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The effect of a task-oriented intervention on arm function in people with stroke: a randomized controlled trial

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Objective: To evaluate the efficacy of a task-oriented intervention in enhancing arm function in people with stroke.
Design: Two-centre, observer-blinded, stratified, block-randomized controlled trial.
Setting: General community.
Patients: Ninety-one individuals within one year of a first or recurrent stroke consented to participate between May 2000 and February 2003.
Interventions: The experimental intervention involved practice of functional, unilateral and bilateral tasks that were designed to improve gross and fine manual dexterity whereas the control intervention was composed of walking tasks. Members in both groups participated in three sessions a week for six weeks.
Main outcome measure(s): The primary test of arm function was the Box and Block Test. Secondary tests included the Nine-Hole Peg Test, maximal grip strength, the Test d'Evaluation des Membres supérieurs des Personnes Agées (TEMPA) and the Stroke Rehabilitation Assessment of Movement.
Results: Results are for the more affected arm. Baseline performance on the Box and Block Test was an average of 26 blocks (standard deviation (SD) = 16) in the experimental group ($n = 47$) and 26 blocks (SD = 18) in the control group ($n = 44$). These values represent approximately 40% of age-predicted values. Values for the postintervention evaluation were an average of 28 (SD = 17) and 28 (SD = 19) blocks for the experimental and control group respectively. No meaningful change on other measures of arm function was observed.
Conclusions: A task-oriented intervention did not improve voluntary movement or manual dexterity of the affected arm in people with chronic stroke.

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Introduction

Stroke affects 15 million people in the world each year and approximately one-third will live with the sequelae of this disease.[1] Stroke commonly leads to paresis of an arm. As many as 85% of stroke survivors initially present with an impaired arm[2,3] and in most patients admitted with severe stroke, the more affected arm never becomes useful.[4] Because use of the arms is necessary for the performance of activities of daily living (ADL) and instrumental activities of daily living (IADL), this lack of recovery can be devastating to a person's health-related quality of life, particularly as more stroke survivors are returning to live at home.[5] The rehabilitation of the affected arm and hand remains a challenge. Although motor recovery of the arm has been shown to be similar to that of the lower extremity,[6] observed improvements are not necessarily translated into increased performance of daily activities as these tasks are more highly complex than functional activities of the lower limbs. Many different therapeutic approaches have been used in clinical settings to rehabilitate the affected arm. None of the studies comparing the effectiveness of these different approaches has consistently proven one approach to be superior to any other.[7–14] This early research led some authors to conclude that for patients with severe initial arm paresis, rehabilitation efforts should be geared more towards the teaching of compensatory techniques using the less affected arm.[4]

More recently, a robotic intervention has demonstrated benefits in decreasing motor impairments in people with chronic stroke but functional gains were small.[15] Also, sensorimotor stimulation was shown to improve motor recovery in the arm. Notably, this intervention was more effective in patients with a severe motor deficit. Unlike the previous study, this intervention was administered in the acute phase post stroke,[16] when the most and the fastest recovery is known to take place. Jang and associates[17] demonstrated that a four-week task-oriented training programme consisting of six arm tasks performed for 40 min/day, four days/week for four weeks led to functional recovery in the chronic phase post stroke. To be included in this study, however, subjects had to meet specific criteria regarding minimal residual movement and no severe spasticity or tremor in their affected arm.

Several randomized controlled trials have also been performed testing the effects of robot-assisted movement,[18] neuromuscular stimulation,[19–21] functional task practice, strength training,[22] and arm ability training.[23] Most of them included only a small number of subjects, decreasing their power to detect any real changes.

As well, a new and very promising treatment modality called 'Constraint induced movement intervention (CIMT)'[24] has received considerable attention over the past few years. Although most studies[25–29] evaluating the effects of this therapy or a modified version have demonstrated positive results,[10] only three randomized controlled trials[25,27,29] have been conducted. Furthermore, the intensity of this programme in its original format (6 h of therapy per day for 14 days during 90% of waking hours while the less affected arm is constrained[30]) is probably beyond the stamina of the vast majority of stroke patients.

In studies with similar interventions to the present study, such as the one by Kwakkel *et al.*,[31] which was a randomized controlled trial comparing treatment with emphasis on arm training versus leg training versus control programme, authors found that individuals in the arm rehabilitation training had a small but significant effect on the functional recovery of dexterity of the paretic arm. Subjects in this study were treated in the acute phase after their stroke, within 14 days.

Dean and colleagues[32] aimed at evaluating the effects of a training programme on the performance of locomotor tasks in chronic stroke (experimental group), in which the control group received arm training for 1 h, three times a week for four weeks. They found no significant difference between the experimental and the control groups in grip strength or dexterity. The authors speculated that failure to observe improvement in arm function may be due to their small sample size, subject inclusion criteria and the measures used. Indeed, the Perdue Pegboard is a very high level evaluation that may have demonstrated floor effects among subjects with lower ability level in their affected arm. The authors suggested that the Test d'Evaluation des Membres supérieurs des Personnes Agées (TEMPA) may have been more

appropriate and sensitive in detecting changes among people with varying levels of arm function.

In their study, Duncan and co-workers[33] examined the effect of therapeutic exercises in subacute phase after stroke. The exercise programme aimed to improve strength, balance and endurance and also to encourage people to use their affected arms more in their activities of daily life. Balance, endurance and mobility improved but improvement in arm activity performance was only observed in patients who entered the study with better arm performance.

The findings emerging from the mobility part of the current randomized controlled trial[34] support the efficacy of task-oriented practice in enhancing functional walking capacity and walking speed within the first year following stroke.

The present study, therefore, focused on a less intensive task-oriented intervention (90-min sessions, three times a week for six weeks) that required a more realistic time commitment. The study included subjects in the chronic phase after stroke with no minimal criteria for movement in their affected arm and used measures of impairment as well as measures of activity limitation such as the TEMPA. The objective of the study was to evaluate the efficacy of task-oriented training in enhancing arm function post stroke. The hypothesis tested was that people who received a six-week programme of arm training would improve their arm function to a greater extent than people who received a walking intervention.

Materials and methods

The results of the present study emerge from a randomized controlled trial designed to evaluate the efficacy of a task-oriented intervention in improving walking competency in people with stroke (walking group).[34] A parallel objective was to evaluate the efficacy of task-oriented training in enhancing arm function post stroke (arm exercise group). The study was designed in parallel and it was powered accordingly, taking into account the two primary hypotheses related to the effect of task-oriented training on arm and walking function.

Subjects

A total of 91 subjects entered the trial between May 2000 and February 2003. Subjects were recruited from nine hospitals and two rehabilitation centres in Montreal or Quebec City. Randomization within each site was separate. Patients included in the study met the following criteria: (1) clinical diagnosis of a first or recurrent stroke, (2) residual walking deficit, (3) a minimum score of 14 out of 22 on the telephone version of the Mini-Mental State Examination,[35] (4) ability to walk 10 m independently, with or without supervision or aid, (5) sufficient language ability to follow testing procedures, (6) living in the community, (7) discharged from physical rehabilitation, and (8) less than 1 year post stroke at the time of recruitment. Patients were excluded if they had: (1) neurological deficit related to metastatic disease, (2) recovery of functional walking capacity defined by age- and gender-specific norms[36] on the Six-Minute Walk Test[37] (SMWT), (3) discharge to a long-term care facility, or (4) comorbid conditions that precluded participation in arm or walking training. All participants provided voluntary, written consent to take part in this study. This study was approved by the Institutional Review Board of McGill University as well as by the ethics committees of individual hospitals and rehabilitations centres from which patients were recruited.

Design

Forty-seven subjects were randomized to receive arm training and 44 were randomized to receive mobility training. Subjects were stratified at baseline as having a mild, moderate or severe walking deficit based on their comfortable gait speed in order to proceed with a permuted block randomization to avoid imbalance in the number of subject randomized to each group. The allocation sequence was randomly ordered in block sizes of two and four within each stratum. People not involved in the study placed the treatment group allocations in envelopes and sealed them. The evaluator opened the appropriate envelope only once the baseline evaluation had been completed.

Evaluations were conducted at baseline and on completion of the intervention by trained evaluators. During this three-year study, eight physical, occupational or exercise therapists served as evaluators. To be an evaluator, these therapists

underwent a 3-h training session in the administration of the study measures employed and were provided with an instruction manual. As well, review sessions were conducted every six months. When conducting postintervention evaluations, raters were unaware of the subjects' group assignment. Participants were advised not to mention their group assignment to the evaluator.

Measurement – measures of arm activity limitation (capacity)

The Box and Block Test[38]

A test of gross manual dexterity was used as the main outcome in the study. The measurement scale (quasi-continuous) is the number of blocks a subject can move from one compartment of a box to another within 1 min. A normal value for people in the age-group of the present sample is approximately 67 blocks.[39] The Box and Block Test has been shown to have good test–retest reliability,[38] and test performance correlated highly with performance on a similar test of dexterity.[39] Test–retest reliability and construct validity of this instrument in an elderly population with arm impairment has been demonstrated.[39] Furthermore, the Box and Block Test is a significant predictor of physical health as measured by the SF-36 (Medical Outcomes Study 36-Item Short from Questionnaire) with a difference of seven blocks associated with a difference in physical health of two units; for a difference of five units on the physical component summary score of the SF-36, the corresponding clinically meaningful difference was 17.5 blocks.[40]

The Nine-Hole Peg Test[41]

The Nine-Hole Peg Test was used to measure fine manual dexterity. The time for a subject to place nine dowels into nine holes on a board and remove them is recorded. High inter-rater reliability and moderate test–retest reliability have been demonstrated and norms for adults up to 75 years of age and above for both genders were established.[42] The time to complete the test was recoded into four ordered categories defined by the number of SD units they were from age- and gender-specific norms. Scores within 1 SD of the normal value were assigned a value of 3, the value decreasing by 1 point for each additional SD away from the normal value. Scores that were 4 SDs or more away from the normal value were assigned a value of 0.

The TEMPA (Test d'Evaluation des Membres supérieurs des Personnes Agées)

This test was developed by Desrosiers and coworkers[43] to evaluate activity performance of the arms in individuals over the age of 60. It contains four unilateral and five bilateral functional tasks. Normative data have been published for this population.[44] Both speed of execution and quality of the movement were analysed for this study. Scores for the timed tasks of the TEMPA were recoded into four ordered categories, defined by the number of SD units they were from age- and gender-specific norms.[44] Scores within 1 SD of the normal value were assigned a value of 3, the value decreasing by 1 point for each additional SD away from the normal value. Scores that were 4 SDs or more away from the normal value were assigned a value of 0. Scores on the functional rating scale of the TEMPA that reflect movement quality were transformed into an ordinal scale from 0 to 3, with 0 representing lowest quality.

Measurement – measures of arm impairment

Grip strength

Three grip strength measures of each hand were taken using the Jamar dynamometer (Sammons Preston Rolyan, Bolingbrook, IL, USA) with standardized positioning and instruction.[45] The highest score was retained. The measurement scale (kilograms of force) is continuous. Good inter-rater and test–retest reliability have been observed using these procedures.[46]

The upper extremity subscale of the Stroke Rehabilitation Assessment of Movement (STREAM)[47]

The Stroke Rehabilitation Assessment of Movement consists of 30 items, equally divided into three sections: voluntary movement of the arm, voluntary movement of the lower extremity and basic mobility. Only the arm subscale was used in this investigation. The total score was transformed to a percentage, making it a quasi-continuous scale. A study by Daley and colleagues reported content validity and excellent inter-rater and intrarater reliability.[48]

Measurement – indices of arm activity limitation (capacity)

The Barthel Index[49]

This is a weighted scale that assesses performance in self-care and mobility. Only responses for items requiring use of the arm (feeding, personal hygiene, bathing and dressing/undressing) were analysed. Items are scored on an ordinal scale. Two items are scored out of 5 and two are scored out of 10 resulting in a maximum summative score of 30.

The Older Americans Resources and Services Scale – Instrumental Activities of Daily Living (OARS-IADL)[50,51]

Each item is scored on an ordinal scale from 0 to 2, a higher score indicating a higher level of performance. Only responses to two items relating to the use of the arm were analysed (meal preparation and housework).

The Medical Outcomes Study 36-Item Short form Questionnaire (SF-36)[52]

This is a commonly used health-related quality of life measure. The two arm-related questions that were analysed (grocery carrying and bathing/dressing) are scored on an ordinal scale from 1 to 3, where higher scores indicate better functioning.

The Geriatric Depression Scale[53]

This was used to classify individuals as having no (0–9 points), mild (10–19 points) or severe (20–30 points) depressive symptoms. Sociodemographic and clinical information was obtained from the medical chart.

Interventions

Arm intervention

Subjects in both groups participated in 18 practice sessions three times a week for six weeks and were supervised by either a licensed physical or occupational therapist. The intervention took place in a research area within a rehabilitation setting. Therapy was administered to subject on a one to one basis with the therapist. Each session lasted approximately 90 min. At the start of the intervention, subjects were asked to identify daily activities that were difficult to perform and that they wanted to improve. Providing patients had sufficient movement in their more affected arm to attempt the functional tasks, they were practised. Examples of such tasks included manipulating playing cards, clothes pins as well as writing exercises. For three subjects who did not have sufficient movement in their more affected arm to practise such tasks, the therapist assisted the person by guiding the limb through the tasks while applying other modalities such as vibration and passive range of movement to facilitate mobility and decrease spasticity. When subjects had maximized their performance, tasks were changed or their level of difficulty was heightened at the discretion of the therapist. Both the duration and level of difficulty achieved in each task were recorded at every session. All subjects were given a home programme to be done for a minimum of 15 min per day for the period of the intervention. The home programme consisted mainly of similar tasks to those practised during the intervention. Most of the therapy material was common objects found in most homes.

Walking intervention

The walking intervention consisted of 10 functional tasks designed to strengthen the lower extremities and enhance walking balance, speed as well as distance.[34]

Statistical methods

Data were analysed on the basis of intention to treat. In the primary analysis, the chi-squared test was used to compare between groups the proportion of subjects who deteriorated, remained the same, improved between one and six blocks, or improved more than six blocks on the Box and Block Test. The effect of arm training on the remaining tests of arm impairment, activity limitation and performance was also evaluated. Group comparisons were made using a t-test for independent samples with associated 95% confidence intervals (CIs) for variables measured on a continuous scale and the Wilcoxon rank sum test for variables measured on an ordinal scale. T-tests and Wilcoxon rank sum test were also done on the change scores between groups. Transformations of scores on the Nine-Hole Peg Test and TEMPA were performed as these tests are scored on an ordinal scale (TEMPA) or on a continuous scale

without a natural zero (TEMPA, Nine-Hole Peg Test). Scores for these tests were transformed into four ordered categories defined by the number of standard deviations away from the normal values (see Measurement section).

Multiple linear regression was then used to identify and adjust for prognostic variables to enhance the accuracy of estimation of the arm training effect on change in Box and Block Test scores. With the indicator variable for group in the model, the effect of adjusting for age, sex, level of depressive symptoms, hand dominance, previous stroke, number of comorbid conditions and type of stroke on change in Box and Block Test as the outcome or 'y' variable was examined. Because the analysis carried out on the mobility outcomes revealed an interaction between treatment group and level of depressive symptoms,[54] we also examined this interaction in our data set.

Lastly, the effect size of the present study, based on the Box and Block Test was calculated by dividing the mean difference in the change score between the experimental and control groups by the standard deviation of the initial score of the control group.

Sample size

As this study had two hypotheses, one related to the effect of walking competency training where the primary outcome was the Six-Minute Walk Test and a second related to the effect of upper extremity training where the primary outcome was the Box and Block Test, two sample size estimates were required. For the first hypothesis related to the waking intervention, the sample size calculation was based on the detection of a group difference of 28 m in average change in Six-Minute Walk Test performance (type I error = 0.05, type II error = 0.10, expected drop-out rate of 10%). This calculation emerges from results of a pilot trial of a similar intervention (group difference on Six-Minute Walk Test = 37 m, SD = 30.4).[32] It was calculated that 60 people were required.[34] For the second hypothesis, related to the subject of this article, the effect of the upper extremity intervention, 60 subjects would yield 90% power to detect a between-group clinically meaningful difference of 17.5 blocks using the Box and Block Test, assuming within-group standard deviation of 20.[55] To account for drop-outs and the simultaneous testing of two hypotheses, we targeted 90 subjects for this study.

Results

Description of the study population

As previously noted,[34] 344 of the 1056 patients assessed for eligibility met the eligibility criteria. A total of 91 subjects agreed to participate and provided written, informed consent (85 in Montreal and six in Quebec City). Forty-seven subjects were randomized to the arm intervention group and 44 to the walking group. Both groups were similar in terms of their baseline characteristics. They are presented in Table 1. Out of the 47 participants in the arm intervention group, three people were missing at postintervention evaluations due to illness. In the mobility group,

Table 1 Demographic and clinical characteristics of study participants

Subject characteristic	Arm group ($n = 47$)	Walking group ($n = 44$)
Age, mean (SD)	73 (8)	71 (12)
Gender, no. (%) male	30 (64)	26 (59)
Number of comorbid conditions, no. (%)		
0	3 (6)	2 (5)
1–2	19 (40)	13 (30)
3–4	18 (38)	17 (39)
>4	7 (15)	12 (27)
Type of stroke, no. (%)		
Ischaemic	36 (77)	40 (91)
Haemorrhagic	11 (23)	4 (9)
Number of strokes, no. (%)		
1	41 (87)	39 (89)
2	5 (11)	5 (11)
4	1 (2)	0
Side of hemiplegia, no. (%)		
Right	22 (47)	17 (39)
Left	24 (51)	27 (61)
Bilateral	1 (2)	
Dominant arm affected, no. (%)	25 (53)	30 (68)
Days post stroke at first evaluation, mean (SD)	217 (73)	239 (83)

SD, standard deviation.

two subjects withdrew due to pain or unwillingness to travel.

Subject compliance

In the arm group, 72% (34) of the subjects attended 17 or 18 treatment sessions, four (9%) discontinued the treatment (Figure 1), four (9%) attended between 10 and 16 sessions and five (11%) were given a home programme. In the walking group, 86% (38) participated in 17 or 18 treatment sessions, three (7%) discontinued the intervention (Figure 1) and three (7%) attended between 12 and 14 sessions.

Figure 1 presents the flow of participants through the study. Postintervention data were missing for three people in the arm group due to illness ($n = 3$) and for two people ($n = 2$) in the walking group (one person unwilling to travel and one person experienced onset of groin pain preventing participation in therapy). One person was unable to complete the SF-36 at the postintervention evaluation due to aphasia. One person was missing grip strength measurements at the postintervention evaluation. The method of last value carried forward was used to replace these missing data as it was thought that an illness or any other reasons why the data were missing would not have a direct impact on their arm function. In a clinical setting such as this one, when recovery is expected, this method can be regarded as conservative.[56] The TEMPA, the OARS-IADL as well the Barthel Index, were missing for six subjects. Values for these participants were estimated from baseline and postintervention scores on the Box and Block Test using simple linear regression. This same method was use for baseline grip strength measurements which were missing for one person.

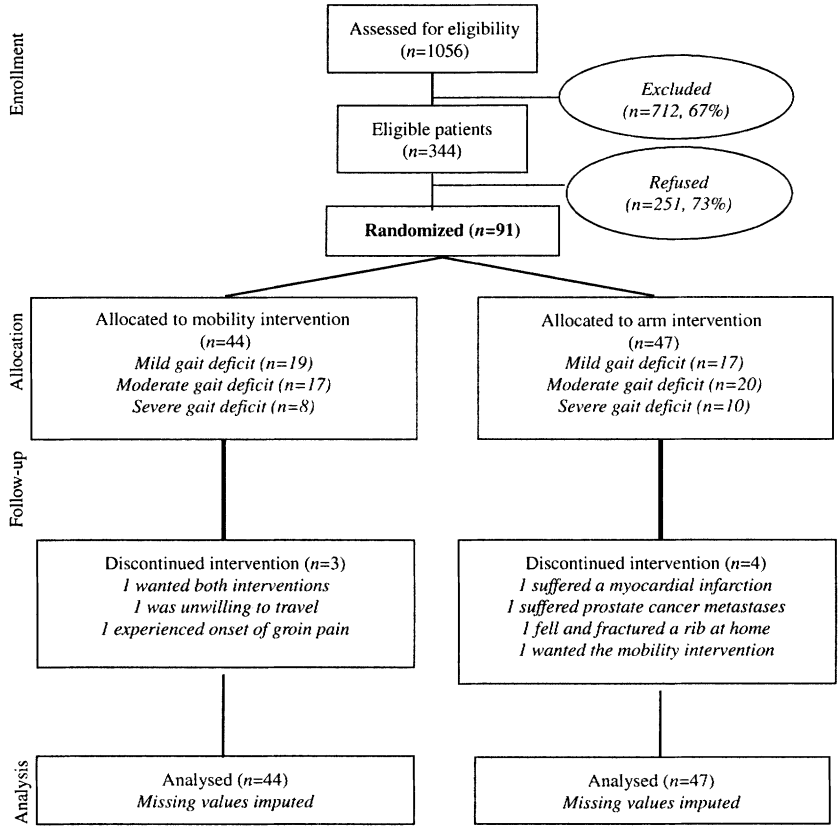

Figure 1 Flow of subjects through the trial.

Measures of arm activity limitation (capacity)

Table 2 presents the proportion of subjects in each group who, on the Box and Block Test, deteriorated, remained the same, improved between one and six blocks, or improved more than six blocks. There were no differences between the two groups on the proportions of persons in these categories. ($\chi^2 = 3$, df = 0.9, $P = 0.818$).

Table 3 presents the scores on measures of activity limitation and impairment at baseline and post intervention for both treatment groups. Members of the arm group improved their score on the Box and Block Test by an average of one block more than members of the mobility group. This improvement is not significant and is not clinically relevant. Little or no change in scores was observed on the Nine-Hole Peg Test and the TEMPA in each group between the initial and postintervention evaluations.

Measures of arm impairment

Members of the arm intervention group improved their grip strength by an average of 0.5 kg more than the mobility group members. Again, this improvement was not significant and is not considered clinically important. Members of both study groups improved by an average of 3 points on the arm subscale of the Stroke Rehabilitation Assessment of Movement, resulting in a between-group difference of zero.

Indices of arm activity limitation (capacity)

Table 4 presents the proportion of members in each of the intervention groups who improved on each of the indices of arm activity limitation (capacity). Improvement was defined as having gained at least one point on an index. Again, there were no differences between the two intervention groups on the proportions of people who improved for any of the questions.

Table 2 Change in score on the primary outcome measure: the Box and Block Test

Change in Box and Block Mean change (no. of blocks)	Arm group ($n = 47$) No. (%)*	Walking group ($n = 44$) No. (%)*
< 0	11 (24)	10 (23)
0	10 (21)	12 (27)
1–6	14 (30)	14 (32)
7–15	12 (26)	8 (18)

*$\chi^2 = 3$, df = 0.9; $P = 0.818$.
df, degrees of freedom.

Change in indices of performance

To explore factors contributing to change in arm function, we carried out a multiple linear regression with change in Box and Block Test as the outcome or 'y' variable and age, sex, depression, hand dominance, previous stroke, number of comorbid conditions and type of stroke as the predictors. The effect of these variables on outcome was examined one at a time with the indicator variable for group in the model.

In the multivariable analysis, none of the potential predictor variables, one at a time with group, was significantly associated with change in Box and Block Test so no further multivariate modeling was carried out. The interaction term with depression and group was also non-significant.

Lastly, the effect size for the present study, calculated using scores on the Box and Block Test is 0.06 (Figure 2).

Discussion

People assigned to receive a six-week programme of arm training did not improve their arm function to a greater extent than people assigned to receive walking training. The small differences observed on measures of arm impairment, activity limitation and performance in the arm training group between the baseline and the postintervention evaluations were not statistically significant or clinically meaningful. On the Box and Block Test, for example, an average gain of three blocks was observed in members of the arm group, but an improvement of at least seven blocks is necessary to translate to improve daily physical functioning.[40] The change on other measures of activity limitation, such as the Nine-Hole Peg Test and the Test d'Evaluation des Membres supérieurs des Personnes Agées (TEMPA), was also clinically unimportant for both treatment groups. Although data on the minimal clinically important change are unavailable for the Nine-Hole Peg Test or the TEMPA, a change of less than 1 point out of a possible 4 did not appear clinically relevant.

Table 3 Scores on measures of arm impairment and activity limitation

Measures	Arm training ($n = 47$)			Walking training ($n = 44$)			Group difference
	Mean	*SD*	*Median (quartiles)*[a]	Mean	*SD*	*Median (quartiles)*[a]	
Activity limitation							
Box and Block Test (no. blocks)							
Pre	26	16	31 (9, 38)	26	18	30 (6, 40)	
Post	29	17	34 (16, 43)	28	19	32 (5, 41)	
Change	3	5	3 (0, 7)	2	5	1 (0, 5)	1 (−1–3)
Nine-Hole Peg Test /3							
Pre	1	1	1 (0, 1)	1	1	1 (0, 1)	
Post	1	1	1 (0, 1)	1	1	1 (0, 1)	
Change	0	0	0 (0, 0)	0	0	0 (0, 0)	$P = 0.6$[b]
TEMPA /27 (timed tasks)							
Pre	9	3	9 (7, 11)	10	4	10 (7, 14)	
Post	9	3	9 (7, 11)	10	4	10 (7, 12)	
Change	0	2	−1 (−1, 3)	0	2	0 (−1, 0)	$P = 0.1$[b]
TEMPA /27 (FR)							
Pre	19	6	19 (13, 25)	19	7	21 (12, 26)	
Post	20	7	22 (14, 26)	19	7	20 (12, 27)	
Change	1	3	1 (−1, 3)	0	3	0 (−1, 1)	$P = 0.2$[b]
Impairment							
Grip strength (kg)							
Pre	16	10	16 (6, 24)	17	12	17 (8, 25)	
Post	17	11	17 (8, 24)	18	12	18 (10, 26)	
Change	1	5	1 (0, 4)	1	4	0	0.5 (1.3–2.4)
STREAM (arm subscale /100)							
Pre	74	30	85 (60, 100)	71	34	88 (58, 100)	
Post	76	30	90 (60, 100)	74	34	95 (50, 100)	
Change	3	7	0 (0, 10)	3	9	0 (0, 5)	$P = 0.9$[b]

CI, confidence interval; SD, standard deviation; BI, Barthel Index; TEMPA, Test d'Evaluation des Membres supérieurs des Personnes Agées; FR, functional rating; STREAM, Stroke Rehabilitation Assessment of Movement.
[a]25th, 75th percentiles.
[b]Wilcoxon rank sum test.

Table 4 Comparison of the two groups on proportions of people who improved on indices of arm activity limitation (capacity)

Indices of arm activity limitation	Arm group $n = 47$ No. (%)	Walking group $n = 44$ No. (%)	$\chi^2 = 3$, df (P)
OARS IADL			
Meal preparation	9 (19)	10 (23)	0.2 (0.675)
Housework	6 (13)	10 (23)	1.6 (0.212)
SF-36			
Grocery carrying	10 (21)	12 (27)	0.4 (0.504)
Bathing/dressing	10 (21)	16 (36)	2.5 (0.111)
Barthel Index			
Feeding	7 (15)	11 (25)	1.5 (0.226)
Personal hygiene	6 (13)	6 (14)	0.0 (0.902)
Bathing	3 (6)	3 (7)	0.0 (0.933)
Dressing/undressing	10 (21)	7 (16)	0.4 (0.512)

OARS-IADL, Older American Resources and Services Scale-Instrumental Activities of Daily Living; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; df, degrees of freedom.

Finally, changes of 1 and 0 points out of a possible 27 on the functional rating scale of the TEMPA were not meaningful to improve performance on activities of daily living. The changes observed on the measures of arm impairment as measured by grip strength were negligible. On the Stroke Rehabilitation Assessment of Movement the change was 3 percentage points for both groups, which was not considered clinically meaningful. The three indices of arm performance did not reveal any statistically significant differences between the two treatment groups (Table 4). The tendency for people in the walking group to have improved their arm performance, especially in

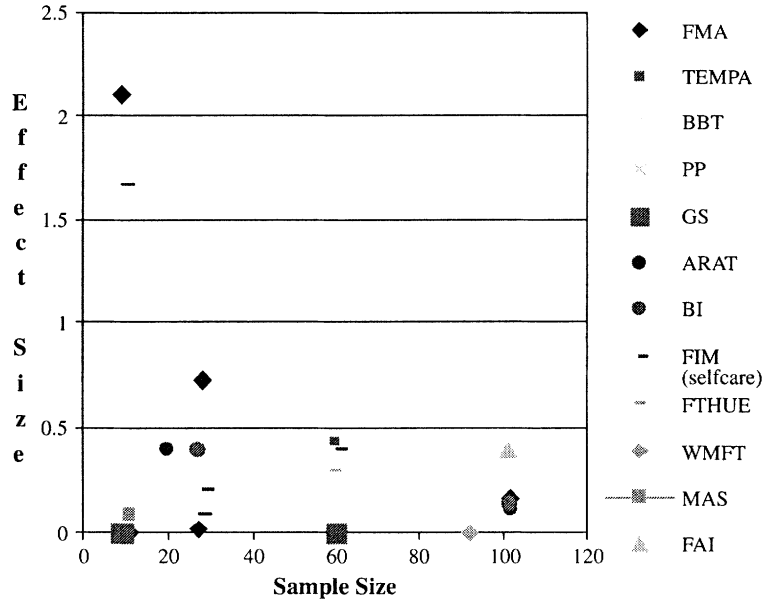

Figure 2 Effect sizes in relation to samples sizes of 12 randomized controlled trials. BBT, Box and Block Test[21] (present study); PP, Perdue Pegboard[32]; GS, Grip Strength[22,32]; TEMPA, Test d'Evaluation des Membres supérieurs des Personnes Agées[23]; FMA, Fugl-Meyer Assessment[22]; ARAT, Action Research Arm Test[16,18–21,33]; BI, Barthel Index[16,29]; FIM, Functional Independence Measure[18,22]; FTHUE, Functional Test of the Hemiparetic Upper Extremity[22]; WMFT, Wolf Motor Function Test[33]; MAS, Motor Assessment Scale[21]; FAI, Frenchay Activities Index.[31]

more integrated tasks that require use of both the arm and the lower extremity (e.g. carrying groceries, meal preparation and housework), may have masked a beneficial effect of task-oriented arm training. These results also support the task-specific effect of the walking and carrying task practised in the walking intervention and the efficiency of training the arm and lower extremity simultaneously to improve specific functional activities.

In 2001, van der Lee *et al.*[57] reviewed several randomized controlled trials aimed at evaluating the effects of rehabilitation; more specifically exercise therapy, for arm function. Although positive results were reported for six trials, the amount of therapy offered to the intervention and control groups sometimes differed and thus the observed results are inconclusive. In 2001, van der Lee *et al.*[58] reviewed the evidence from three randomized controlled trials that used this therapeutic approach and found that the evidence was inconclusive and that positive results may have been attributable to an increased amount of therapy on the more affected arm than the effects the constraint of the less affected arm. When the possibility of decreasing the amount of therapy given in a standard CIMT protocol from 6 h to 3 h a day was explored,[59] researchers found increased arm performance in both groups but the treatment effect was greater for the 6 h per day group. It is important to note that even by decreasing the number of hours from 6 to 3, the total time of treatment is still almost double the one in the present study.

Figure 2 presents effect sizes relative to the sample size of several randomized controlled trials aimed at evaluating different rehabilitation techniques to improve arm function post stroke.[16,18–23,29,31–33] Effect sizes were calculated from results of postintervention evaluations just as in the present study. Some of these studies will be discussed below. In one of the studies using training as the intervention under investigation,[22] 20 h of additional training of the arm were offered to the experimental group. The latter improved more than the standard care group but the long-term benefits were significantly greater among people with mild arm deficits. In another study[32] in which the treatments were offered three times a week for four weeks (similar to the present study), researchers found, on average, no significant difference between the experimental and control groups in grip strength or dexterity at the post-training or follow-up evaluation. A third study[33] examined the effect of therapeutic exercises in subacute stroke. The intervention consisted of 36 intervention sessions of 90 min each over a 12- to 14-week period. An improvement in arm performance was only observed in subjects with mildly affected arm function upon entry into the study. The results of this study do not appear to agree with those of the author's earlier study in which it was found that the arm and lower extremity had similar recoveries.[8] Looking at Figure 2, it is apparent that studies with the smallest sample sizes are the ones that demonstrated the largest effect size. This may be an indication that in these particular studies, patients selected to participate were the ones with at least minimal movement in their arm and hand which is known to be a good precursor for improvement in arm performance.

In the present study, the intervention was limited to 90-min sessions, three times per week, for six weeks, not including the home exercise programme of 15 min a day. Also, we did not select patients based on their arm function at baseline and thus subjects with a wide range of arm dysfunction were included, over 16% (15) of patients were unable to move a single block using their more affected arm at the start of the study and none of these patients were able to move a single block at the postintervention evaluation. Furthermore, 30 subjects (68%) in the walking group had their dominant arm affected versus 25 subjects (53%) in the arm training group. Although a statistically significant difference was not detected between the two groups, this difference may have contributed to people in the walking training group using their affected arm more in everyday life and thus improving their performance despite not receiving therapy as part of the study. The noteworthy findings showing a tendency for the mobility group to have improved more on the indices of arm performance (OARS-IADL and SF-36) may also indicate that these subjects were using their arm in some of the tasks (holding on the railing for step-ups and for treadmill walking, carrying and walking) and this may have partially contributed to the gains in arm function observed.

Future research should include more intensive intervention that lasts for a longer period of time that also includes bilateral meaningful activities that integrate both the upper and lower extremities. Treatment should focus on the performance of activities of daily life and be based on integrated tasks requiring the simultaneous use of both arm and lower extremity, including use of meaningful objects as this has been shown to have a positive effect on the performance of tasks.[60] A major challenge still remaining is the treatment of those individuals whose arm is severely affected and cannot participate in task-oriented activities. There may be a need for the development of a different treatment strategy for individuals who have very little or no movement in their arm and the restrictia of task-oriented programmes to individuals who have some arm movement and dexterity at baseline.

Limitations

One of the limitations of this study is that we did not stratify on level of arm deficit. It was also difficult to challenge and motivate patients for whom no active movement of the affected arm was present. For these patients, vibration and assisted movements were clearly insufficient to improve function over the relatively short period of the study intervention. A specific intervention, tailored to their needs would have been required. Although the outcome measures used spanned a wide range of ability levels from impairment to activity performance, the sensitivity to change of the TEMPA, situated at the higher end of the ability scale, has not yet been demonstrated in a chronic stroke population. It may not have been useful for detecting small changes at the level of fine manual dexterity and higher level performance tasks. Questionnaires, such as the Motor Activity Log (MAL), on the amount of use of the affected arm in everyday life may have been useful to detect changes in behaviours not always associated with a large improvement in motor ability.

Clinical messages

- An improvement in upper extremity function was not observed after a task-oriented intervention in the first year post stroke.
- An intervention geared to those who present with a severely affected arm is required.
- Sensitive outcome measures are needed in order to detect small changes occurring at the level of arm performance.

Conclusion

The task-oriented intervention did not improve arm function. In fact, although not statistically significant, greater improvement on the indices of arm performance in the mobility group seems to indicate that the performance of integrated functional tasks may be more beneficial. This study also indicates that for people with no initial movement in their arm, very little gain is to be expected with therapies now in use.

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