Meaningful engagement in activity can enhance upper extremity motor performance more than rote exercise in stroke rehabilitation

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Meaningful engagement in activity can enhance upper extremity motor performance more than rote exercise in stroke rehabilitation

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CLINICAL SCENARIO: In the United States each year, about 780,000 people experience a stroke. It is a leading cause of serious, long-term disability (American Heart Association & American Stroke Association, 2008). Impaired motor function of the upper extremity is a common symptom seen in individuals who have experienced stroke. Upper extremity impairments can prevent or hinder occupational performance. Rehabilitation of upper extremity function is therefore of special concern. What is the evidence evaluating the effectiveness of poststroke rehabilitation interventions for the upper extremities?

FOCUSED CLINICAL QUESTION: Among people with impaired upper limb motor function following stroke, is meaningful engagement in activity a more effective intervention than rote exercise?

SUMMARY of Search, 'Best' Evidence appraised, and Key Findings:
Two Level II studies (Nelson et al., 1996; Winstein et al., 2004) and three Level III studies (Delecheck & Schkade, 1999; Gasser-Wieland & Rice, 2002; Trombly & Wu, 1999) were found that compare the effectiveness of meaningful engagement in activity to rote exercise as an intervention for stroke rehabilitation. Key findings were as follows:

- The best evidence appraised compared two upper extremity rehabilitation approaches (functional task practice and strength training) with standard care for stroke (Winstein et al., 2004). The study found nine months post-treatment, the task-specific functional training resulted in significantly better functional outcomes than did the strength training or standard care in less severely impaired participants.

- A specially constructed apparatus was used to compare the effect of an occupationally embedded exercise with that of a rote exercise in individuals with stroke with pronator spasticity (Nelson et al., 1996). The occupationally embedded condition involved rotating a handle as a means to facilitate a dice game, while the rote exercise consisted of simply rotating the handle. The results showed that the occupationally embedded condition enhanced motor performance in persons with pronator spasticity due to stroke.

- Goal-directed reach, compared to rote exercise, was found to significantly enhance movement in individuals who had experienced a stroke (Trombly & Wu, 1999).

Wu, 1999). Goal-directed reach involved asking the participant to reach for and take a piece of preferred food, while in the rote exercise condition, participants were asked to reach to a place on an empty plate.

- Lifting and placing soup cans into a cabinet resulted in significantly better quality of movement than did lifting and placing similarly sized nonrepresentational masses of clay, in individuals who had had a stroke (Gasser-Wieland & Rice, 2002).
- Participants who had experienced a stroke who were asked to stand and perform a personally meaningful activity stood for significantly longer periods of time than when asked to perform nonmeaningful activity (Delecheck & Schkade, 1999).

**CLINICAL BOTTOM LINE:** Meaningful engagement in activity is more effective than rote exercise in the rehabilitation of individuals having experienced stroke.

**Limitation of this CAT:** This critically appraised topic has been individually prepared and has not undergone a process of peer review. Furthermore, a comprehensive search of all databases was not conducted.

**SEARCH STRATEGY:**

**Terms used to guide Search Strategy:**

- Patient/Client Group: CVA; Stroke
- Intervention (or Assessment): meaningful engagement in activity
- Comparison: rote exercise
- Outcome(s): skill acquisition, motor performance

<table>
<thead>
<tr>
<th>Source (database, library catalog, etc)</th>
<th>Search terms/Search strategies</th>
<th>Inclusion/Exclusion Criteria</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>CINAHL</td>
<td>&quot;Find Citing Articles&quot; for Trombly &amp; Wu (1999)</td>
<td>same</td>
<td>Returned 14 citations 0 useful</td>
</tr>
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<td>--------</td>
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</tr>
<tr>
<td>CINAHL</td>
<td>&quot;Find Citing Articles&quot; for Winstein et. (2004)</td>
<td>same</td>
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</tr>
<tr>
<td>CINAHL</td>
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<td>same</td>
<td>Returned 6 citations 0 useful</td>
</tr>
<tr>
<td>CINAHL</td>
<td>Search keyword field with « movement » AND «stroke&gt;&gt; AND «&lt;occupational therapy&gt;&gt;</td>
<td>same</td>
<td>Returned 61 citations</td>
</tr>
</tbody>
</table>

Gasser-Wieland & Rice (2002), *OTJR: Occupation, Participation and Health*

Dolecheck JR. Schkade JK.
RESULTS OF SEARCH

Five relevant studies were located and categorized as shown in Table 1.

**Table 1: Summary of Study Designs of Articles retrieved**

<table>
<thead>
<tr>
<th>Study Design/ Methodology of Articles Retrieved</th>
<th>Level</th>
<th>Number Located</th>
<th>Author (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual RCT’s ( or meta-analysis of such trials) of good quality</td>
<td>I</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>RCT’s too small to provide Level I evidence.</td>
<td>II</td>
<td>2</td>
<td>Nelson et al. (1996); Weinstein et al. (2004)</td>
</tr>
<tr>
<td>Nonrandomized, controlled, or cohort studies; case series; case-controlled or cross-sectional studies</td>
<td>III</td>
<td>3</td>
<td>Delecheck &amp; Schkade (1999); Gasser-Wieland &amp; Rice (2002); Trombly &amp; Wu (1999)</td>
</tr>
</tbody>
</table>

BEST EVIDENCE

The following study/paper was identified as the ‘best’ evidence and selected for critical appraisal. Reasons for selecting this study were:

- Level II randomized controlled trial
- Target population
- Met all other inclusion/exclusion criteria

SUMMARY OF BEST EVIDENCE

**Table 2: Description and appraisal of RCT by Weinstein et al., 2004.**

**Aim/Objective of the Study/Systematic Review:** To evaluate the immediate and long-term effects of 2 upper-extremity rehabilitation approaches for stroke compared with standard care in participants stratified by stroke severity.

**Study Design:** Nonblinded randomized controlled trial. Outcomes were measured at baseline, postintervention, and at a 9-month follow-up.

**Setting:** Neuro-rehabilitation Service at Rancho Los Amigos National Rehabilitation Center in Downey, CA

**Participants:** 60 participants between the ages of 29 and 76 who had experienced a first-time stroke from infarction in anterior circulation, hemorrhagic or pontine stroke. The onset of stroke must have been 2-35 days before study entry. Required FIM scores were originally 40-80; range was later widened to an unspecified range.
Exclusion criteria included: condition that interfered with arm movement, cardiac disease that limited function, subarachnoid hemorrhage w/out evidence of infarction, progressive hydrocephalus, previous history of brain injury, or conditions that could limit participation. Participants were randomized to groups within severity strata, so that the proportion of subjects in each group was similar across strata. The Orpington Prognostic Scale (OPS) was used to determine stroke severity. Only 44 of the original 60 participants completed the 9-month follow up.

**Intervention Investigated** (provide details of methods, who provided treatment, when and where, how many hours of treatment provided)

**STANDARD CARE GROUP (SC):** delivered primarily by OT’s; included
- muscle facilitation exercises emphasizing the neuro developmental treatment approach
- neuromuscular e-stim applied primarily for shoulder subluxation
- stretching exercises
- ADL
- caregiver training

**TASK-SPECIFIC FUNCTIONAL TRAINING GROUP (FT):** received standard care + 20 additional hours of therapy provided by PT’s
- systematic and repetitive practice of tasks that could be performed within the level of available voluntary motion
- tasks designed to be standard, repeatable, and to have some functional goal

**STRENGTHENING & MOTOR CONTROL GROUP (ST):** received standard care + 20 additional hours of therapy provided by PT’s
- used resistance to available arm motion to increase strength in shoulder, elbow, wrist and hand motions
- used eccentric, isometric or concentric muscle contractions
- exercises were progressed to repetitions against resistance using free weights, Theraband strips, or grip devices for the fingers
- strengthening program on alt. days, 3 days/week; on other days, same exercises with less resistance and greater speeds

Therapy dose: 1h/d, 5d/wk for 4-6 weeks, conducted in inpatient and outpatient setting

**Outcome Measures**
Primary and secondary outcomes were measured by a single evaluator pretreatment (baseline), posttreatment, and at 6 and 9 months after stroke

**Primary:**
- upper extremity portion of Fugl-Meyer physical assessment with motor, sensory and ROM sections
- isometric torque at the shoulder, elbow, wrist – measured using lever arm, the distance from the joint center to dynamometer placement for each of the joints (6 torque measures were summed for a composite isometric torque score that was used for analysis)
- grip and pinch force – measured with a hand-held dynamometer from the flexor and extensor muscle groups of the shoulder, elbow and wrist
• Functional Test of the Hemiparetic Upper Extremity (FTHUE) – number of items successfully completed out of a 17-item hierarchically arranged battery of functional tasks

Secondary:
• self-care and mobility portions of the FIM

Main Findings:
In addition to looking at differences across treatment groups, 2 planned subgroup analyses were also conducted. Outcomes were contrasted between the SC group and the combined FT and ST group. Also, outcomes across all 3 treatment conditions and between the SC vs FT+ST groups were contrasted according to stroke severity, using “less severe” or “more severe” baseline OPS. All statistical analyses were conducted at the 0.05 significance level.

1. Baseline
• across the treatment groups: no significant difference in OPS, FIM, upper-extremity Fugl-Meyer, FTHUE, isometric torque, or grasp and pinch force
• between OPS groups:
  □ less severe group scored significantly higher (27.25±19.94) on upper-extremity Fugl-Meyer motor capability than the more severe group (7.60±8.66) (P<.0001)
  □ less severe group had less pain on Fugl-Meyer pain score (less severe group, 22.65±2.26; more severe group, 21.15±3.17; P=.04)
  □ less severe group had greater sensory perception on Fugl-Meyer sensory score (less severe group, 10.78±2.27; more severe group, 6.60±4.71; P=.001)
  □ less severe group could accomplish more items on the FTHUE (less severe group, 7.03±6.18; more severe group, 220.58±260.26) (P=.04)
  □ less severe group scored higher on overall admission FIM score (less severe group, 67.08±13.51; more severe group, 50.10±11.82; P<.0001)
  □ less severe group scored higher on FIM mobility (less severe group, 13.13±5.72; more severe group, 7.75±2.38; P<.0001)
  □ less severe group scored higher on FIM self care (less severe group, 19.13±4.78; more severe group, 14.10±3.43; P<.0001)

2. Posttreatment Outcomes
• combined treatment groups, all OPS scores included:
  □ FT+ST group had significantly greater improvements in Fugl-Meyer motor scores (17.35±13.49) than SC group (220.58±260.26) (P=.04)
  □ FT+ST group had significantly greater improvements in isometric torque (361.41±329.79) than SC group (220.58) (P=.02)
• for less severe OPS scores, combined treatment groups:
  □ FT+ST group had significantly greater improvements in Fugl-Meyer motor scores (21.73±13.77) than SC group (9.36±8.05) (P=.005)
  □ FT+ST group had significantly greater improvements in FTHUE score (5.88±4.53) than SC group (3.14±3.53) (P=.05)
  □ FT+ST group had significantly greater improvements in isometric torque (448.08±364.98) than SC group (250.46±276.79) (P=.03)

3. Longterm Outcomes (completed by 44 (73%) participants; 15 in SC group, 13 in FT group, and 16 in ST group)
• no significant differences across the treatment groups and combined treatment groups, all OPS scores included
• for less severe OPS scores, across treatment groups:
• FT group improved significantly more than ST group in isometric torque (FT group, 558.92±261.31; ST group, 140.19±334.33; P<.05)
• FT group improved significantly more than SC group in palmar pinch (SC group, 0.95±1.06; FT group; P<.05)
• for less severe OPS scores, combined treatment groups:
  • FT+ST group had significantly greater improvements in palmar pinch (2.31±1.93) than SC group (P=.05)

Original Authors’ Conclusions
“Our RCT suggests that specificity of training and stroke severity are important factors for recovery and rehabilitation of arm use in the acute rehabilitation stage. An additional 20 hours of therapy specific to the upper extremity and distributed over 4-6 weeks positively influenced both immediate and long-term outcomes only for the less severe cohort. Although the immediate benefits of a protocol specific to a functional task were similar to those of a strength and motor control protocol, and both were superior to standard care immediately posttreatment, the functional-task protocol was most beneficial 9 months after stroke” (p. 627).

Critical Appraisal:

Validity
PEDro rating score = 8/11 (posttreatment); 7/11 (follow-up)
1. Eligibility criteria specified: yes
2. Random allocation: yes
3. Concealed allocation: yes
4. Groups similar at baseline regarding important prognostic indicators: yes
5. Blinding of subjects: no
6. Blinding of therapists: no
7. Blinding of all assessors: no
8. outcomes obtained from at least 85% of original participants: yes (posttreatment), no (9-month follow-up)
9. Intention to treat analysis: yes
10. Between groups statistical comparisons: yes
11. Point measures and measures of variability: yes

Interpretation of Results (Favourable or unfavourable, specific outcomes of interest, size of treatment effect, statistical and clinical significance; minimal clinically important difference – some of which you may have calculated yourself. Email original authors for information needed such as additional data needed to calculate confidence intervals.)

Outcomes of interest and level of significance were that both the ST and the FT Group exhibited better motor performance than did the ST Group posttreatment. Combining the ST and FT group for analysis showed improvements in an increased number of motor performance areas than just the 2 groups individually. Looking only at participants with less severe OPS scores, analysis showed improvement in the combined group for functional arm use as well as motor performance.

For the follow-up, no significant differences were seen between the treatment groups when looking at all participants. When looking only at the participants with the less severe OPS score, analysis showed that the ST and FT groups were both better
In isometric torque and palmar pinch force than the SC group, and the ST+FT group was better in palmar pinch.

In answer to the research question currently being studied, at the 9-month follow-up, the FT group performed better than the ST group in isometric torque among participants with less severe OPS scores. However, only 44 of the original 60 participants completed the follow-up, introducing uncertainty into the validity of the results.

**Summary/Conclusion:**
While strength training and functional task training are both more effective than standard OT intervention for stroke, task specificity is key for longterm treatment effects among individuals who have experienced less severe effects from a stroke. However, the results should be interpreted with some caution due to validity concerns regarding the follow-up data collection.
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</thead>
<tbody>
<tr>
<td><strong>Intervention Investigated</strong></td>
<td>Strength Training (ST), Functional Task Training (FT)</td>
<td>occupationally embedded exercise</td>
<td>personally meaningful goal-directed therapeutic activities</td>
<td>occupationally embedded condition</td>
<td>goal-directed action; functional specificity of the object</td>
</tr>
<tr>
<td><strong>Comparison Intervention</strong></td>
<td>Standard OT</td>
<td>rote exercise</td>
<td>activities not personally meaningful</td>
<td>nonoccupationally embedded condition</td>
<td>rote exercise</td>
</tr>
<tr>
<td><strong>Outcomes used</strong></td>
<td>upper extremity portion of Fugl-Meyer; isometric torque at the shoulder, elbow, wrist; grip and pinch; FTHUE</td>
<td>bilaterally assisted supination, as measured by degrees of rotation of a handle that was turned during the exercise</td>
<td>standing endurance</td>
<td>motor performance (mvmt. time, total displacement, mvmt. units, peak velocity, % of mvmt. time where peak vel. occurred)</td>
<td>smoothness, directness, and speed of movement; strategy, peak velocity</td>
</tr>
<tr>
<td><strong>Findings</strong></td>
<td>FT and ST are more beneficial than standard care in acute stroke rehab. In the long-term, FT is more beneficial than ST. (results true for individuals with less severe stroke)</td>
<td>The occupationally embedded exercise resulted in significantly more handle rotation than the rote exercise.</td>
<td>Inclusion of personally meaningful activities may increase intervention effectiveness.</td>
<td>Providing naturalistic occupational forms may facilitate better quality of movement.</td>
<td>Goal-directed action produced significantly smoother, faster, more forceful, and more preplanned mvmt. than rote exercise.</td>
</tr>
</tbody>
</table>
IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH

Treatments and interventions that involve functional tasks are commonly used by occupational therapists. Research done by Winstein et al. (2004) indicates that this type of activity is more effective in the long-term than rote exercise in the acute care rehabilitation of individuals who have experienced a stroke. Studies done by Nelson et al. (1996), Gasser-Wieland & Rice (2002), and Trombly & Wu (1999) contribute evidence to these findings by looking at motor performance in individuals while actually performing an occupationally embedded task or a rote exercise. In addition, Delecheck & Schkade (1999) found that tasks personally meaningful to the individual may further enhance performance.

The implications of these findings are that occupational therapy plays a key role in stroke rehabilitation. The unique background occupational therapists have in the therapeutic use of occupations, as well as in obtaining occupational histories and eliciting what is meaningful to the client, well-position them to be instrumental in effective stroke rehabilitation. Therapists should use their training and clinical reasoning skills to choose the occupational form that will most optimally influence the client’s performance, by considering the feedback and sensory stimulation that will be provided and the symbolic meaning within the individual's culture (Nelson et al., 1996). Because of the apparent effect of goal-directed, object-present activity on movement, Trombly & Wu (1999) also suggest considering the use of this type of activity when evaluating clients’ capabilities.

The results of each of these studies support the idea that meaningful occupation is more effective in stroke rehabilitation than rote exercise, yet further study is still needed. Each of the studies reviewed involved a relatively small number of participants. Winstein et al. (2004) found that the functional task was more effective than rote exercise in the long-term, but at that point in the study, approximately 25% of the participants had dropped out of the study. A greater understanding is also needed as to the characteristics of an effective functional therapeutic task. For example, how much does the client’s familiarity with the task and/or object and it's meaning to the client influence performance (Trombly & Wu, 1999).
REFERENCES


