	If so, did the study use multiple baselines across subjects and behaviours, as well as randomization of the order of active treatment phases?

Research Participants vs. Real World Patients

- Example of Exclusion Criteria from a common study of Upper Extremity Rehabilitation
- Does this Reflect the Patients we see in clinic every day?

Individuals were excluded from the study if they presented with any of the following:

1. Mostly resolved UE hemiparesis indicated by > 58/66 on the UE Fugl-Meyer[28] motor and coordination score
2. Ataxia out of proportion to weakness, NIHSS ataxia > 0
3. Severe UE sensory impairment indicated by anesthesia to light touch on the UE Fugl-Meyer assessment of sensation and proprioception
4. Neglect, as determined by NIHSS neglect item ≥ 1
5. Inability to give informed consent for study participation
6. Severe arthritis or orthopedic problems that limit passive range of motion (ROM) of UE joints indicated by shoulder flexion < 90°, shoulder abduction < 90°, shoulder external rotation < 45°, elbow extension < 20° from full flexion, forearm supination and pronation < 45° from neutral, wrist extension less than neutral, finger extension < 30° from full flexion
7. Pain that interferes with daily activities as indicated on the pain subcomponent, pain score of 1 for at least 2 joints on the pain/ROM Fugl-Meyer UE assessment
8. Balance and transfer function that requires more than contact-guard assistance
9. History of sustained alcohol or drug abuse in the last 6 months
10. Previous or current enrollment in other rehabilitation or drug intervention studies
11. Residence too far from the training site to participate reliably
12. Receipt of oral or injected antispasticity medications during study treatment

Lessons from the LEAPS Trial

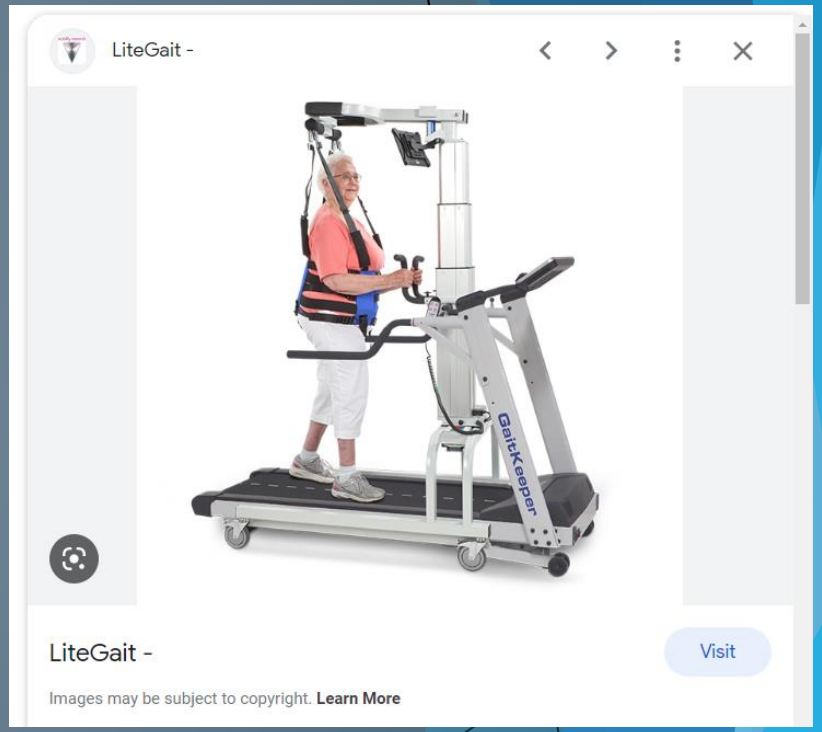
- ***Clinical Question: Am I performing Evidence Based Practice or am I performing experimental practice?***

- The Locomotor Experience Applied Post-Stroke (**LEAPS**)
- Body Weight supported Treadmill Walking.
  - Positive Effects in small trials .
  - Sold A LOT of LiteGait Systems.

  - LEAPS Study was a Multi-Center RCT from 6 Clinical Centers with 408

Study participants.

Result: Locomotor training, including the use of body-weight support in stepping on a treadmill, ***was not shown to be superior to progressive exercise at home managed by a physical therapist.***



Investigating Current EBP for Hemiplegic UE Neuro-Recovery

Finding the Pathway from Research to my Patient

Mass Practice

- No study has systematically determined a critical threshold of rehab intensity needed to obtain a benefit (MacLellan et al 2011).

- Assumptions:
  - If threshold is not reached-
    - there is less recovery of the affected arm
    - Patients develop compensatory movements (Schweighofer et al 2009).

- ***The Big Question: Where is the threshold????***
  - Lang et al. (2007)
    - found practice of task-specific, functional upper extremity movements occurred in only 51% of rehab sessions.
    - Average number of repetitions per session was only 32

- Technology (video gaming, robotics) may be necessary to achieve the maximum number of reps (Saposnik et al. 2010).

Task Oriented Training

- Likely the most researched and accepted Practice Model in stroke recovery.

- Emergent movement kinematics are organized differently for real objects vs. simulated.
  - Virtual reality?
  - Upper limb kinematics more efficient reaching for a telephone vs. reaching for a stick.

- Practice of problem solving- more effective for learning than drill like repetition.

- At least 3 ingredients must be involved:
  - Be challenging – solve the motor problem
  - Be progressive and optimally adapted
  - Solicit active participation
- "Intensity" in the literature has defied a clearly accepted definition.

Task Oriented Training and ASAP – The ICARE RCT (Accelerated Skill Acquisition Program)

CONCLUSIONS AND RELEVANCE—Among patients with motor stroke and primarily moderate upper extremity impairment, use of a structured, task-oriented rehabilitation program did not significantly improve motor function or recovery beyond either an equivalent or a lower dose of UCC upper extremity rehabilitation. These findings do not support superiority of this program among patients with motor stroke and primarily moderate upper extremity impairment.

- Weinstein, Wolf, et al.
- Comparison of "Structured TOT Program vs. Usual and Customary OT.
- Phase 3, Single Blinded Trial
- N= 361 Participants from 7 hospitals.
  - ASAP
  - Dose equivalent OT (DEUCC) group : 30 1 hour sessions x 10 weeks
  - Monitoring only OT (UCC) : Only monitored regardless of dose.

TOT and ASAP – Results of the ICARE Trial

- Typical outpatient treatment sessions last 36 minutes
  - Patients engage in an average of only 12 purposeful actions within an otherwise "unstructured treatment session."
  - "This program is principle based, impairment focused, task specific, intense, engaging, collaborative, self-directed, and patient centered; it has been previously described and feasibility tested"
  - Primary Outcome Measure: Wolf Motor Function Test
  - Secondary Outcome Measure: Stroke Impact Scale (Hand section).
  - ***"The results suggest that usual and customary community-based therapy, provided during the typical outpatient rehabilitation time window by licensed therapists, improves upper extremity motor function and that more than doubling the dose of therapy does not lead to meaningful differences in motor outcomes."***
    - ***More dosage may not mean "more better."***
    - ***Is there a dose ceiling?***

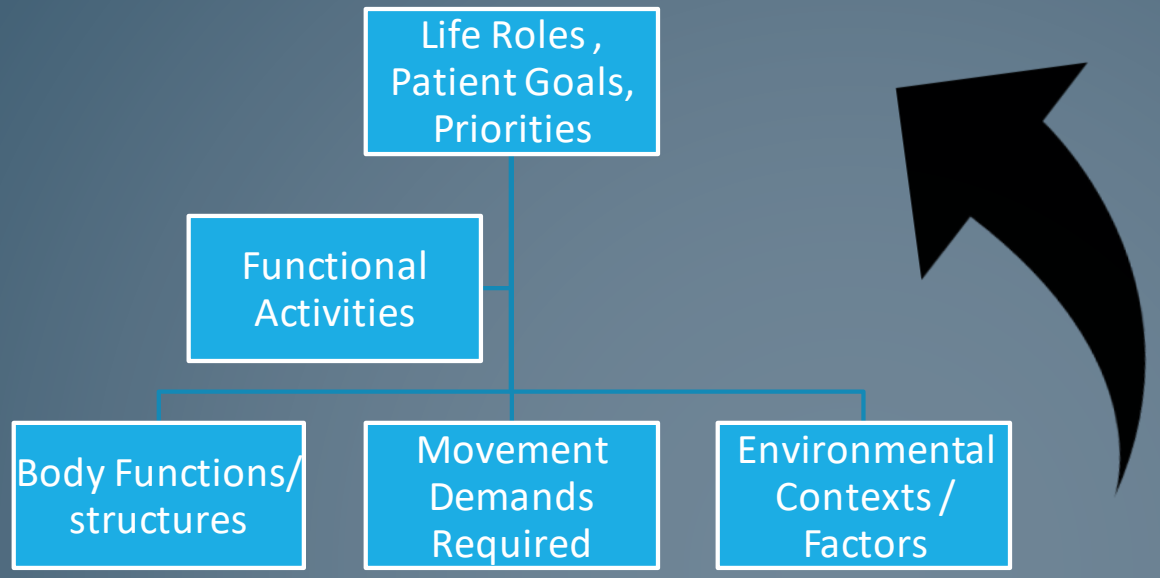
Pictures of Im Confused Meme - kidskunst.info

NDT- Neuro Developmental Treatment

- Developed by Bobath when lack of neuroscience research was available.
  - As evidence has evolved, NDT's guiding principles and treatment approach(es) has adapted

- Unique Concepts:
  - Priority: Maximize motor recovery and function becomes ***WAY EASIER***
    - ***Functional Compensations for Safety***– progress away from "easiest" to "what gets you to the next level"
      - ie. Weak arm in the jacket first, up with the good leg– down with the bad leg
  - ***Teach patients to move*** in the most ~~(normal)~~ efficient way possible.
  - ***POSTURE MATTERS! A LOT***
  - ***All body parts must work together eventually***, why not include them all as early as possible?
  - ***Quality of movement*** can be trained.
  - ***Hands on*** a patient can teach them lots….. ***LOTS!***
  - ***Priority of impairments***- "If I could only fix one thing, what would have the biggest impact?"

NDT Enablement Model



- Fits into the Patient Centered Model of Care / Rehabilitation.
- Increase Functional Participation and Independence through remediation of maladaptive movement patterns.
- Top-Down Approach vs. Bottom Up.
  - Or somewhere in the middle
- Remediation of efficient movement = Ability to function in various environments.
  - Flexible Independence
  - Whole Body Approach
  - Environmental change= no problem

NDT

- Slammed by academicians
  - Lack of evidence
  - Takes too long
  - Does not support intensity of practice
    - When I say intensity, I mean repetitions/mass practice, not complexity. NDT totally supports complexity.

- "Researching NDT is like…..hard"
  - Treatment philosophy- not protocol
  - There are many right answers
  - Skill of the clinician matters
  - Not all patients are the same

Constraint Induced and Modified Constraint Induced Therapy

Two key features:

1) Constraint of the unaffected arm
2) Mass practice of affected arm

Overcoming “learned nonuse”

Use dependent cortical reorganization

Suitable Candidates :

- At least 20 degrees of active wrist ext
- 10 degrees of active finger ext
- minimal sensory or cognitive deficits

In the EXCITE trial, only 6.3% of patients screened were eligible

Constraint Induced	Modified Constraint Induced
2-3 week training program	~10 week training program
Constraint wear= 90% of waking hours	Constraint wear varies study to study (3-6 hours)
3-6 hours of intense upper extremity training (in person session) .	45 minutes of intense upper extremity training 3 days per week
Transfer package	Transfer package

Constraint Induced Therapy

- Necessary Ingredients for CIT
  - **Shaping:** Motor task is gradually made for challenging or less challenging
  - **Task Practice**
  - **Transfer Package**
    - Behavioral techniques that transfers gains from clinical setting to the real world

- ***Transfer Package***:
  - Behavioral Contract: Must be signed and visible in patient's home at all times.
  - Motor Activity Log is performed each session (14 items)
    - Active problem solving is performed to encourage increased MAL scores between sessions.
  - Rich feedback from therapist, positive encouragement, regular systemic encouragement.

- CIT Primary Purpose: Increase the amount of UE use in daily practice
  - "Constraint induced therapy is very rarely pretty"
  - Little to no attention on Quality of Movement

MOTOR ACTIVITY LOG

Instructions:
To monitor the progress your stroke affected arm is making, it is important that we can see how much you use it on a daily basis and how well. Below is a list of activities one would normally do throughout the day. After each activity, please mark the appropriate score that best describes how you use your stroke affected arm. For some people, it may be helpful to get some feedback from family members who see you perform your daily activities. Each activity has two categories that you will score.

1. Amount of use: How often are you performing these activities at home?
2. Quality of movement: How easy or difficult is it for you to perform these activities?

Amount of use:
0 = I do not use my weaker arm for this task.
1 = I occasionally try to use my weaker arm for this task.
2= I use my weaker arm but my stronger arm does most of the task.
3 = I use my weaker arm for about 50% of the task.
4 = I use my weaker arm almost as much as I did before my stroke.
5 = I use my weaker arm as much as I did before my stroke.

Quality of Movement:
0 = I never used my weaker arm for this type of task.
1 = I move my weaker arm during the task but it is of little use *(very poor)*.
2 = My weaker arm is of some use but needs some help from the stronger arm. It moves very slowly, or with difficulty. (Poor).
3 = My weaker arm is used during the task, but movements are slow or are made only with some effort.
4 = The movements made by my weaker arm are almost normal, but not quite as fast or accurate as normal.
5 = I can use my weaker arm for that activity with little to no difficulty. (normal).

Activity (Circle the score that best fits you)	Amount of use:						Quality of Movement					
1. Turn on a light with a light switch	0	1	2	3	4	5	0	1	2	3	4	5
2. Open drawer	0	1	2	3	4	5	0	1	2	3	4	5
3. Remove an item of clothing from drawer	0	1	2	3	4	5	0	1	2	3	4	5
4. Pick up phone	0	1	2	3	4	5	0	1	2	3	4	5
5. Wipe off a kitchen counter or other surface	0	1	2	3	4	5	0	1	2	3	4	5
6. Get out of a car	0	1	2	3	4	5	0	1	2	3	4	5
7. Open refrigerator	0	1	2	3	4	5	0	1	2	3	4	5
8. Open a door by turning a door knob	0	1	2	3	4	5	0	1	2	3	4	5
9. Use a TV remote control	0	1	2	3	4	5	0	1	2	3	4	5
10. Wash your hands	0	1	2	3	4	5	0	1	2	3	4	5
11. Turning water on/off with knob/lever on faucet	0	1	2	3	4	5	0	1	2	3	4	5
12. Dry your hands	0	1	2	3	4	5	0	1	2	3	4	5
13. Put on your socks	0	1	2	3	4	5	0	1	2	3	4	5
14. Take off your socks	0	1	2	3	4	5	0	1	2	3	4	5
15. Put on your shoes	0	1	2	3	4	5	0	1	2	3	4	5
16. Take off your shoes	0	1	2	3	4	5	0	1	2	3	4	5
17. Get up from a chair with arm rests	0	1	2	3	4	5	0	1	2	3	4	5
18. Pull chair away from table before sitting down	0	1	2	3	4	5	0	1	2	3	4	5
19. Pull chair toward table after sitting down	0	1	2	3	4	5	0	1	2	3	4	5
20. Pick up a glass, bottle, drinking cup, or can	0	1	2	3	4	5	0	1	2	3	4	5
21. Brush your teeth	0	1	2	3	4	5	0	1	2	3	4	5
22. Use a key to unlock a door	0	1	2	3	4	5	0	1	2	3	4	5
23. Carry an object in your hand	0	1	2	3	4	5	0	1	2	3	4	5
24. Use a fork or spoon for eating	0	1	2	3	4	5	0	1	2	3	4	5
25. Comb your hair	0	1	2	3	4	5	0	1	2	3	4	5
26. Pick up a cup by a handle	0	1	2	3	4	5	0	1	2	3	4	5
27. Button a shirt	0	1	2	3	4	5	0	1	2	3	4	5
28. Eat half a sandwich or finger foods	0	1	2	3	4	5	0	1	2	3	4	5
Score	Total:						Total:					

Shown here: Modified take home version

Constraint Induced Therapy

- In the acute phase:
  - Etoom et al. (2016) : Performed 36 trial Meta-analysis
    - Found that CIT performed in the first 6 months : non-significant effect
  - Conflicting evidence of timing
    - Taub & Morris 2001 showed benefit
    - VECTORS Trial (Dromerick et al. 2009) : found evidence ***that it may be harmful***
      - Inverse effect using the ARAT
      - Some controversy regarding activity dependent lesion enlargement
- Chronic Phase
  - Hundreds of small studies performed
  - Largest study was the EXCITE study
    - 222 subject multi site study over 3 year period.
    - Strongest evidence to date supporting CIT
    - Subjects with CIT showed improved WMFT and MAL scores.
      - Maintained at 12 and 24 month follow up.

CIT

- Other considerations
  - Ambulatory devices?????
  - $$$$$ Cost- lack of coverage for traditional model.
    - Modified model is even challenging if documentation names the treatment by it's name.
      - Encouragement was made to only describe movements, exercises, ect
  - Patients who qualify: Need to have a strong motivation and high frustration tolerance.
  - Roots for CIT:
    - Founder/Inventor: Dr. Edward Taub was a psychologist
    - Many of the CIT Providers are psychologists ; not PT/OTs
    - ***They know psychology, not movement!!***

Trunk Restraint Therapy

- Studied throughout the 1980's to modern day.
- Treatment approach: Perform active reaching and grasping in a chair with a restraint preventing forward leaning or compensatory trunk movements.
  - Trunk compensations: Often utilized by stroke patients to replace shoulder movement in forward reach.
  - Does inhibiting trunk movement foster improved movement at the shoulder?

Trunk Restraint to Promote Upper Extremity Recovery in Stroke Patients: A Systematic Review and Meta-Analysis

Neurorehabilitation and Neural Repair
2014, Vol. 28(7) 660–677

DOI: 10.1177/1545968314521011
nnr.sagepub.com
SAGE

Seng Kwee Wee, PT[1,2], Ann-Marie Hughes, PhD[1], Martin Warner, PhD[1], and Jane H. Burridge, PhD[1]

Abstract

Background. Many stroke patients exhibit excessive compensatory trunk movements during reaching. Compensatory movement behaviors may improve upper extremity function in the short-term but be detrimental to long-term recovery. *Objective.* To evaluate the evidence that trunk restraint limits compensatory trunk movement and/or promotes better upper extremity recovery in stroke patients. *Methods.* A search was conducted through electronic databases from January 1980 to June 2013. Only randomized controlled trials (RCTs) comparing upper extremity training with and without trunk restraint were selected for review. Three review authors independently assessed the methodological quality and extracted data from the studies. Meta-analysis was conducted when there was sufficient homogenous data. *Results.* Six RCTs involving 187 chronic stroke patients were identified. Meta-analysis of key outcome measures showed that trunk restraint has a moderate statistically significant effect on improving Fugl-Meyer Upper Extremity (FMA-UE) score, active shoulder flexion, and reduction in trunk displacement during reaching. There was a small, nonsignificant effect of trunk restraint on upper extremity function. *Conclusion.* Trunk restraint has a moderate effect on reduction of upper extremity impairment in chronic stroke patients, in terms of FMA-UE score, increased shoulder flexion, and reduction in excessive trunk movement during reaching. There is insufficient evidence to demonstrate that trunk restraint improves upper extremity function and reaching trajectory smoothness and straightness in chronic stroke patients. Future research on stroke patients at different phases of recovery and with different levels of upper extremity impairment is recommended.

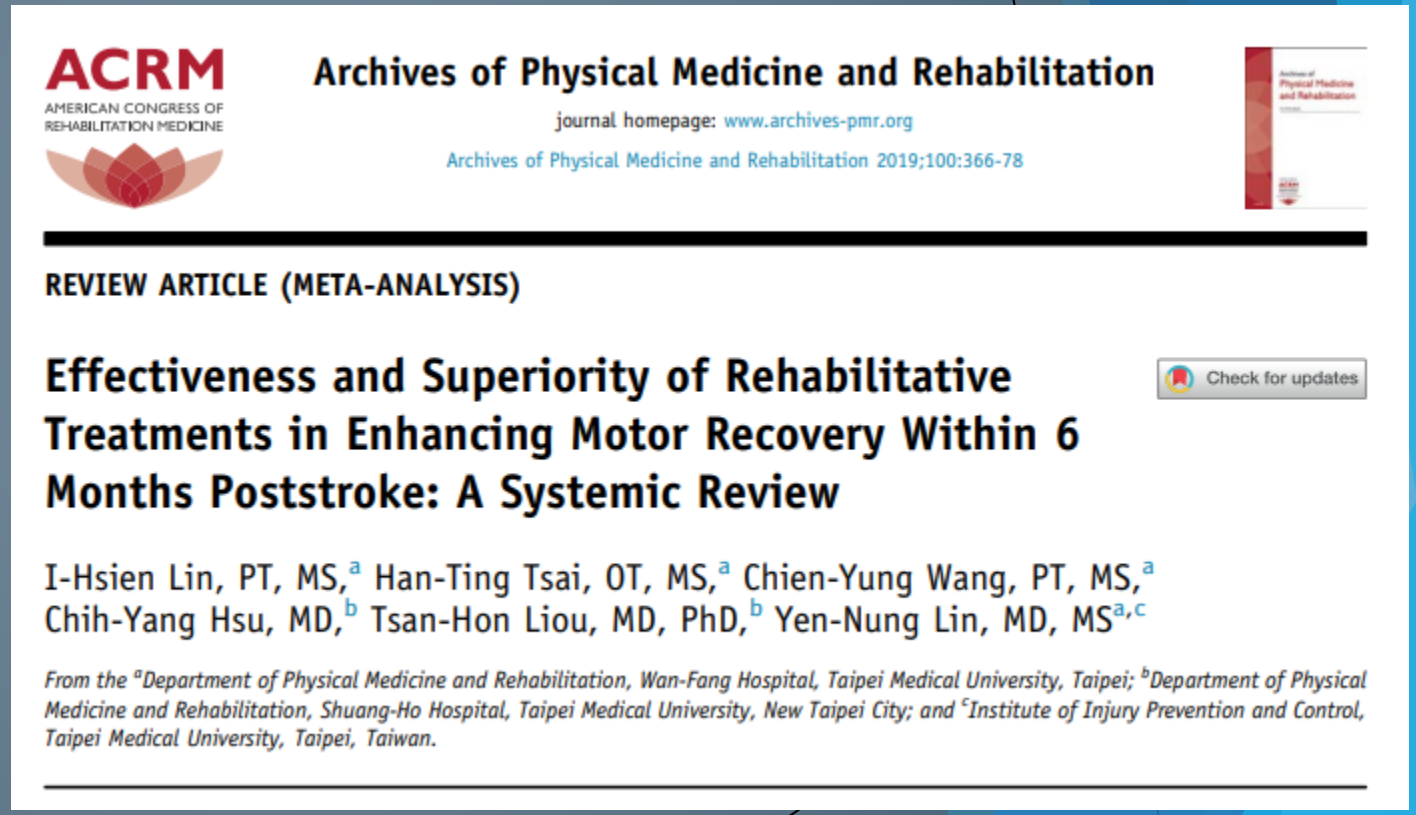
Results: Trunk restraint group showed improved active range of motion at the shoulder and elbow than control groups.

Take away: Restricting compensatory movements enhances motor recovery at the proximal UE.

Electrical Stimulation (FES, NMES).

- 2 Comparison patterns- – ETP (experimental therapy programs) vs. no treatment – ETP vs. placebo – Experimental vs. Conventional pooled results from 31 studies.

- Results: – 6 experimental treatment programs were found to be beneficial for stroke recovery include:
  - CIMT
  - FES Motor
  - Mirror therapy
  - Mixed approach
  - Robot assisted
  - Task oriented training



ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation
journal homepage: www.archives-pmr.org
Archives of Physical Medicine and Rehabilitation 2019;100:366-78

REVIEW ARTICLE (META-ANALYSIS)

Effectiveness and Superiority of Rehabilitative Treatments in Enhancing Motor Recovery Within 6 Months Poststroke: A Systemic Review

Check for updates

I-Hsien Lin, PT, MS,[a] Han-Ting Tsai, OT, MS,[a] Chien-Yung Wang, PT, MS,[a] Chih-Yang Hsu, MD,[b] Tsan-Hon Liou, MD, PhD,[b] Yen-Nung Lin, MD, MS[a,c]

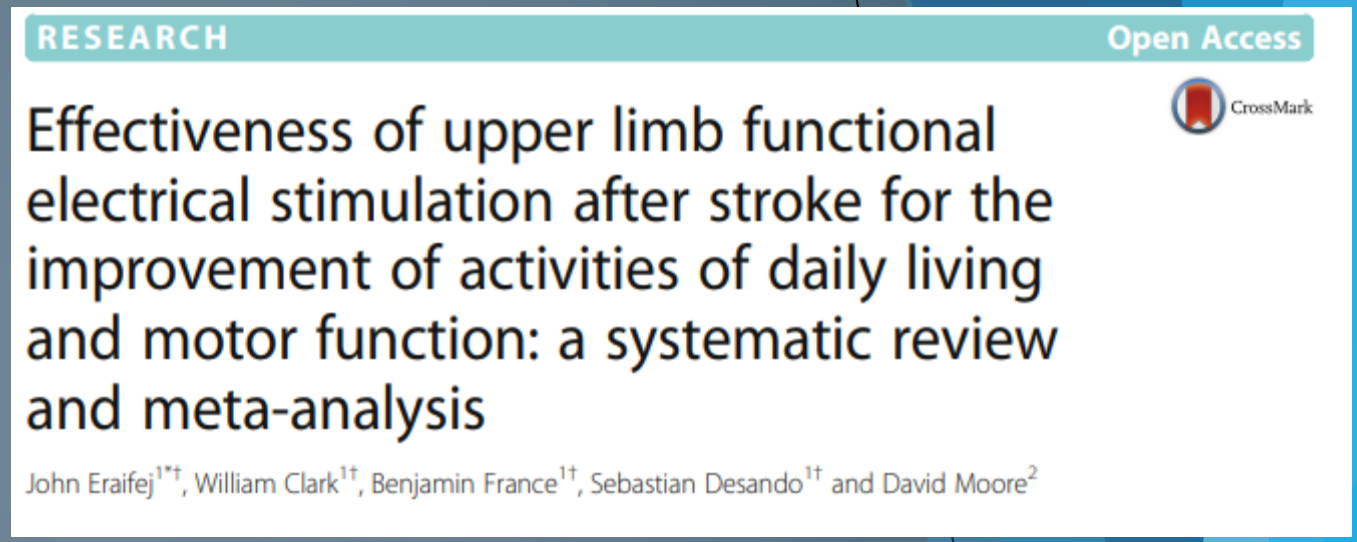
From the [a]Department of Physical Medicine and Rehabilitation, Wan-Fang Hospital, Taipei Medical University, Taipei; [b]Department of Physical Medicine and Rehabilitation, Shuang-Ho Hospital, Taipei Medical University, New Taipei City; and [c]Institute of Injury Prevention and Control, Taipei Medical University, Taipei, Taiwan.

Electrical Stimulation (FES, NMES).

- Sub-group analysis: – showed that experimental studies were not superior to conventional treatment, regardless of intensity."
- *"Experimental training programs can be considered optional but not mandatory substitutions to conventional training."*
- *After years of searching for experimental treatment programs, researchers have yet to identify one treatment that is more effective than conventional training."*

Functional Electrical Stimulation

- Impact on ADL: – 7 studies were suitable for review based on authors' criteria for the data provided.
- No difference was found between FES and control groups
- ***Significant benefit of FES***: shown when started in the acute phase.
- ***Chronic Phase: (after 1 year)***
  - no difference was observed.


RESEARCH Open Access

Effectiveness of upper limb functional electrical stimulation after stroke for the improvement of activities of daily living and motor function: a systematic review and meta-analysis

John Eraifej[1*†], William Clark[1†], Benjamin France[1†], Sebastian Desando[1†] and David Moore[2]

Franciso et al (1998): ***Significantly improved results if FES initiated within 2 months.***

Mangold et al reported improvement in the Barthel Index hand subscore within 2 months.

Timing of FES: ***Strongest benefit if started prior to 2 months post stroke.***
Unlikely benefit after 12 months post stroke.

Functional Electrical Stimulation- Lin et. al (cont)

- Impairment or "Tasks" (tasks) Based Studies
  - 17 studies included –
    - 7 studies using the FMA-
      - **FES showed a statistically significant difference.**
      - **Studies supported improvement when FES started within 2 months CVA**
      - **Past 1 year-> suggests little treatment effect would be anticipated**
  - Box and Blocks used as Outcome Based Measure
    - Showed no significant difference.
    - Very low participant numbers (n=30 tx group and 24 control)
    - ***Chronic stroke bias? -*** All performed after 1 year- Eraifej et al, 2017 (continued)

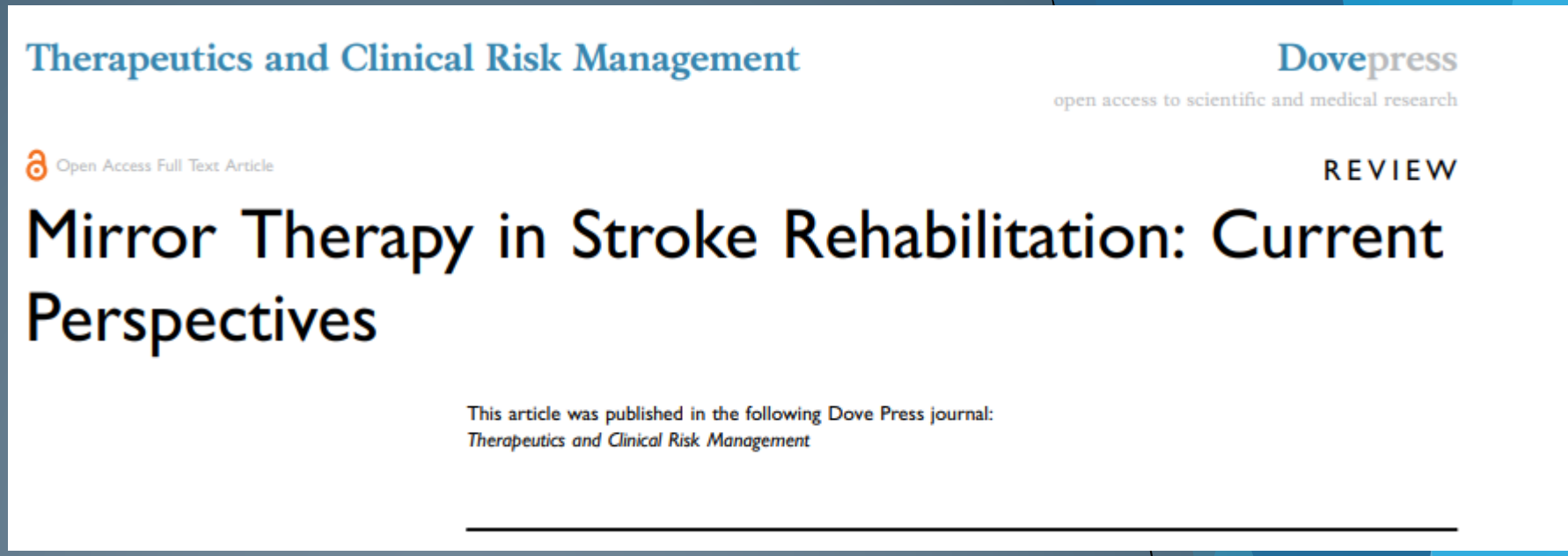
Functional Electrical Stimulation- Lin et. al (cont)

- All of these studies scored very low on the quality using the GRADE subscale
  - Poor patient blinding, substantial heterogeneity, low participant numbers

- ***"This systematic review found insufficient evidence of clinical benefit to support use of FES in clinical practice; however this may reflect a lack of high-quality trials in the field."***

  - Suggests need for an RCT that includes intervention groups at 2 different time points to clarify the optimal time window.

Mirror Therapy



Therapeutics and Clinical Risk Management

Dovepress

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REVIEW

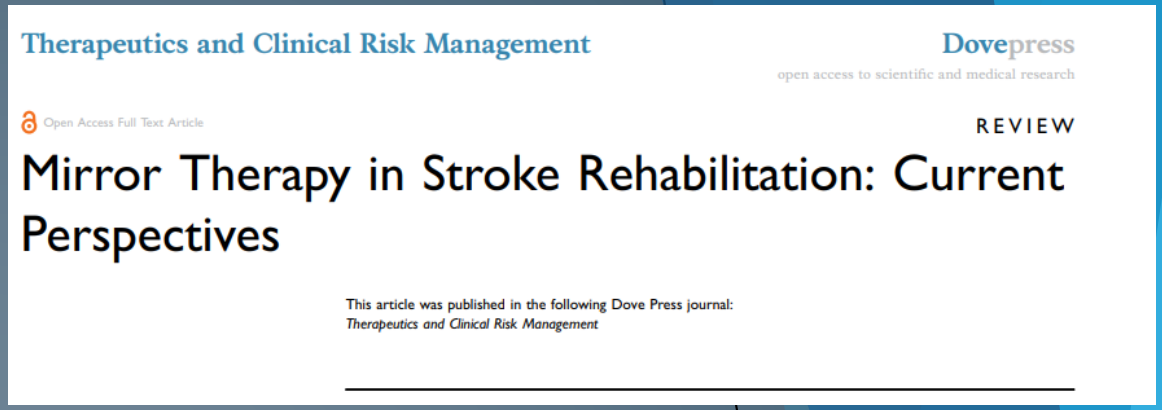
Mirror Therapy in Stroke Rehabilitation: Current Perspectives

This article was published in the following Dove Press journal:
Therapeutics and Clinical Risk Management

- Advantage to Mirror Therapy: Can be used in even completely hemiparetic stroke survivors.
  - Unlike other varied approaches.

- 28 Studies including RCTs.
  - Motor Impairment: Was reduced in all but 5 studies- using FMA.
  - Dexterity, fine motor, gross motor: Improvement in 10 of the 28 studies.
  - Spasticity: Only measured in 4 of the 28 studies.
    - 3 of the 4 showed no significant effect.
  - Sensation: 6 of 28 studies measured sensation.
    - 4 of 6 report improved response to noxious, tactile, or temperature.

Mirror Therapy


Therapeutics and Clinical Risk Management

Dovepress

open access to scientific and medical research

Open Access Full Text Article

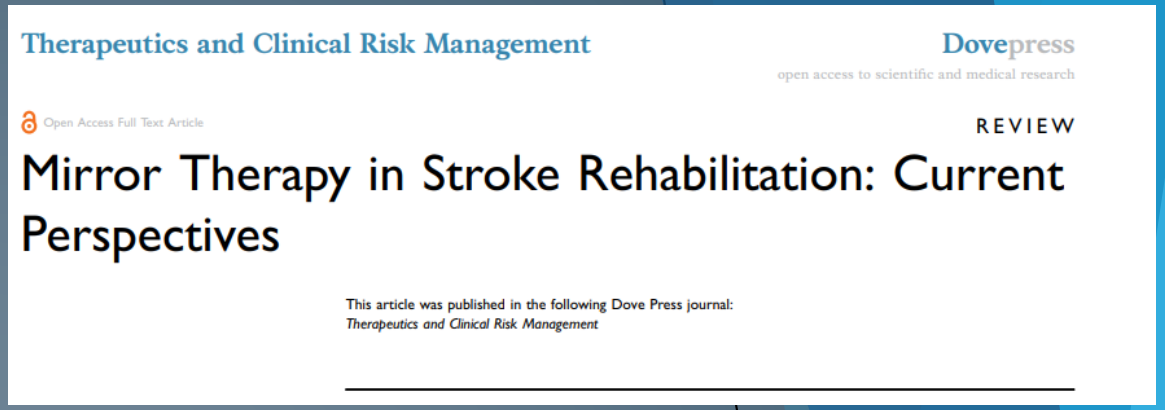
REVIEW

Mirror Therapy in Stroke Rehabilitation: Current Perspectives

This article was published in the following Dove Press journal:
Therapeutics and Clinical Risk Management

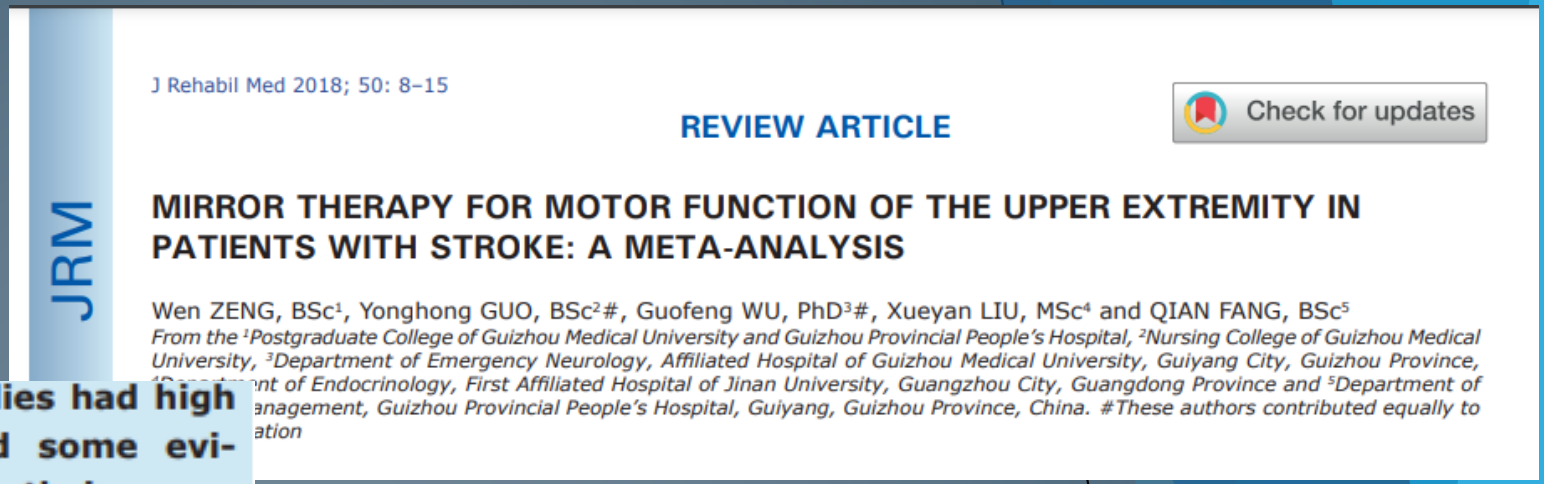
- 12 of 28 studies studied chronic stroke.
  - 16 of the remaining studies might be biased by ***spontaneous recovery.***
- Intervention Details:
  - Varies greatly
  - 50% of studies included bilateral training; 50% used only unaffected UE motor training.
  - 4 studied used Task based activities.
- Intensity:
  - Varies from 1 week to 8 weeks.
  - Frequencies ranges from 3-5 sessions per week.
  - Sessions range from 20-60 minutes.
- Control groups: Vary greatly.
  - Poor consistently in intensity, frequency or sham vs. “conventional therapy.”

Mirror Therapy



- Limitations in Studies:
  - Small sample sizes were included in nearly all studies.
  - Mechanism of the mirror box :
    - Does not allow for reaching activates such as overhead motion or rotation.
      - Improvements in proximal movements less pronounced than distal improvements in wrist and hand motion
    - Lack of Quality of movement analyzed.

Mirror Therapy



J Rehabil Med 2018; 50: 8–15

REVIEW ARTICLE

Check for updates

JRM

MIRROR THERAPY FOR MOTOR FUNCTION OF THE UPPER EXTREMITY IN PATIENTS WITH STROKE: A META-ANALYSIS

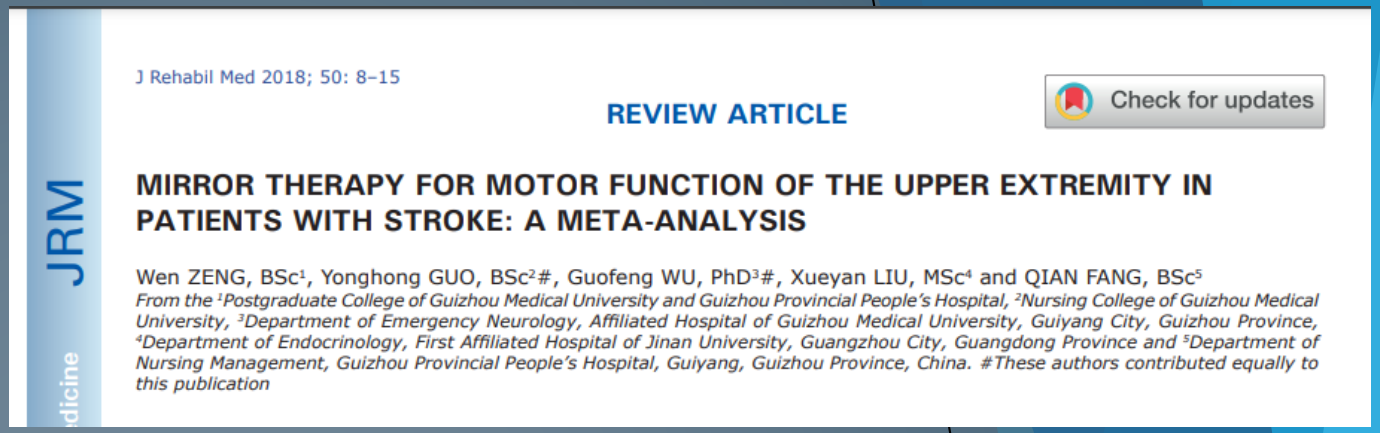
Wen ZENG, BSc[1], Yonghong GUO, BSc[2]#, Guofeng WU, PhD[3]#, Xueyan LIU, MSc[4] and QIAN FANG, BSc[5]

From the [1]Postgraduate College of Guizhou Medical University and Guizhou Provincial People's Hospital, [2]Nursing College of Guizhou Medical University, [3]Department of Emergency Neurology, Affiliated Hospital of Guizhou Medical University, Guiyang City, Guizhou Province, [4]Department of Endocrinology, First Affiliated Hospital of Jinan University, Guangzhou City, Guangdong Province and [5]Department of Management, Guizhou Provincial People's Hospital, Guiyang, Guizhou Province, China. #These authors contributed equally to this work

Conclusion: **Although the included studies had high heterogeneity, meta-analysis provided some evidence that mirror therapy may significantly improve motor function of the upper limb in patients with stroke. Further well-designed studies are needed.**

- 11 Trials with a total of 347 patients.
  - 172 Received MT ; 175 underwent conventional rehabilitation.
- Total of 4, 072 records were identified, of which 11 trials were included.
- 7 Studies included chronic stroke greater than 6 months.
- Intervention: Ranged from 400 minutes to 1920 minutes

Mirror Therapy



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From the [1]Postgraduate College of Guizhou Medical University and Guizhou Provincial People's Hospital, [2]Nursing College of Guizhou Medical University, [3]Department of Emergency Neurology, Affiliated Hospital of Guizhou Medical University, Guiyang City, Guizhou Province, [4]Department of Endocrinology, First Affiliated Hospital of Jinan University, Guangzhou City, Guangdong Province and [5]Department of Nursing Management, Guizhou Provincial People's Hospital, Guiyang, Guizhou Province, China. #These authors contributed equally to this publication

- Limitations of the Studies Meta-analysis
  - Unable to draw clear definitive conclusion that MT was the primary factor driving recovery.
    - Significant heterogeneity
      - Large Range of motor severity.
        - Bruunstrom level 1 to IV
          - Higher levels of recovery at time of study usually indicate larger improvement.
      - Large mean age of study participants (45 to 64.9 years old).
        - Research that shows younger survivors show more recovery vs. older survivors.
    - Risks of bias in the included studies were varied.

Virtual Reality

- 72 trials - 2470 participants.
- 35 new studies (in addition to the studies included in the previous version of this review).
- Study sample sizes were generally small
- Interventions varied in terms of both the goals of treatment and the VR devices used.
- ***"While there are a large number of randomized controlled trials, the evidence remains mostly low quality when rated using the GRADE system. "***
- Control groups usually received no intervention or therapy based on a standard-care approach.

Virtual Reality

- **Primary outcome: "results were not statistically significant for upper limb function "**
  - when comparing virtual reality to conventional therapy.
- ***However, VR in addition to usual care = a statistically significant difference between groups***
  - ***Supports use of treatment model as an adjunct to standard care– not a replacement!***
- Results were statistically significant for the activities of daily living (ADL) outcome (moderate-quality evidence);

Virtual Reality

Authors' conclusions

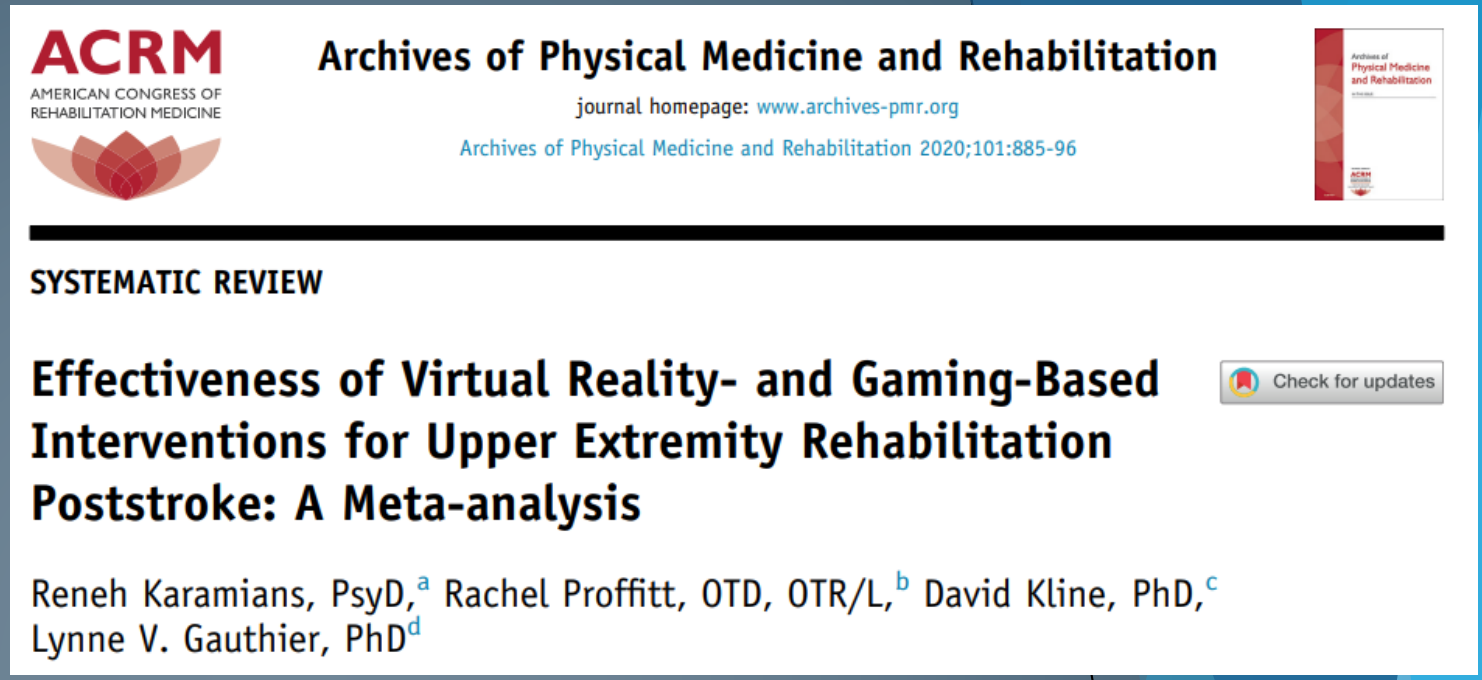
- ***"We found evidence that the use of virtual reality and interactive video gaming was not more beneficial than conventional therapy approaches"***
- ***"VR may be beneficial in improving upper limb function and activities of daily living function when used as an adjunct to usual care (to increase overall therapy time)."***
- ***" There was a trend suggesting that higher dose (more than 15 hours of total intervention) was preferable as were customized virtual reality programs" ; however, these findings were not statistically significant.***

Virtual Reality

38 Articles published (2005-2019.)

The primary outcome:

- Proportional improvement on the Wolf Motor Functioning Test, Fugl-Meyer, or Action Research Arm Test.



ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation
journal homepage: www.archives-pmr.org
Archives of Physical Medicine and Rehabilitation 2020;101:885-96

SYSTEMATIC REVIEW

Effectiveness of Virtual Reality- and Gaming-Based Interventions for Upper Extremity Rehabilitation Poststroke: A Meta-analysis

Check for updates

Reneh Karamians, PsyD,[a] Rachel Proffitt, OTD, OTR/L,[b] David Kline, PhD,[c] Lynne V. Gauthier, PhD[d]

- Results:
  - ***On average, VR or gaming interventions produced an improvement of 28.5% of the maximal possible improvement.***
  - ***Dose and severity of motor impairment did not significantly influence rehabilitation outcomes.***
  - ***Treatment gains were significantly larger overall (10.8%) when the computerized training involved a gaming component vs just visual feedback.***
  - ***VR or gaming interventions showed a significant treatment advantage (10.4%) over active control treatments.***

Virtual Reality

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Archives of Physical Medicine and Rehabilitation

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SYSTEMATIC REVIEW

Effectiveness of Virtual Reality- and Gaming-Based Interventions for Upper Extremity Rehabilitation Poststroke: A Meta-analysis

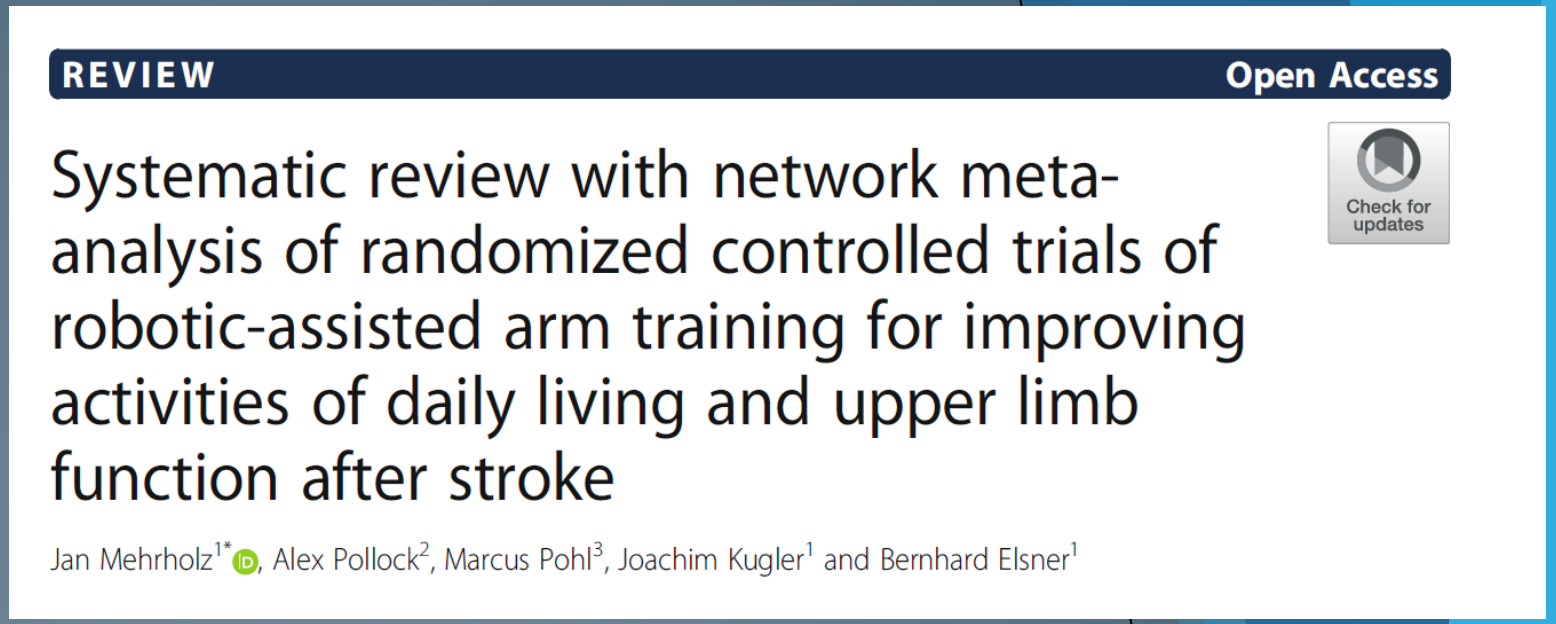
Reneh Karamians, PsyD,[a] Rachel Proffitt, OTD, OTR/L,[b] David Kline, PhD,[c] Lynne V. Gauthier, PhD[d]

- ***Conclusions:***

"Overall, VR- or gaming-based upper extremity rehabilitation poststroke appears to be more effective than conventional methods."

" Further in-depth study of variables affecting improvement, such as individual motor presentation, treatment dose, and the relationship between them, are needed."

Robotics



REVIEW Open Access

Systematic review with network meta-analysis of randomized controlled trials of robotic-assisted arm training for improving activities of daily living and upper limb function after stroke

Check for updates

Jan Mehrholz[1*], Alex Pollock[2], Marcus Pohl[3], Joachim Kugler[1] and Bernhard Elsner[1]

- 55 RCTs including 2664 patients.
- Primary Purpose:
  - Effect on ADLs
  - Effect on impairment related movement/function

- ***"The Results of Robotic – assisted arm therapy were comparable to conventional therapy"***
- ***"Indirect comparisons show that no one type of robotic device is any better or any worse than any other device, providing no clear evidence to support the selection of specific types of robotic devices"***

Robotics

REVIEW ARTICLE

Brain and Behavior Open Access WILEY

Robot-assisted therapy for upper-limb rehabilitation in subacute stroke patients: A systematic review and meta-analysis

Wai-tong Chien[1] | Yuen-yu Chong[1] | Man-kei Tse[1] | Cheuk-woon Chien[2] | Ho-yu Cheng[1]

- Eleven RCTs involving 493 participants were included for review.
- ***Effects of RT when compared to usual care on motor control, functional independence, upper extremity performance, muscle tone, and quality of life were similar to conventional therapy.***
- The quality of this evidence was generally rated as low-to-moderate.

Therapist Challenge:

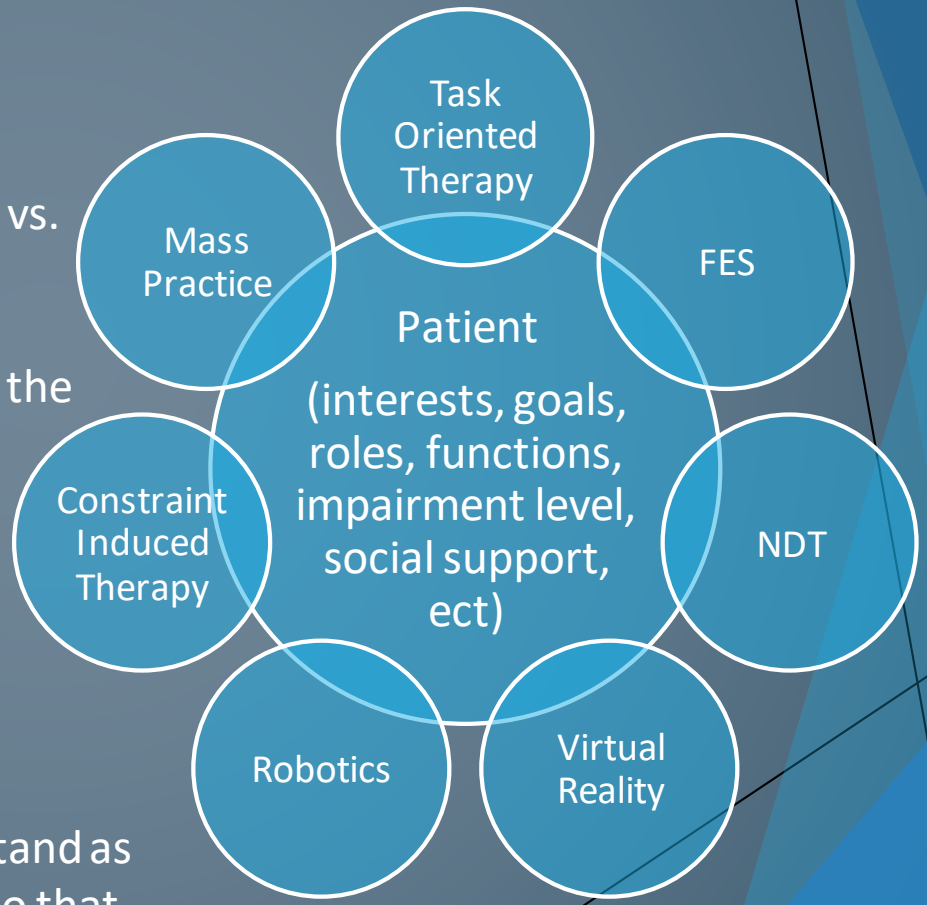
Integrating the Strengths of Each Model to the Individual Patient.

A patient motivated by VR- may thrive in this as their HEP vs. exercises.

Possible to integrate many of the concepts of CIT without the mitt.

Should HEPs be more task based when the client has the capacity to reach in low planes without maladaptive movement patterns?

It should really be the mission for the therapist to understand as much as possible on ALL of these treatment modalities so that combining these strategies can be possible.



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