

ผลเปรียบเทียบการฝึกระหว่างฝึกเป็นคู่และฝึกลำพังต่อการเรียนรู้ทักษะเรียงแก้วด้วยมือสองข้าง ในผู้ป่วยโรคหลอดเลือดสมอง

Comparative Effect of Dyad and Individual Training of Bimanual Cup Stacking on Motor Learning in Individuals with Stroke

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บทคัดย่อ

เนื่องจากการฝึกทักษะแบบเป็นคู่ในผู้ฝึกที่มีสุขภาพดีเป็นวิธีการฝึกที่มีประสิทธิภาพดีกว่าการฝึกลำพังหรือฝึกเพียงคนเดียว แต่ก็ยังเป็นข้อสงสัยอยู่ว่าการฝึกแบบเป็นคู่นี้สามารถนำไปประยุกต์ใช้กับการฝึกในประชากรกลุ่มอื่น เช่น ผู้ป่วยโรคหลอดเลือดสมอง หรือไม่ ดังนั้นในการศึกษานี้ทำขึ้นเพื่อทดสอบประสิทธิภาพของการฝึกแบบเป็นคู่ต่อการเรียนรู้ทักษะเรียงแก้วด้วยมือสองข้างในผู้ป่วยโรคหลอดเลือดสมอง และนำมาเปรียบเทียบกับประสิทธิภาพของการฝึกลำพังหรือการฝึกเพียงคนเดียวซึ่งเป็นวิธีการฝึกแบบปกติ ผู้ฝึกในครั้งนี้แบ่งออกเป็น 2 กลุ่ม กลุ่มละ 10 คน โดยทุกคนจะได้รับการฝึกทักษะการเรียงแก้วด้วยมือทั้งสองข้าง กลุ่มหนึ่งจะได้รับการฝึกเพียงลำพัง ส่วนอีกกลุ่มหนึ่งได้รับการฝึกแบบเป็นคู่ คือ ในขณะที่ผู้ฝึก 1 คนกำลังฝึกเรียงแก้วอยู่ ผู้ฝึกอีกคนหนึ่งจะได้นั่งพักและสังเกตการเรียงแก้วของคู่ที่ฝึกร่วมกับตนเอง จากนั้นจะสลับกันฝึกระหว่างผู้ฝึกทั้งสองไปเรื่อยๆ ผู้ฝึกทุกคนจะได้รับการฝึกในวันแรกจำนวน 20 ครั้งและกลับมาทดสอบอีกครั้งในวันถัดไปจำนวน 10 ครั้ง โดย 5 ครั้งแรกผู้ฝึกจะไม่ทราบเวลาในการเรียงแก้วของตนเองหลังการฝึกเพื่อศึกษาความสามารถในการจดจำ และอีก 5 ครั้งถัดมาจะทราบเวลาในการเรียงแก้วหลังการฝึกแต่ละครั้ง (เหมือนการฝึกในวันแรก) เพื่อศึกษาการเรียกคืนความสามารถการเรียงแก้ว ตัวแปรตามของการศึกษานี้คือ เวลาที่ใช้ในการเรียงแก้ว ผลการศึกษาพบว่ากลุ่มที่ฝึกแบบเป็นคู่ใช้เวลาในการเรียงแก้วมากกว่ากลุ่มที่ฝึกเพียงลำพังในช่วงแรกของการฝึก จากนั้นมีการพัฒนาความสามารถจนกระทั่งสามารถเรียงแก้วได้เร็วกว่ากลุ่มที่ฝึกเพียงลำพัง นอกจากนั้นผู้ฝึกที่ฝึกแบบเป็นคู่ยังคงใช้เวลาการเรียงแก้วในวันที่ 2 ไม่ต่างจากวันแรกทั้งเมื่อทราบและไม่ทราบเวลาที่ใช้ ซึ่งแสดงว่าผู้ฝึกแบบเป็นคู่ยังจดจำและเรียกคืนความสามารถในการเรียงแก้วในวันที่สอง (เทียบกับกับวันแรก) ได้ดีกว่ากลุ่มที่ฝึกลำพัง อีกทั้งเมื่อเปรียบเทียบการพัฒนาความสามารถจากช่วงแรกที่ทำการฝึกถึงการทดสอบในวันที่สองระหว่างสองกลุ่มพบว่ากลุ่มที่ฝึกแบบเป็นคู่ใช้เวลาในการเรียงแก้วน้อยลงอย่างมีนัยสำคัญกว่ากลุ่มที่ฝึกเพียงลำพัง ซึ่งแสดงให้เห็นว่ากลุ่มที่ฝึกแบบเป็นคู่พัฒนาได้ดีกว่ากลุ่มที่ฝึกเพียงลำพัง ผลการศึกษาเหล่านี้ชี้ให้เห็นว่าการฝึกแบบเป็นคู่ที่มีการฝึกสลับกับการสังเกตขณะพักในผู้ป่วยโรคหลอดเลือดสมองสามารถเพิ่มประสิทธิภาพในการฝึกโดยการส่งเสริมการเรียนรู้ทักษะการเรียงแก้วด้วยมือทั้งสองข้างได้ดีกว่าการฝึกเพียงลำพัง

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คำสำคัญ : โรคหลอดเลือดสมอง ฝึกเป็นคู่ การเรียนรู้ทักษะ การเรียงแก้ว เวลาในการเคลื่อนไหว

ABSTRACT

It is known that training in pairs of non-disabled individuals so called dyad training results in increase learning effectiveness. However, it is still questionable if dyad training can be applied in stroke patients. Therefore, the authors examined the effect of adding observational training into the rest interval between trials in dyad training protocol on the learning of bimanual cup stacking task in stroke patients and compared with the individual training, which is conventional training. Two groups of participants (n=10 in each group) performed bimanual cup stacking. One group trained individually (individual group) and another group trained in pairs (dyad group) which 1 performer performed the task while another one observed and alternated between physical and observational training on each trial. All participants performed 20 trials on acquisition phase. On next day, they first performed five trials of retention test without feedback (retained capability) followed by another five trials with feedback (retrieval capability). Dependent measure of this study was the time to complete each trial. The results showed that the dyad group initially completed with longer movement time but it rapidly decreased at the end of block 4 compared to individual group. Moreover, the dyad group demonstrated the retained and retrieval capability on the delayed retention test as evidenced by no difference in movement time between acquisition phase and retention test. The improvement of movement time from early acquisition block to delayed retention test in the dyad group was significantly greater than individual group. Those results indicate that physical training and observation of dyad training protocol enhance learning effectiveness of bimanual cup stacking in individuals with stroke compared to individual training.

Keywords : stroke, dyad training, motor learning, cup stacking, movement time

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INTRODUCTION

Stroke causes sudden focal neurological deficit and lasts longer than 24 hours(1). It is a major problem worldwide. In Thailand, Pongvarin N. et al. reported that there are approximately at least 150,000 individuals suffering from stroke each year(2). Stroke patients have significant sensorimotor impairments and disabilities in the contralateral limbs (3). Therefore, they need to receive training for recovery and regaining ability of their paretic limbs. But there are several factors that affect the training effectiveness. Those factors are deteriorated movement initiation resulted from decreasing speed of information processing(4), decreasing movement speed and cognitive deficits, in the domains of attention and memory (5). Based on aforementioned deterioration, several researchers explored ways to enhance the effectiveness of trainings. Many studies argued about contributing factors to enhance

training effectiveness through enhanced motor learning, such as the type of instructions or feedback, practice order of different tasks, learner-controlled practice, observational or mental practice and dyad practice (6, 7).

Dyad practice is a practice which is performed in couples(6). Some studies on people without central nervous system injuries reported that dyad training can increase effectiveness (6, 7). The results from study of Granados and Wulf (7) showed that the learning advantages of dyad practice are primarily due to the opportunity to observe another learner. Observation might have served as a potent reminder of the correct movement sequence, error detection and correction process of partner and received twice as many practice trials and half of which were physical, and half observational as those in the no-observation condition. And practice with another person might increase learners' motivation by adding a competitive component to the practice situation. That is, it might have caused them to set goals at a higher level of difficulty(6). An additional benefit of observational practice might have been that it allowed the individual to direct most of his and her attentional resources to observing the sequence are thereby rehearsing it at the same time(7).

From these reasons, dyad training may enhance motor learning and training effectiveness in stroke patients partly due to direct attentional resource to solve attention deficit and rehearsing the sequence, which may result in memory enhancement. Additionally, individuals who train with dyad protocol set their goal higher than those who train with individual protocol. Furthermore, dyad training can minimize the cost (reflecting by time, money, etc.) as well as maximizing the training effectiveness whereas other protocols can increase only effectiveness (6, 7). Therefore, If dyad training can enhance stroke patients' training effectiveness, it is the worthwhile and optimal training protocol for these patients more than other protocol.

Thus, the aim of present study was to examine the effectiveness of dyad training in stroke patients and to compare with effectiveness of individual training, a conventional protocol.

MATERIALS AND METHOD

1. Subjects

Twenty first-stroke patients aged 50 to 79 years were recruited into this study from Physical Therapy Clinic Mahidol University, Siriraj Hospital, and Golden Jubilee Medical Center. They were mild to moderate impairment and mild spasticity of upper extremity. They were divided into 2 groups (individual and dyad groups) by matching their paretic side, age and level of arm impairment. For dyad group, both partners were level of arm impairment-matched and their paretic arms were on an opposite side.

2. Experimental task

The task was speed cup stacking which consisted of two phases “up-stacking” (build a 3X6X3 pyramid stack) and “down-stacking” (putting the 3 pyramid stacks into their original three towers) (Figure 1). Participants were instructed to perform as quickly as possible upon the auditory signal by moving their non-paretic arm first and alternating their hand movement until the stack was completed. Movement time (MT) was measured in each trial and was used as a feedback for participant. Prior to the training each participant was received instructions regarding the task and one trial of demonstration. Then, they practiced 2 trials and followed by performing the stacking. In individual group, participants trained individually with the breaks between trials of 50-seconds, whereas in dyad group, participants trained in pairs. In dyad group, participants took turns training the task with a partner. This sequence of physical practice and observational practice continued until both partners completed 20 trials. All participants performed 20 trials on acquisition phase. On next day, they first performed five trials of retention test without feedback followed by another five trials with feedback, this time both group performed the task individually in the same manner as the acquisition phase.

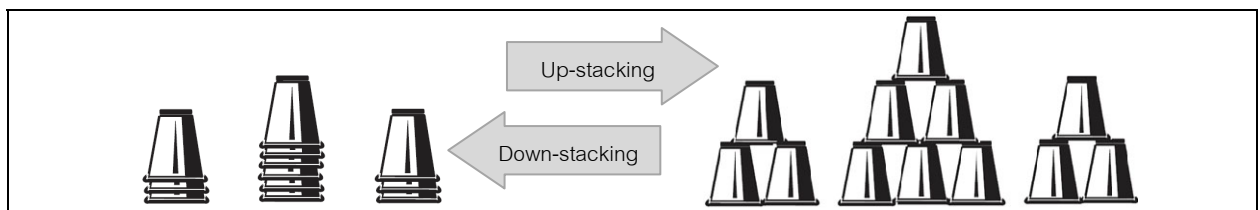


Figure 1 Schematic of the 3 X 6 X 3 cup stack

3. Data Analysis

3.1. Motor learning in acquisition phase were analyzed using two factors [groups (dyad, individual) X Block* (4 of five trials)] analysis of variance (ANOVA) with repeated measures on the last factor.

3.2. The retained capability between two groups were analyzed by using two factors [groups (dyad, individual) X Block* (last block of acquisition phase, a block without feedback of retention test)] ANOVA.

3.3. The retrieval capability between two groups were analyzed by using two factors [groups (dyad, individual) X Block* (last block of acquisition phase, a block with feedback of retention test)] ANOVA.

3.4. The improvement from early acquisition to retention test (without feedback) between two groups was analyzed using two factors [groups (dyad, individual) X Block* (first block of acquisition phase, a block without feedback of retention test)] ANOVA.

3.5. The improvement from early acquisition to retention test (with feedback) between two groups was analyzed using two factors [groups (dyad, individual) X Block* (first block of acquisition phase, a block with feedback of retention test)] ANOVA.

* Each block was an average movement time of five trials

RESULTS AND DISCUSSIONS

1. Acquisition phase

Movement times (MT) of the individual and dyad groups during training were shown in Figure 2. All groups became more effective at performing the task as evidenced by a reduction in their average MT across training trials. Although the dyad group had longer MT than the individual group early in the training, the dyad group tended to outperform the individual group participants by the end of the acquisition phase. There was a significant main effect of block with no main effect of group as shown in Table 1. In addition, the data revealed significant Group \times Block interaction.

2. Retention test

On average, the patterns of retention performances of the two groups were similar to those at the end of the acquisition phase. However, the dyad group had shorter MT than the individual group. The main effects of group and block, and the Group \times Block interaction were shown in Table 1.

2.1. Comparison of the retained capability between last block of acquisition phase and first block of retention test between two groups showed no main effect of group. However, there were significant main effect of block and the Group \times Block interaction. This indicates that the dyad group retains their capability better than the individual group.

2.2. Comparison of the retrieved capability between last block of acquisition phase and last block of retention test between two groups showed no main effect of block nor main effect of group. However, the Group \times Block interaction was significant. This indicates that the retrieves capability between dyad and individual groups was significant difference.

2.3. Comparison of the improvement from first block of acquisition phase to first block of retention test between two groups showed no main effect of group. However, the main effect of block and the Group \times Block interaction were significant. This indicates that the dyad group improves their performance from first block of acquisition phase to first block of retention test better than the individual group.

2.4. Comparison of the improvement from first block of acquisition phase to last block of retention test between two groups showed the same pattern as comparing to the first block of retention test. This indicates that the dyad group improves their performance from first block of acquisition phase to last block of retention test better than the individual group.

Table 1 The main effects of block and group, and interaction (Group X Block) in movement time

Block	P-value ^a				
	Block 1-2-3-4	Block 4 – Ret.1	Block 4 – Ret.2	Block 1 – Ret.1	Block 1 – Ret.2
Block effect	0.000*	0.000*	0.118	0.000*	0.000*
Group effect	0.622	0.108	0.091	0.578	0.516
Interaction	0.000*	0.016*	0.017*	0.001*	0.001*

a = p-value from two factors analysis of variance with repeated measure

* = significantly different (p-value < 0.05)

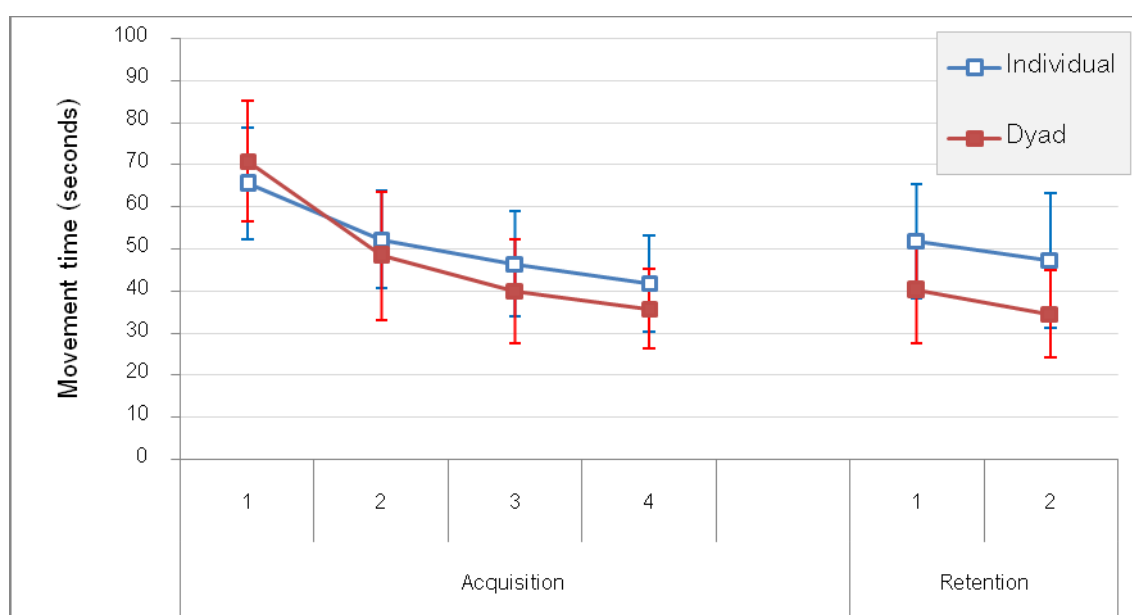


Figure 2 Movement time in each block of acquisition phase and retention test for individual and dyad groups (retention 1 = retention without feedback, retention 2 = retention with feedback).

Each block was an average movement time of five trials. Error bars indicates standard deviation.

The results showed that alternating between physical and observational training with a partner in stroke patients was more effective than individual practice. Compared with individual training group, dyad training group poorly performed the task in early acquisition phase (Block 1). The dyad group participants quickly caught up with the individual group participants and tended to be more effective at the end of acquisition phase. In addition, patients who had trained with a partner showed more effective retention performance than those in individual group, evidenced by the capability to retain and retrieve their performance in retention blocks of the dyad group. However, the improvement from early acquisition block to retention block in the dyad group was greater than those in individual group. This suggests that the benefits of dyad training transfer to situations in which participants perform

individually and perform without external feedback. Thus, dyad training in stroke patients was not only more efficient in term of cost but also more effective than individual training. These findings support the results from studies of Shea and colleagues (1999)(6), and Grandos and Wulf (2007)(7) that dyad training protocol can enhance training effectiveness through enhance motor learning.

Several factors might be responsible for the beneficial effects of dyad training in stroke patients. Possible benefits may gain from observing another patient perform the task. A combining action observation with repetitive practice of the observed actions in stroke patients may provide significant improvement of motor function when compared with no-observation condition and may also increase activation in a network of areas which build up the activation observation/action execution matching system (mirror neuron system)(8). In addition, the alternating between observational learning and physical learning might have caused them to rehearse the up-stacking and down-stacking sequence, to facilitate error detection and correction process (9). Moreover, learners received twice as many training trials, half of which was physical, and the other was half observational trials, as those in the no-observation condition. An additional benefit of observational training might be that it allows the individual to direct most of learners' attentional resources to observing the sequence thereby rehearsing it at the same time. The rehearsing and directing their attentional resources may reduce memory and attention deficit in stroke patients. Moreover, practicing with another performer could increase the patients' motivation by adding a competitive component to the practicing session and might encourage patients to set goal at a higher level of difficult. Goal setting in brain-damaged patients has been found to benefit the performance. A study reported that patients with a high goal setting performed significantly better than patients with a "do your best goal" (10). Therefore, if individuals see their partners performing better than them, they might set a higher goal. This higher goal therefore, could be one factor which improves the performances of the stroke patients who train with dyad protocol.

CONCLUSIONS

In summary, our results suggest that physical training and observation can be combined in an interactive way in individuals with stroke. In addition to increase efficiency in term of cost and time, this dyad protocol enhances learning effectiveness of bimanual cup stacking more than conventional protocol like individual training. Therefore, dyad training is a suggestive protocol and optimal training for these patients.

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