Comparison of post-stroke patient coordination level between frequency exercise of proprioceptive neuromuscular facilitation (PNF)

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Abstract. Stroke is a neurological deficit that result of brain malfunction. Approximately 10% of post-stroke patients have coordination disorders while sitting, standing and walking. This coordination disorder is caused by several factors such as muscle tone, motoric, sensory, perception, balance, motion pattern, and associative reactions. Coordination disorder in post-stroke patients can be treated with Proprioceptive Neuromuscular Facilitation (PNF). PNF is a method of exercise therapy that aims to facilitate the neuromuscular system by stimulating proprioceptive which in the end will be achieved coordinated ability or movement. This study aim was to determine the difference between the coordination level of the PNF exercise frequency given in post-stroke patients. This research is quasi experimental with research design two group pretest-posttest time design. The sample was 20 people with 6x and 12x PNF exercise frequency. Main measure that used is a non-equilibrium coordination test pre and post PNF exercise. The result showed Mann Whitney U test was obtained p value of 0.006 (P<0.05) which there were differences between PNF exercise frequency given in post-stroke patients.

1. Introduction

Stroke is second most common cause of mortality among adult population in the developed countries [1]. Stroke was occurred when brain tissue is damaged due to lack of blood flow or oxygen delivery to the brains cell. Stroke was classified into two types such as haemorrhagic and ischemic. The haemorrhagic strokes caused by rupture of blood vessel which caused bleeding into the brain parenchyma and damage to brain tissue, while ischemic strokes is occurred since blood supply blockage into artery leads to brain ischemia and infraction [2].

Haemorrhagic stroke caused severe and damage to the brain tissue leads to individual paralyse or weak, difficulty in speaking, swallowing, think properly or doing any daily activities [2]. The stroke always correlated with aging and changing in lifestyle. The stroke risk factors such as hypertension, smoking, diabetes mellitus, obesity, unhealthy diet, lack of physical activity, alcohol consuming, depression, cardiac cause and apolipoproteins B to A1 ratio [3].

There were 10% of post stroke patients have coordination disorder while sitting, standing and walking. The coordination disorder in post stroke patients are caused by several factors such as muscle tone, motor, sensory, perception, equilibrium, motion pattern and association reactions. Coordination disorder in post stroke patients can be handled with Proprioceptive Neuromuscular Facilitation (PNF).
The PNF is a therapy approach which combined functional diagonal patterns with neuromuscular facilitation techniques to generate motor responses and improve neuromuscular control and function. In PNF exercise, the exercise dose also important so that the goal will be achieved. Hence, this study aim was to determine the difference between the coordination level of the PNF exercise frequency given in post-stroke patients.

2. Methodology
The study was used quasi experimental method with two group pretest- post test design. The study location was Asy-Syifa clinic and Physio Sakti Makassar. The study population were all stroke patients who had treatment in Asy-Syifa clinic and Physio Sakti Makassar. Meanwhile, there were 20 samples with 10 samples for two treatments. The samples were obtained by using sample calculation formula and met the inclusion criteria. The inclusion criteria included post stroke patients with coordination, cooperative, regularly attend for physiotherapy of 6 times or 12 times, minimum muscle strength of 3, Asworth scale of 0-2 and in recovery phase (3 months and above).

The data was collected included respondent characteristic and general condition from the patient medical record. The coordination level in patients was measured using non-equilibrium coordination check which carried out for 3 times, which patient coordination level was measured before PNF exercise was given and after 6 and 12 times of PNF exercises. The patient coordination level was categorized into 4 categories such as severe coordination disorder, moderate coordination, mild coordination and normal. The data was analysed by Wilcoxon test and Mann Whitney U test with using SPSS program.

3. Result and Discussion
3.1. Result
Table 1 showed the characteristics of sample were based on age, gender and stroke type in post stroke patients were given PNF exercise. There was 1 respondent (10%) aged between 31 years old and 40 years old and 4 respondents (40%) were aged between 41 years old and 50 years old. Meanwhile, there were 8 respondents (80%) aged between 51 years old and 60 years old and 1 respondent (10%) aged between 61 years old and 70 years old had 12 times PNF exercises. There was no respondent aged between 31 years old and 40 years old.

In additions, 7 respondents (70%) were male and 3 respondents (30%) were female which had 6 times of PNF exercise. There were 4 male respondents (40%) and 6 female respondents (60%) had 12 times of PNF exercise.

Furthermore, 2 respondents (20%) were suffered haemorrhagic stroke and 8 respondents (80%) were non-haemorrhagic stroke patients whose had 6 times of PNF exercised. Besides, 3 respondents (30%) were haemorrhagic stroke patients and 7 respondents (70%) were non-haemorrhagic patients had 12 times of PNF exercise.
Table 1. Respondent characteristics.

| Characteristics   | PNF exercise frequencies |           |           |           |
|-------------------|--------------------------|-----------|-----------|-----------|
|                   |                          | 6 times   | 12 times  |           |
|                   | N | % | N | % |           |
| Age (years old)   |   |   |   |   |           |
| 31-40             | 1 | 10 | 0 | 0 |           |
| 41-50             | 4 | 40 | 1 | 10 |           |
| 51-60             | 2 | 20 | 8 | 80 |           |
| 61-70             | 3 | 30 | 1 | 10 |           |
| Total             | 10 | 100 | 10 | 100 |           |
| Gender            |   |   |   |   |           |
| Male              | 7 | 70 | 4 | 40 |           |
| Female            | 3 | 30 | 6 | 60 |           |
| Total             | 10 | 100 | 10 | 100 |           |
| Stroke type       |   |   |   |   |           |
| Hemorrhagic       | 2 | 20 | 3 | 30 |           |
| Non-hemorrhagic   | 8 | 80 | 7 | 70 |           |
| Total             | 10 | 100 | 10 | 100 |           |

Table 2 showed that 5 respondents (50%) had heavy coordination disorder and 5 respondents (50%) had medium coordination disorder for stroke patients had 6 times of PNF exercise during pre-test. In post-test, 2 respondents (20%) were experienced medium coordination disorder and 8 respondents had experienced less coordination disorder for stroke patients with 6 times of PNF exercise.

There were 10 respondents (100%) had heavy coordination disorder in the pre-test for stroke patients with 12 times. Meanwhile, there were 3 respondents (30%) had less coordination disorder and 7 respondents (70%) had normal coordination level in post-test.

Table 2. Pre-test and post-test distribution of PNF exercise toward coordination level.

| Exercise frequency | Coordination level | Heavy | Medium | Less | Normal |
|--------------------|--------------------|-------|--------|------|--------|
|                    |                    | N | % | N | % | N | % | N | % |
| 6 times            | Pre test           | 5 | 50 | 5 | 50 | 0 | 0 | 0 | 0 |
|                    | Post test          | 0 | 0 | 2 | 20 | 8 | 80 | 0 | 0 |
| 12 times           | Pre test           | 10 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
|                    | Post test          | 0 | 0 | 0 | 0 | 3 | 30 | 7 | 70 |

The statistic result showed Wilcoxon test for both PNF exercise frequencies, 6 times and 12 times was p-value = 0.005<0.05. Besides, Mann Whitney U test also showed p value = 0.006< 0.05. These results showed there was significant relationship between PNF exercise frequency and coordination levels in post stroke patients.
Table 3. Normality test, influence test and PNF exercise frequency.

| Exercise frequency | Coordination level | Median | Min | Max | Shapiro Wilk test Sig. (P)* | Wilcoxon test Sig. (P)* | Mann Whitney U Sig. (P)* |
|--------------------|--------------------|--------|-----|-----|-----------------------------|-------------------------|-------------------------|
| 6 times            | Pre test           | 35     | 20  | 47  | 0.774                       | 0.005                   |                         |
|                    | Post test          | 59.5   | 41  | 65  | 0.024                       | 0.006                   |                         |
| 12 times           | Pre test           | 28     | 26  | 34  | 0.008                       | 0.005                   |                         |
|                    | Post test          | 77.5   | 59  | 85  | 0.153                       |                         |                         |

3.2. Discussion
This study was quasi experimental study with purpose to determine the coordination level between PNF exercise which given to post stroke patients group.

Based on age of respondents, highest respondents were aged between 41 years old and 50 years old which had 6 times of PNF exercise. Sofyan et al. (2015) found highest stroke patients were aged between 41 years old and 50 years old with percentage of 47.6% [4]. Meanwhile, highest respondents were aged between 51 years old and 60 years old for 12 times of PNF exercise. The stroke occurrence with increasing age is correlated with the aging process in which decline in organ function especially the brain. The aging brain is related of present and neutron loss which elderly brain will loss more neutron compared to normal brain [5]. In additions, hypertension also main risk factor that contributed to the stroke which due to smoking, insufficient of physical activity and unhealthy diet [6,7]. Antihypertensive treatment in hypertension help reduce the stroke and death.

Based on gender characteristic, there were 7 male and 3 female respondents with 6 times of PNF exercise. Meanwhile, 4 male and 6 female respondents had 12 times of PNF exercise. In this study, male respondents were observed suffered stroke than female respondents. Samai and Schild (2015) mentioned the stroke incidence was 1.25 times higher than female and increased with age for both genders [8]. The male had high risk due to alcohol and tobacco use, myocardial infarction history, peripheral arterial disease and decrease in testosterone level [9]. The testosterone hormone can increase Low Density Lipoprotein (LDL) level which increase cholesterol level in blood and leads to stroke [10].

In additions, there are 5 respondents with hemorrhagic stroke and 15 respondents with non-hemorrhagic stroke. High number of non-hemorrhagic stroke compared to hemorrhagic stroke is caused by several factors. However, atherosclerosis is major cause of non-hemorrhagic stroke among elder patients.

The coordination level was measured using non-equilibrium coordination examination consisted 4 criteria starting from 19-35 (weight coordination disturbance), 36-52 (moderate coordination disturbance), 53-69 (mild coordination disturbance) and 70-85 (normal level). In this study, PNF exercise frequencies had significant effect on the coordination level. Mann Whitney U test showed $p=0.006<0.05$ which meant there is different in coordination level between PNF exercise frequencies given to the post-stroke patients. Freitas et al. (2014) had mentioned PNF exercise was aimed to increase strength, flexibility and coordination since this method had include three planes of motion [11]. In additions, Kyoung et al. (2015) stated that coordination movement using PNF pattern in the water had very significant effect in post stroke patients especially in term of equilibrium and pattern [12].

PNF is method of therapy intended to facilitate the neuromuscular system by stimulating the proprioceptive. The PNF general principle is giving certain stimulation to revive latent mechanism that which achieve normal and coordinated functional. The movement pattern used were spiral and diagonal that closely related to normal functioning movement. Tung et al. (2010) found 12 times PNF exercise had improve the balance and muscle strength for the stroke patients [13].
The PNF exercise repetition will give sensory and motor control stimuli that can improve brain regeneration ability by changes in motor function and cognitive which consequences of neuronal plasticity and increased neuron number. The changes occurred as brain development result are associated with structural and functional changes in the brain. The structural changes was associated with neurochemical changes which is neurotransmitters enhancement will have an effect on the increment of neurons, neuro-receptive electricity and plasticity. The functional changes was associated with changes in nerve or neuron cells included synapse activation and sprouting process.

4. Conclusion
In conclusion, there was significant relationship between the PNF exercise frequencies and coordination level in post-stroke patients. Meanwhile, 12 times of PNF exercise demonstrated more significant effect than 6 times of PNF exercise toward the coordination level in post stroke patients. Therefore, the comparison test showed there was different of coordination level based on PNF exercise frequencies. Based on this study, there is expect that physiotherapist in hospitals or clinics may choose PNF exercise modality to improve coordination level in post stroke patients and also determine the accurate exercise dose for post stroke patients.

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