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Effects of Communal Exercise with 'Parkinson Home Exercise' Application on Gait Ability for Parkinson's Disease Patients

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Abstract: The purpose of this study was to invest the effect of communal exercise with 'Parkinson home exercise' application on gait ability. Twenty nine subjects were randomly divided into three groups, CSG (Communal Exercise with Smart App. Group), ISG (Individual Communal Exercise with Smart App. Group) and CG (Control Group). The subjects were instructed to carry out 10 weeks exercise program. Values were measured before and after the exercise program and the differences were analyzed by two-way repeated measures ANOVA and Scheffe post-hoc test ($p<0.05$). In the present result, ambulation time and single leg support (%) were significantly increased among groups, CSG was the most significant among groups ($p<0.001$). Double leg support (%) and distance time were significantly difference among time ($p<0.001$). These findings indicate that communal exercise with Smart App. Can be effective in gait abilityfor PD patients.

Key words: Parkinson's disease, communal exercise, 'Parkinson home exercise' application, spatial parameters, temporal parameters

INTRODUCTION

Exercise is an important therapeutic intervention for patients with Parkinson's disease because of its beneficial effects such as gait ability improvement, fall prevention, and improvement in physical performance (Paula *et al*., 2006).

However, although, exercise is an essential therapeutic intervention for such patients, it is realistically difficult for patients to participate in voluntary and constant physical exercise as the lesion progresses because they lose confidence, avoid interpersonal relationships and are unable to lead an independent life (Cubo *et al*., 2004; Paula *et al*., 2006).

Accordingly, the Association of Physical Therapists in Parkinson's Disease (ADDP) developed the Parkinson home exercise application for smart phones so that patients can receive visual and auditory feedback whenever and wherever they are. However, regardless of the quality of the program, its effect is limited if patient participation is low. It is important to motivate patients to participate in programs consistently. Such motivation can be provided through active recommendations for participation from supervisors and development of an environment where patients can work out with other patients in a similar situation (Morris *et al*., 2010). In particular, communal exercise improves interpersonal relationships and enhances social functioning. This greatly contributes to improvement in physical performance (Lee, 2015).

Thus the aim of this study is to prove the effects on gait ability of group exercise program with external stimuli of Smart App. which feeds a visual and auditory signal back to the patients of PD.

MATERIALS AND METHODS

Procedure for paper submission

Subjects: The participants of this study were 29 patients diagnosed with non-demented PD in a community-dwelling in South Korea. The participants were randomly divided into the Communal Exercise with Smart App. Group (n = 10, CSG), Individual Exercise with Smart App. Group (n = 10, ISG) and Control Group (n = 9, CG). Selection criteria were a diagnosis of PD according to Department of Neurosurgery of Y Hospital, classification at modified Hoehn and Yahr (H&Y) stage 1 through 3 and able to gait of independence.

Subjects were excluded if they had other neurologic problem such as acute medical problems that could affect

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Table 1: Physical characteristics

Groups	Gender	Age (years)	Hoen and Yahr stage	BMI (kg/m^2)	Duration of disease (years)	MMSE-K
CSG (n = 10)	M1, F9	71.10±5.10	2.71±0.48	23.62±1.42	6.22±0.78	20.70±0.94
ISG (n = 10)	M1, F9	73.50±6.93	2.42±0.51	22.45±1.61	5.90±0.87	21.40±1.07
CG (n = 9)	M1, F8	72.75±7.94	2.53±0.53	25.12±2.13	6.25±7.70	20.75±1.03

Communal Exercise with Smart App. Group (CSG), Individual Communal exercise with Smart App. Group (ISG), Control Group (CG), values are mean±SD

Table 2: Parkinson home exercise program

Weeks	Order	Exercise type (time)	Contents	Intensity	Frequency
1-3		Relaxing exercise (5 min)	Relaxing arms, leg	RPE	3 days/week
		Relaxation using breathing (5 min)	feel youre breathing experience deep	13-15	
		Flexibility (10 min)	breathing stretching on sitting, standing		
		Balance and coordination training (10 min)	Standing up stepping away		
		Walking (10 min)	Walking straight		
		Relaxing exercise (5 min)	Moving and relaxing back		
		Relaxation using breathing (5 min)	Relaxation using breathing		
		Flexibility (10 min)	Stretching on sitting, standing		
4-6	Smart App.	Walking with rhythms (10 min)	Walking with rhythms		3 days/week
	Program	Balance and coordination training (10 min)	Lunge, reaching chair forward, backward		
		Relaxing exercise (5 min)	Tensing and relaxing neck and trunk		
7-10		Relaxation using breathing (5 min)	Relaxation using breathing		3 days/week
		Flexibility (10 min)	Stretching on sitting, standing		
		Starting/freezing (10 min)	Let go 1,2,3' start, stop, turn, back, forward, big steps		
		Balance and coordination training (10 min)	Stepping away		
	Cool down (10 min)	Breathing exercise	Segmental, diaphragmatic and deep breathing	RPE 8-9	

gait, a score below 23 on the mini-mental state examination and fallen more than once in the prior year. The physical characteristics of the subjects are shown in Table 1.

Study design: Subjects were randomly separated into CSG, ISG and CG in order to evaluate single limb support (%), double limb support (%), ambulation time and distance time before and after the 10 weeks exercise intervention. The process of this study is as following (Fig. 1).

Measures of gait parameters: The GAITRite system (GAITRite, CIR systems Inc., Clifton, NJ, USA, 2008) is made of 5 m length walkway and 16,128 sensors. Over the walking of the subject, the system automatically detect pressures through the sensors and delivers the data to the computer to calculate gait parameters. The subjects walk three times and the calculated average of the three trials was used to analyze the data.

Exercise intervention: Subjects performed a communal exercise program using a smart application for 60 min, three times per week for a period of 10 weeks which focused on improving their deep breathing, relaxation levels, flexibility, strength, balance and gait pattern. The subjects and caregivers were instructed how to use the smart application and how to perform the exercise program. The exercise program used a smart application named "Parkinson home exercise application" (Table 2).

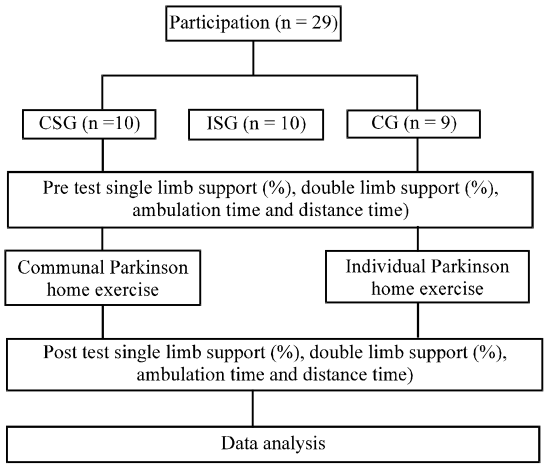

Fig. 1: The screening g process

which has been developed by the Association of Physiotherapists in Parkinson's Disease Europe (APPDE).

Saving diles in TIFF: Most graphing programs allow you to save graphs in TIFF, however, you often have no control over compression or number of bits per pixel. You should open these image files in a program such as Microsoft Photo Editor and re-save them using no compression, either 1 or 8 bits and either 600 or 220 dpi resolution (File>Properties; Image>Resize).

Data analysis: With all data obtained from this study we calculated Mean (M) and Standard Deviation (SD) using

SPSS/PC 18.0 statistic program for Windows. We carried out two-way repeated measures ANOVA analysis used to demonstrate the differences among values from the experimental groups (CSG, ISG and CG) and measuring period (before/after 10 weeks intervention). In addition when the statistical significance in the data was shown, post-verification of Scheffepost-hoc test analysis was conducted. Statistical significance was adopted at $p<0.05$ in this study.

RESULTS AND DISCUSSION

The change of temporal parameters: As shown in Table 3, after 10 weeks intervention, CSG and ISG groups showed the significant improvement in single limb support (%), double limb support (%) and ambulation time, ambulation time change of CSG was the most remarkable among three groups ($p<0.01$).

The change of spatial parameters: As shown in Table 4, after 10 weeks intervention, CSG and ISG groups showed the significant improvement in distance time. Distance time showed significant differences among groups ($p<0.05$). Gait disability, reduced mobility, falls risk and social isolationaffectbad influences on PD patient's physical and mentalhealth, social interaction and quality of life. Most of all, gait disability is associated with increased risk of falls and hospitalization, decrease ofindependenceand even higher risk of mortality (Morris *et al*., 2010; Giladi *et al*., 2001). Therefore, gait disability is the best barrier for them to restrict physical performance and to reduce the mental health, social interaction and health-related quality of life (Giladi and Balash, 2006; Dibble *et al*., 2009; Elsinger *et al*., 2006).

Most useful method to improve gait ability is regular exercise (Allen *et al*., 2010). But it is very hard for them due to complex symptoms representing disorders of cognition, language, depression and fatigue, self-care, communication as well as motor disorder. Therefore, resent researches are reported that communal exercise improved physical performance and emotional stability by enhanced familiarity and social integrityfunction. The social interaction and physical performance were improvedas a consequence of the communal exercise undertaken by the PD patients (Bloem *et al*., 2004). On the other hand, Association of Physiotherapists in Parkinson's Disease (APPDE) released 'Parkinson home exercise' which provides easy exercise guide and

Table 3: Change of temporal gait ability

Items/Groups	Pre-test	Post-test	2-way ANOVA	F-values	p-values	Post-hoc
Ambulation						
CSG	6.66±1.42	3.00±0.78	Group	7.078	0.004**	
ISG	6.48±1.09	5.68±1.27	Time	130.531	0.000***	a>b
CG	6.47±0.86	6.50±0.84	Group*time	74.951	0.000***	a>c
Single limb support (%)						
CSG	30.25±2.77	33.00±3.06	Group	3.019	0.066	
Left						
ISG	31.66±3.32	34.12±3.86	Time	84.977	0.000***	
Right						
CG	34.94±2.12	34.86±2.00	Group*time	22.640	0.000***	
CSG	30.71±2.62	33.52±2.93	Group	3.723	0.038*	
ISG	31.95±2.97	33.62±2.84	Time	95.747	0.000***	a>c
CG	35.16±1.99	35.30±2.14	Group*time	23.828	0.000***	
Double limb support (%)						
CSG	39.26±2.56	36.58±2.13	Group	2.898	0.073	
Left						
ISG	40.08±2.45	37.82±2.31	Time	79.370	0.000***	
Right						
CG	40.09±1.22	40.33±1.60	Group*time	25.960	0.000***	
CSG	39.97±2.18	37.76±1.53	Group	1.795	0.186	
ISG	40.04±2.55	37.96±2.37	Time	61.706	0.000***	
CG	40.38±1.48	40.44±1.51	Group*time	16.343	0.000***	

Table 4: Change of spatial gait ability

Items/Groups	Pre-test	Post-test	2-way ANOVA	F-values	p-values
Distance time					
CSG	303.02±37.83	361.69±25.48	Group	3.536	0.044*
ISG	304.03±29.00	309.94±28.01	Time	74.691	0.000***
CG	302.01±19.87	303.28±18.66	Group*time	53.277	0.000***

CSG: Communal exercise with Smart App. Group, ISG: Individual communal exercise with Smart App. Group CG: Control Group; values are mean±SD; *p<0.5**; p<0.01; ***p<0.001, a: CSG, b: ISG, c: CG

audio-video stimulus. It makes Pds easy to exercise (Paula *et al*., 2006). The spatiotemporal parameters of gait in PD patients were improved by the external audio-video stimulus (Caglar *et al*., 2005; Lee, 2015). Besides, they felt similarity during the communal exercise and it made better social integrity function (Morris *et al*., 2010). The aforementioned social facilitation effect from communal exercise motivated their willing to overcome the physical disorder, competitive spirit and can-do attitude (Caglar *et al*., 2005; Lee, 2015).

Thus we have investigated the effect of a communal exercise program with the smart phone App. On gait ability by comparing with the effect of an individual exercise group and a control group.

As a result of this study, communal exercise program with smart phone App. For PDs was effective to improve gait ability. After 10 weeks exercise, temporal parameters of CSG and ISG groups showed the significant improvement in single limb support (%), double limb support (%) and ambulation time. Especially the change of ambulation time in CSG was the most remarkable among three groups ($p<0.01$). And spiral parameters of CSG and ISG groups showed the significant improvement in distance time which was showed significant differences among groups ($p<0.05$). These finding indicates that the communal exercise with smart phone App. Have benefit on gait ability comparing to individual exercise. According to recent research reported that outcomes relating to gait significantly improved in walking speed and balance of PD following the exercise intervention (Cubo *et al*., 2004). But it was very difficult to find any precedent study and similar research using smart application for PDs' communal exercise. Therefore, comparison result and conclusion could not be drawn. The present study examines community-dwelling patients who tend to have weaker socioemotional relationships with families, relatives, neighbors, etc. These patients could improve their gait ability more when they worked out with peers than when they worked out alone because a group workout actively motivated them.

CONCLUSION

This communal exercise using audio-video feedback by smart phone application has positive effect on gait ability. The communal exercise motivated PD patient's emotional stability by enhanced familiarity and social integrity function and the audio-video feedback helped their physical performance of the exercise.

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