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Improving upper extremity function in chronic stroke using occupational therapy task-oriented approach

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ABSTRACT

Background: Recovery of upper extremity function in chronic stroke requires functional rehabilitation.

Objectives: The objective of this study was to investigate the effects of task-oriented occupational therapy on the upper extremity function of chronic stroke clients.

Materials and methods: Twenty participants were selected for the study, which was carried out through purposeful sampling process. The participants were then divided into two groups: the intervention and the control groups. Both groups were given a conventional rehabilitation program. The intervention group was also provided with occupational therapy task-oriented training within the duration of 6 weeks, with the consistency of 3 sessions a week, and 1 hour each session. The training program was individually designed based on an analysis of the three most important activities identified by the participants from the Canadian Occupational Performance Measure (COPM). Each training session consisted of task-oriented training (75%) and supplementary exercise (25%). The Functional Test of the Hemiparetic Upper Extremity-Thai version (FTHUE-Thai Version) and COPM were used as outcome measurements before and after the training programs.

Results: The FTHUE-Thai version study showed that the intervention group had significant improvement in the function of paretic upper extremity (p<0.05). The COPM's report found a dramatical change in performance and satisfaction of the intervention group after the training program (p<0.05). These changes were also significantly different when compared between groups (p<0.05).

Conclusion: This study indicated the effect of occupational therapy task-oriented training based on client-centered approach on improving functions of paretic upper extremities, occupational performance, and satisfaction in people with chronic stroke.

Introduction

A stroke is a major health problem that can cause disability and deaths globally.[1-3] The effects of stroke vary depending on the size of the brain and the parts of the body that are affected. It can cause various types of disability. In most cases, one of these disabilities is paralysis of the upper extremity (UE).[4-5] Weakness of UE is particularly found in acute stroke patients (85%).[6] This condition is remained in chronic stroke (more than 40%).[5,7] This impacts on a person's ability to perform their daily activities and community participation.

There are two recovery methods after a stroke: spontaneous neurological recovery and functional recovery. Neurological recovery can be accelerated up to 3 months after a stroke.[8] Meanwhile, functional recovery can happen several years after a stroke.[7,9] It is the vital recovery for stroke clients in improving their ability to perform daily functions within the limitations of their physical impairment.[10] For better

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improvement of functional recovery of UE in clients with chronic stroke, rehabilitation focusing on motor impairment and disability was necessary.[11] Some neurorehabilitation techniques are useful in promoting upper extremity motor recovery; for example, stretching, constraint-induced movement therapy, task-specific training, mirror therapy, mental practice with motor imagery, etc.[8,12]

Task-oriented (TO) approach is a neurorehabilitation technique that involves practicing real-life tasks. It is based on motor control, motor learning, and motor behavior model.[13] This approach is wildly used in stroke rehabilitation by multidisciplinary team as well as in research.[14-18] A great number of evidence is focused on the effectiveness of TO training for UE after stroke. TO approach alone or in combination with other treatment approaches can help restore UE function after stroke.[12,19] A systematic review in 2014 suggested that high intensity TO practice may improve UE function after stroke, though further investigation is needed.[20] However, the recommended intensity of TO practice is performing occupational tasks taking up 70% of therapy time. The remaining time is spent on other components enhancing motor performance.[21] A study conducted by Timmermans, Spooren, Kingma, and Seelen[22] revealed that the number of training components used in TO training was not associated with the treatment effect size. This meant that the numbers of training used in TO training was not relate with UE functional recovery. However, the components of TO training that had the great impact on the outcomes were distributed practice and feedback. Also, random practice and using of clear functional goals had an influence on the training outcomes.

The concept of occupational therapy is focused on the notion of human occupations. Occupation itself is used as therapeutic occupation and occupational outcome.[23] To improve UE function in clients with stroke, TO approach concurs with the core concept of occupational therapy. The goal of occupational therapy task-oriented (OT-TO) approach is to improve the client's performance in specific tasks. Apart from having the same principles as the TO approach, it is also based on client-centered approach by emphasizing the relationship between clients, tasks, and environments.[24] Therefore, clients' role and occupational performance task are required for designing various and specific training that fits to the individual needs.[24] The study of a randomized clinical trial aiming to evaluate functional and impairment efficacies of OT-TO approach on the affected UE of persons after stroke 3 months onset showed that impairment outcomes of the OT-TO approach were not significantly larger than the control ones. In contrast, OT-TO approach seems to be an effective post-stroke rehabilitation strategy that can improve functional status and reduce chronicity and severity of stroke. Further studies are needed to analyze the effects of OT-TO approach on stroke patients.[17] In Thailand, there is no research evidence on OT-TO approach even though Thai occupational therapists have provided stroke clients with intervention specific to their real-life activities so far. Therefore, this study aimed to investigate the effect of using OT-TO approach on UE function in clients with chronic stroke.

Materials and methods

This study was a quasi-experimental research with a two-group pretest-posttest design. Participants, outcome measures, intervention, procedure, and data analysis were described accordingly.

Participants

Sample size was calculated by using G*power 3.1 based on effect sizes of Almhdawi's study[17] (α=0.05, power test=0.80). Eighteen participants were the calculated number of participants. Ten percentage of drop out is added to calculated number of sample size. Total number of participants in this study will be 20 participants: intervention group (N=10) and control group (N=10). Research project was approved by the Ethics Committee, Faculty of Associated Medical Sciences, Chiang Mai University, Thailand. The ethics clearance number was 341/2561.

To recruit participants for the study, they had to meet the following inclusion criteria: first stroke at least 6 months onset, age range between 17-80 years, no sign of dementia (Mini- Mental State Examination-Thai version; MSET-10>17 for participants whose education level were primary school; and >22 for participants whose education level were higher than primary school), Modified Ashworth Scale <3, Fugl-Meyer Assessment Upper Extremity (FMA-UE) score 32-52. They were excluded if they had at least one other condition that affected training including seizer, UE fracture and deformity, visual field deficit, body neglect, sensory loss, and aphasia. All participants were asked to postpone other treatments affecting muscle tone e.g., botulinum toxin injections, splinting, and acupuncture.

Outcome measures

The functional outcome measures included the Canadian Occupational Performance Measure (COPM) and the Functional Test for Hemiplegia Upper Extremity in Persons with Hemiplegia Thai version (FTHUE-Thai version). The COPM serves as a self-perceived measure aiming to assesses the level of occupational performance and satisfaction with performance for each of the five problems identified by stroke clients.[25] The COPM has shown good psychometric properties in Thai stroke patients.[26]

The FTHUE-Thai version is a performance test to measure the functional limitations of UE impairments. It was adapted from the FTHUE-Hong Kong version, of which activities were closer to Thai culture than the original FTHUE.[27] The test consists of 14 tasks, from the total of 7 functional levels. The tasks are arranged from less to more complex motion. Each activity is scored on pass/fail basis. A "pass" (score=1 point) means that the participant successfully completes the task within three minutes whilst a "fail" (score=0 point) means that the participant could not complete the activity or exceeded the allowed time. The score is reported as the number of passed activities. The score of functional levels could be counted when all the activities in each level could be achieved. Also, spending time for completing each activity is measured in the 7 out of 14 activities. The FTHUE-Thai version has shown good content validity and strong inter-rater reliability.[28]

Intervention

Both groups received the usual rehabilitation training, which usually consists of occupational and physical therapy. The intervention group also trained with the OT-TO approach. A video about OT-TO training was used to gain a good understanding about OT-TO approach to generate collaboration throughout the program in the intervention group. Training tasks were identified by participants from the COPM and analyzed to fit with individual performance. The intensive training consisted of 3 significant activities that were designed to fit with the client's needs. The intervention took one hour to complete which included OT-TO training taking up 75% of therapy time. The remaining 25% of the time was spent on supplementary training due to the client's impairments and interests such as range of motion exercise, spasticity management, strengthening exercise, and grasp-carry-release objects. The training program was undergone 3 times a week for 6 weeks consecutively. Objects and materials used in the training program were real. Furthermore, environments where occupations occurred were set to be as real as possible. To improve problem solving and learning skills in motor function, physical guidance and verbal feedback was provided at the beginning of each task which included controlling and correcting movement direction. The guidance and feedback were faded out when participants got used to the task. Admiration and encouragement were also provided for promoting positive reinforcements and motivations.

Procedure

Twenty participants who met the inclusion criteria were invited from 6 hospitals and rehabilitation centers in Chiang Mai Province, Thailand. Participants were divided into two groups; intervention (n=10) and control (n=10) groups, based on their preferences. Furthermore, age, chronicity, MSET-10 score, FMA-UE score, and the center where they normally received rehabilitation were concurred between groups. All of them were asked to identify their occupational problems which resulted from stroke. They were asked to rate the importance of those occupational problems, as well as performance and satisfaction (COPM-Pretest). Then, FTHUE-Thai version was used to evaluate their UE motor functions (FTHUE-Pretest). After 6 weeks, their performances and satisfactions on those 3 activities (COPM-Posttest), and their UE motor functions (FTHUE-Posttest) were assessed. The assessments were carried out by the same blinded OTs assessor.

Data Analysis

The data was analyzed using a SPSS software version 26. Descriptive statistic was used to summarize demographic data. Multivariate analysis of variance (MNOVA) was used to test the homogeneity of the variables of age, chronicity, MSET-10 score, and FMA-UE score. Man-Whitney U test was used to compare the differences between the different group. Wilcoxon signed-rank test was also used to investigate the differences between pre-intervention and post-intervention within each group.

Results

In this section, the characteristics of the participants and the effect of OT-TO training on UE function were presented as follows.

Demographic and characteristics of the participants

Demographic and characteristics of the participants were presented in Table 1. The comparison of controlling factors between 2 groups were not significant difference as shown in Table 2.

Table 1 Demographic and characteristics of the participants.

Variable	Intervention group	Control group
Sample size *(N)*	10	10
Gender: *N (%)*		
Male	9 (90)	9 (90)
Female	1 (10)	1 (10)
Dominant side: *N (%)*		
Right hand	10 (100)	8 (80)
Left hand	0 (0)	2 (20)
Type of stroke: *N (%)*		
Ischemic	1 (10)	2 (20)
Hemorrhage	9 (90)	8 (80)
Affected side: *N (%)*		
Right hemiparesis	7 (70)	6 (60)
Left hemiparesis	3 (30)	4 (40)
Consciousness level: *N (%)*		
Alert	10 (100)	10 (100)
Muscle tone impairment		
MAS: *N (%)*		
- level 1	5 (50)	5 (50)
- level 1+	2 (30)	2 (20)
- level 2	3 (20)	3 (30)

Values are expressed as numbers (%), MAS: Modified Ashworth Scale (level 0, 1, 1+, 2, 3, 4)

Table 2 Univariate MANOVAs analysis demographic and characteristics of the participants.

Variable	Intervention group	Control group	F	*p* value
Chronicity (month):	36.60±6.56 (6-78)	43.50±8.07 (6-84)	0.440	0.515
Age (year):	48.70±2.96 (37-61)	56.50±2.38 (46-70)	4.223	0.055
Cognitive level				
MSET-10:	26.60±0.50 (23-28)	25.50±0.64 (22-29)	1.849	0.191
Sensorimotor function impairment				
FMA-UE:	40.40±1.92 (33-48)	39.90±2.11 (33-50)	0.031	0.863

Values are expressed as Mean±SD (min-max), MSET-10: Mental State Examination T10, FMA-UE: Fugl-Meyer Assessment Upper Extremity

Effect of OT-TO training on UE function

The comparison between pre and post-test was shown in Table 3. The results of the study found that there were significant differences (p<0.05) between pre and post-test of FTHUE and COPM scores in the intervention group whilst there were only significant differences (p<0.05) between pre and post-test of COPM scores in the control group.

Table 3 Results for functional outcome measures within group comparisons.

Independent variable	Pre-test Mean±SD	Post-test Mean±SD	Mean rank	Sum of rank	Z	Wilcoxon signed rank	*p* value
Intervention group							
FTHUE							
Function level	3.80±0.42	4.20±0.42	2.50	10.00	-2.00	10.00	0.046*
Activity level	6.50±0.85	7.40±0.84	3.00	15.00	-2.12	15.00	0.034*
COPM							
Performance	3.57±0.96	6.88±0.72	5.50	55.00	-2.81	55.00	0.005*
Satisfaction	3.27±1.16	7.5±1.13	5.50	55.00	-2.81	55.00	0.005*
Control group							
FTHUE							
Function level	3.90±0.32	3.90±0.32	0.00	0.00	0.000	0.000	1.000
Activity level	6.20±0.92	6.50±0.53	1.50	3.00	-1.34	3.000	0.180
COPM							
Performance	2.67±0.94	3.23±0.80	4.00	28.00	-2.410	28.000	0.016*
Satisfaction	2.53±0.76)	3.67±0.99	5.50	55.00	-2.814	55.000	0.005*

**Significant (p<0.05) for each analysis, FTHUE: Functional Test for Hemiplegia Upper Extremity in Persons with Hemiplegia, COPM: Canadian Occupational Performance Measure*

When comparing between intervention and control groups, there was no significant difference between both groups in pre-test scores either in FTHUE nor COPM. On the other hand, post-test scores were found to have significant differences (p<0.05) in activity level of FTHUE and COPM. (Table 4) In addition, there were significant differences in the change scores of performances and satisfaction of COPM between the intervention and control group (Table 5).

Table 4 Results for functional outcome measures between group comparisons.

Independent variable	Mean rank (Sum of rank)		Z	Mann-Whitney U	*p* value
	Intervention group	Control group			
Pre-test					
FTHUE					
Function level	10.00 (100.00)	11.00 (111.00)	- 0.610	45.000	0.739
Activity level	11.65 (116.65)	9.35 (93.50)	- 0.967	38.500	0.393
COPM					
Performance	12.85 (128.50)	8.15 (81.50)	-1.792	26.500	0.075
Satisfaction	12.65 (126.50)	8.35 (83.50)	-1.636	28.500	0.105
Post-test					
FTHUE					
Function level	11.90 (119.00)	9.10 (91.00)	-1.724	36.000	0.315
Activity level	13.50 (135.00)	7.50 (75.00)	-2.690	20.000	0.023*
COPM					
Performance	15.50 (155.00)	5.50 (55.00)	-3.807	0.000	0.000*
Satisfaction	15.50 (155.00)	5.50 (55.00)	-3.807	0.000	0.000*

**Significant (p<0.05) for each analysis, FTHUE: Functional Test for Hemiplegia Upper Extremity in Persons with Hemiplegia, COPM: Canadian Occupational Performance Measure*

Table 5 Changes score differences for functional outcome measures.

Independent variable	Changes score differences	Across categories of group		
	Mean±SD	Z	Mann-Whitney U	*p* value
COPM				
Performance				
Intervention group	3.32±0.94	-3.804	0.000	0.000*
Control group	0.57±0.45			
Satisfaction				
Intervention group	4.13±1.27			
Control group	1.13±0.36	-3.791	0.000	0.000*

**Significant (p<0.05) for each analysis, Changes score differences: mean treatment change score–mean control change score, COPM: Canadian Occupational Performance Measure*

Discussion

The objective of this study was to investigate if OT-TO training could improve the UE function of clients with chronic stroke. In this study, a higher-dosage of OT-TO training was provided to the participants with chronic stroke in the intervention group. The OT-TO training was provided 3 times/week for 6 weeks on top of the usual conventional rehabilitation whilst the control group received only the conventional rehabilitation. The result of the study indicated that OT-TO training could enhance UE functions which its effect was greater than the control group who received only the conventional rehabilitation. (Table 3 and 4) This highlighted the benefit of using OT-TO approach in improving UE functions in chronic strokes. However, the effect of

OT-TO training did not have the significant difference on the functional level of FTHUE-Thai version when comparing between intervention and control group. (Table 4) This might be the result of the FTHUE-Thai version criteria that could be counted as "pass" when all tasks in each functional level were accomplished. It might be difficult for the participants who had a chronic stroke to pass all tasks in each functional level.

Similar to other studies,[29-30] this study proved that UE function could be recovered after having acquired stroke for many years. The recovery in chronic stroke depended on learning adaptation strategies.[31] This study was in line with Almhdawi et al.[17], that OT-TO intervention had a positive effect on UE functions both objective and subjective performance outcomes (FTHUE and COPM scores). In this study, an intensive training with various activities could provide an opportunity for motor learning in client with chronic stroke with repeated multiple movement planes.[22,24] In addition, the intervention is based on a client centered approach whereas the participants' three most significant problems from COPM were used as training activities. Those activities were a goal-directed training that were carefully designed and graded to suit with participants' abilities. All these encouraged participants to repeat attempts in performing those activities. Furthermore, this study utilized real materials and instruments to provide participants with sensorimotor demands. Feedback was also provided throughout the intervention period to help performance improvement. All these enhanced behavioral experiences that directly replicated the sensorimotor demands requiring on an execution of the motor skill successfully.[32]

Interestingly, there were significant differences in performance and satisfaction scores of COPM in the control group after receiving the conventional rehabilitation for 6 weeks (Table 3) even though there were not much change in the FTHUE score of the control group. The evidence of systematic reviews supported the use of rehabilitation intervention for improving motor function and activities of daily living.[12,33] Hence, it was possible that participants in the control group would perceive better performance and satisfaction than prior conventional rehabilitation for 6 weeks. However, the changes on performance and satisfaction scores of COPM in the control group were not greater than those changes in the intervention group. (Table 5) Therefore, it demonstrated that the OT-TO training had the positive effect on performance and satisfaction higher than the conventional rehabilitation. This is because OT-TO approach is an individual directed intensive training for helping people to function as best as they can within the limitation of their conditions.[34]

Limitation and future research

Although this study supported the evidence that OT-TO training was a useful intervention for improving UE functions in chronic stroke. However, there were key limitations of this study. To organize efficient strategies for performance training, context-specific environment (supporting surface, people, room, etc.) was recommended to be equal or mimic the natural environment for a specific task execution.[24] The limitation of the study was that the training activities were performed at facilities that the participants received services from. Therefore, the environment where those activities occurred was set closely to the natural environment. It was difficult for the study to set specific environments for the training activities. The second limitation was distributed practice, which schedules the training program to relate with periods of time during the day of participants.[22,24] In this study, each research site had its own schedule. This means that it was difficult to set training activities to correlate with a certain period during the days.

Further research should be carried out to deliver training in the participants' home environment. This method would be applicable if the training is done in the community setting. A large group of participants is needed for the effective testing of the method. In addition, other outcomes should be added to confirm the improvement of UE functions such as magnetic resonance imaging and electromyography.

Conclusion

The impairment of UE functions in clients with chronic stroke is a priority to concerned for abilities of UE in performing activities. OT-TO training can promote the recovery of UE motor function in chronic stroke patients. It is a useful training that can encourage participants to participate in meaningful activity which relate to mental health and quality of life. The findings of this study provide guideline of using OT-TO practice for improving UE functions in clients with chronic stroke in Thailand.

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Conflict of interest

The authors declare that there is no conflict of interests.

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