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Research Article

The Effectiveness of Combined Mental Practice and Conventional Physiotherapy for the Improvement of Upper Extremity Function and Activity of Daily Performance in Post-stroke Hemiplegic Patients: A Comparative Study

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Abstract

Objective: To evaluate the effectiveness of Conventional Physiotherapy (CP) alone versus Conventional Physiotherapy (CP) associated to Mental Practice (MP) on post-stroke hemiplegic patients.

Methods: An experimental study was undertaken on 20 post-stroke hemiplegic patients (sub-acute and chronic). Participants were allocated into two groups using consecutive sampling: the experimental group (11) received MP+CP while the control group (09) received CP alone. The experimental group received 20 minutes of MP+CP 3 times a week for 5 weeks. The control group received CP alone. The Wolf Motor Function Test (WMFT) and the Frenchay Activity Index (FAI) was used to evaluate UE functions and ADP, respectively by a blinded rater.

Results: In the Experimental group: the mean scores for the WMFT and FAI before treatment were 40.0 and 38.5, 28.4 and 24.5 for the sub-acute and chronic patients respectively; after intervention, they were respectively; 56.3 and 36.4, 33.2 and 26.5. While in the Control group: before treatment, they were respectively; 28.9 and 33.0, 22.4 and 28.4. After treatment, we had; 41.5 and 27.5, 25.3 and 26.0.

Conclusion: MP+CP was found to improve post-stroke hemiplegic patient's UE function and ADP after five weeks of treatment.

Keywords: Mental Practice; Conventional Physiotherapy; Upper Extremity; Post-stroke Hemiplegic Patients

Abbreviations

MP: Mental Practice; CP: Conventional Physiotherapy; UE: Upper Extremity; ADP: Activity of Daily Performance; WMFT: Wolf Motor Function Test; FAI: Frenchay Activity Index; BI: Berthal Index; ARCH: Associated Rehabilitation Center for the Handicap; BRH: Buea Regional Hospital; RR: Relative Risk; CI: Confidence Interval

Background

Cerebro-Vascular Accident (CVA) or stroke is a health condition causing disability due to an interruption in the blood supply to the brain or a hemorrhage in the brain tissue caused by cerebro-vascular disease, cardiac disorder or (cardiac disorder, diabetes, and stroke) diabetes, and stroke is said to be one of the leading causes of functional handicap due to hemi-paralysis [1]. Additionally, it's the leading cause of hospitalization in the neurological unit in the USA [2]. It is increasing in other parts of the world not leaving out Africa and Cameroon in particular. Furthermore, the prevalence of post-stroke motor deficits is estimated to be over 50% [3].

Moreover, the overall burden of stroke is likely to rise due to an increase of the aging population and many other risk factors such as obesity, diabetes mellitus, smoking and high alcohol consumption [4], sex and marital status [5]. Despite the fact that most conventional rehabilitation treatment in the first phase of stroke are currently advised in many clinical guidelines, little data is available on such conventional therapy for improving Upper Extremity (UE) function in this phase [4]. For most patients, conventional physiotherapy has many constraints of time, place, and expense [6]. Recently, Mental Practice (MP) interventions stand out as a method of learning, improving motor skills and have been introduced in such diverse fields as; sports psychology, cognitive psychology, physiotherapy and medical sciences [6]. Mental practice is less expensive, does not require expensive equipment, easy to use, can be used anywhere; can be used by patients who do not have the ability to practice physical exercise. In addition, results from brain imaging experiments have demonstrated that executed and imagined movements share a common neural substrate [7].

However, combining MP training principles with conventional therapy appears more beneficial than MP training alone [7-10]. Mental Practice (MP) also known, as motor imagery is a technique by which physical skills or movement can be cognitively rehearsed in a safe repetitive manner [11]. Several investigations with different techniques, and intensities have been carried out to demonstrate the possible benefits of movement imagery on motor performance in acute and in chronic post-stroke hemiplegic patients [10-12].

A marked improvement in the arm function compared to that of the control group in post-stroke hemiplegic patients, using Mental Practice techniques has been demonstrated [7,11]. Similar effects in the training of neglect motor skills have been reported by other studies on Mental Practice [12,13].

Although the brain is damaged by stroke, the ability to train using motor imagery remains. Page and collaborators carried out a controlled randomized trial in 2009on chronic stroke patients and confirmed the effects of MP in improving Upper Extremity (UE) function [7].

Also, Yoo and collaborators have shown improvements in various areas of UE function and Activity of Daily Performance of hemiplegic stroke patients in a study using MP [12].

In similar manner, the long-term effect of MP in stroke patients have been demonstrated by some researchers, evaluations were conducted just one month after training and the conclusions were positive [6].

Most of the available studies lacked a control group or had a limited number of subjects; it was difficult to generalize their results. Also, the duration of therapy, number of applications, and treatment times of each session varied across the studies, making it difficult to decide how to apply therapy. Generally, little data is available online in this domain in most African countries, particularly in Cameroon, reason why we needed to carry out such a study, using clear definitions of Mental Practice content and standardized outcome measurements which are currently advised [14].

Aim of the Study

Thus, our aim was to evaluate the effect of Mental Practice performed in combination with Conventional Physiotherapy to improve Upper Extremity (UE) function and Activity of Daily Performance of post-stroke hemiplegic patients.

Materials and Methods

We carried out an experimental study on two different groups; intervention group (group receiving Mental Practice combined with Conventional Physiotherapy) and control group (group re-

ceiving Conventional Physiotherapy alone) types, at the Buea Regional Hospital (BRH) and the Associated Rehabilitation Center for the Handicap mile 14 Dibanda (ARCH), both found in the South West Region of Cameroon between the 25th of May and the 16th of September 2016. We evaluated the effectiveness of Mental Practice (MP) which is a new physiotherapeutic technique associated to Conventional Physiotherapy (usual techniques use by physiotherapists) versus Conventional Physiotherapy (CP) alone to improve Upper Extremity (UE) function and Activity of Daily Performance (ADP) of post-stroke hemiplegic patients.

Participants who responded to our inclusion criteria were considered in the study. A non-probabilistic consecutive type sampling was used to recruit patients into two groups (Intervention and Control). Both sub-acute and chronic post-stroke hemiplegic patients were considered in our study. Either the intervention group [n = 14] and control group [n = 14], as they visited the ARCH and physiotherapy service at the (BRH) respectively (i.e. patient 1 was put into control group and patient 2 into intervention group, patient 3 into control group and patient 4 into intervention group, and it continued thus with no particular influence from the participants or investigators. The sampling technique for patient's recruitment was exhaustive.

Inclusion criteria

- All post-stroke hemiplegic patients with a complete medical record
- Recent stroke < 3 months (acute or sub-acute) and stroke > 3 months (chronic)
- 18 to 75 years of age
- A CT-scan or MRI was to be presented by the patients before recruitment (however, we accepted patients who agreed to bring their CT-scan or MRI results subsequently)
- Present (Intact or presence) of superficial sensibility of the affected arm.

Exclusion criteria

- Visual deficits
- Aphasia
- severe depression (score between 20 - 27) using the Patient Health Questionnaire (PHQ-9)
- Absence of upper limb motor weakness
- Participated in other studies
- Excessive pain in the more-involved wrist or arm (> 5 on the Visual Analogue Scale)
- Presence of any cardiovascular, neurological and orthopedic impairments other than stroke
- Cognitive impairment, we used the Mini-Mental State Examination (MMSE < 2).

Study procedure

Standard informed consent procedures were used. More so, participants were not made to know their treatment groups (intervention or control groups) so as not to influence the therapy outcome and participant's compliance to therapy.

A total of 53 volunteers were screened, with 25 subjects who were not retained in this study for the following reasons: (1) still enrolled in some form of motor rehabilitation study (n = 2); (2) severe pain on the more affected UE (n = 6); (3) other medical conditions such as cardiovascular, neurological or orthopedic impairments (n = 8); (4) age > 75 (n = 4); (5) auditory and visual problems (n = 5). Thus, 28 patients were retained to participate in our study. Eight (n = 8) out the 28 participants previously selected and portioned into the study groups failed to present a CT-scan in the proceeding days as was recommended, so they were excluded (3 from the intervention group and 5 from the control group). Therefore twenty (20) participants were left to proceed in this study with nine (09) participants in the control group and eleven (11) in the Intervention group.

The following socio-demographic variables were recorded: age, sex, living conditions and educational level. The clinical variables included systematical scores of stroke-related neurological variables such as: lesion site, stroke type (hemorrhagic or ischemic), paresis level and the presence of other disorders due to stroke. These clinical variables were derived from the medical file of the referring consultant or neurologist. Firstly, patients were asked for permission to use information from their medical files in the informed consent procedure. Secondly, personal interview for counselling on the importance of time respect and rehabilitation techniques used to improve on results was done. Finally, observations were made before and after treatment sessions to correct the patients on the use of MP techniques. The most widely used Mini-Mental State Examination (MMSE) scale to measure the cognitive levels of participants was used.

Scores of UE functions and ADP were collected using UE evaluative scale (WMFT) and ADP Scales (Frenchay Arm Index) before and at the end of treatment intervention in both groups. Comparison of both groups was done with the Mann Whitney test.

Control group: conventional physiotherapy alone

In accordance with post-stroke hemiplegic rehabilitation guidelines compliance with the clinical guidelines for stroke management by the national stroke foundation of Australia 2010 [15] applied in this study in both treatment centers (the physiotherapy service at the BRH and ARCH mile 14 Dibanda), patients [n = 09] received the following treatments at the frequency of three (3) sessions per week for five (5) weeks for approximately 40 minutes; Electrotherapy (use of transcutaneous electrical nerve stimulator of low frequency at <10 Hz with four-lead TENS unit with two channels to stimulate the affected UE for 15 minutes); Mobilization (both active and passive for 5 minutes) to reduce pain and increase ROM and arm/hand function; Active and passive stretching exercises for 5 minutes (to improve on the muscle tone and flexibility); Techniques for proprioception purpose for 5 minutes, Upper extremity weight bearing was used to lengthen or inhibit tight or spastic muscles while simultaneously facilitating muscles that are less active (5 minutes); Muscle training or strengthening exercises to improve strength of the weaker arm for 5 minutes.

In addition, patients were taught and instructed to practice home therapy mostly positioning therapy to prevent contracture, spasm any injury, and respiratory complications, constrained induce therapy (keeping the stronger arm fixed and trying to use the affected arm) to improve UE functions and strength.

Also, the use of sling (shoulder support) to reduce shoulder joint pain and relief downward traction; Shoulder orthosis, elbow orthosis, wrist-hand orthosis to prevent deformation of joints; Good body posture to prevent postural problems like low back pain, neck pain and sub-luxation of the shoulder was encouraged at home. Therapeutic exercises for patients able to practice physical exercises of the upper limb were encouraged.

Intervention group: Conventional physiotherapy and mental practice

Patients [n = 11] in this group received Conventional Physiotherapy as explained above and additional Mental Practice-based upper extremity function training (MP+CP) at the Associated Rehabilitation Center for the Handicap mile 14 Dibanda (ARCH) and the Buea Regional Hospital (BRH). Before mental practice technique, we had to follow the 5-steps framework of mental practice approach. These steps were as follows: Assess mental capacity (using the Mental Capacity Act 2005); Establish nature of mental practice; Teach imagery technique; Implant incorporate monitor; Develop self-generated treatment [14]. The procedure of Mental Practice technique lasted approximately twenty minutes (20 minutes) and divided into three parts:

- **Part one:** Relaxation therapy lasted approximately 2 to 3 minutes in a quiet relaxed room. It consisted of Jacobson's relaxation technique. At the start, Therapist said to patients: "Lie on your back (supine); Close your eyes; And imagine yourself in a warm relax place (beach, cinema, piscine, sitting room, etc.); Feel the contractions of the muscles of the affected UE, relax the muscles (all the muscles of the affected UE); contract just the muscles of your hands, relax them slowly, contract the muscles of the fore arm, relax them slowly, contract the muscles of the arm, relax them slowly, close your hands, open your hands".
- **Part two**: Mental rehearsal task, derived from the Frenchay Arm Test, this part took approximately 15 minutes, and each task was repeated twice and slowly. "Imagine yourself sitting on a writing table: Stabilize a ruler with the strong hand, while drawing a line with a pencil held in the weaker hand. Stabilize it well and draw a straight line; Extend the affected UE from the elbow, grasp a cylinder (12 mm diameter, 5cm long), feel it on your hands, lift it about 30cm and replace it on the table without it dropping; Extend your elbow, extend your fingers, pick up the glass, half full of water or milk, feel the glass in your hands positioned about 15 to 30cm from the edge of the table, flex your elbow and drink some water/milk and replace without it spilling: Fold the towel (front): grasps the towel, folds it lengthwise, and then use left or right (hand tested) to fold the towel in half again; Imagine yourself standing in front of a mirror in your room; Take the comb on the table, comb your hair; must come across top, down the back and down each side of the head. Keep the comb back on the table".
- **Part three**: Patients are provided ≈2 to 3 minutes to refocus into the room: "Feel you are okay, looking neat now, well combed hairs; Ready to go and visit your doctor; Knock the office of your doctor; Enter back into your body and; Come back to reality; Open your eyes" [16].

During the first week, the patients were taught how to use the mental practice techniques to improve UE function. For all tasks, training sessions with oral files and photocopies of a detailed MP technique and procedure were available to guide the patients. They were educated as to basic imagery principles and the importance of regular imagery training in increasing therapy success. After baseline measurements, patients were familiarized with the Mental Practice therapy after the third session. Practical sessions were available for every task for right and left-handers. After the five weeks-intervention period, functional UE progress was evaluated by a qualified blinded evaluator (a physiotherapist) using the Frenchay Activity Index to evaluate Activity of Daily Performance (ADP), while the Wolf Motor Function Test (WMFT) was used to evaluate UE function before and at the end of the treatment session.

Data management and analysis

Data collected were then coded, entered and analysed. The UE functions and ADP were evaluated at the beginning (Start), and also after 5 weeks of the treatment (end), only the Barthel Index (one of the evaluative scales for ADP) was used only at the end of the 5th week. Data was entered and analyzed using Excel 2010, SPSS version 23 and Epi-info version 3. 5. 4. We first calculated proportion for qualitative variables and means for quantitative variables. The Mann Whitney test was used to compare the outcome of the treatment of the two groups (MP+CP and CP alone) before and after therapy, and for the estimation of p-value. Also, Fisher exact test was used to identify factors affecting the outcome of patients in those involved in mental practice. $P < 0.05$ was considered statistically significant.

Results

Our study consisted of 20 patients who presented a CT-scan confirming stroke by the referral specialists. 13 (65%) out of the 20 participants were males and 07 (35%) were females. The mean age was 56 years (Table 1). The experimental group consisted of 11 (55%) patients while the control group had 09 (45%) patients (Table 2). Also, 35% of patients in our study were at the chronic stage of post-stroke while 65% of the identified patients were at the sub-acute stage (Table 2). Furthermore, our findings showed that 80% of patients had ischemic stroke while 20% suffered a hemorrhagic stroke. 60% of patients had lesion at the right cerebral hemisphere, and 80% of the identified post-stroke patients also had associated high blood pressure (Table 3). Age, sex, stroke type and lesion site of the brain were identified as factors that affected the outcome of mental practice combined with conventional physiotherapy. With the male sex, hemorrhagic stroke and patients with left brain lesions shown to respond better to mental practice combined with conventional physiotherapy ($P = 0.23$, 0.08, and 0.37) respective (Table 4). 55% of patients in this study were recommended physiotherapy by general practitioners or nurses. Also, most of these patients came for therapy three times a week and majority of them (60%) had favorable evolution. A good number of the patients received psychological supports from the physiotherapists and 60% of them said the treatment given to them was good.

		Age group			Total (%)
		0-40	41-55	56-74	
Sex	Male	02	04	07	13 (65)
	Female	01	02	04	07 (35)
Total (%)		03 (15)	06 (30)	11 (55)	20 (100)

Table 1: Table showing the frequencies and percentages of sex with respect to age groups.

From table 1 above, we see that the most represented age group of patients were between 56-74 years giving a percentage of 55%, and majority of this patients were males (65%).

	Interventional group	Control group	Total (%)
Chronic (>14weeks)	03	04	07 (35)
Sub-acute (<14weeks)	08	05	13 (65)
Total (%)	11 (55)	09 (45)	20 (100)

Table 2: Distribution of post-stroke hemiplegic stage with respect to the study groups.

The table above shows that 35% of patients in our study were at the chronic stage of post-stroke while 65% of the identified patients were at the sub-acute stage.

The table above shows that patients with ischemic stroke (80%) had the highest proportion. 20 (100%) presented a CT-scan and majority of them 80% underwent medical treatment. Furthermore, 60% had lesion at the right cerebral hemisphere and 80% of the identified post-stroke patients also had associated high blood pressure.

Medical variables	Modalities	Frequency	Percentage (%)
Type of stroke	Hemorrhagic	4	20
	Ischemic	16	80
Complementary Tests	CT-Scan	20	100
Treatments	Medical	16	80
	Surgical	01	5
	Traditional	03	15
Lesion site of brain	Left	08	40
	Right	12	60
Dominant hand in active life	Left	00	00
	Right	20	100
Main associated deficits	Depression	04	20
	Facial palsy	09	45
	Visual deficit	00	00
	Other deficits	07	35
Degree of paralysis	Mild	11	55
	Moderate	05	25
	Severe	04	20
Degree of spasticity	Mild	18	80
	Moderate	04	20
	Severe	00	00
Other chronic diseases	Diabetes	04	20
	Any heart diseases	00	00
	High blood pressure	16	80

Table 3: Description of stroke related medical variables.

Factors	RR	Adjusted RR (with age)	CI	P value
Sex- Male	5.3	5.3	0.3-82.4	0.23
Type of stroke-Hemorrhagic	7.3	37.0	1.5-80	0.08
Lesion site-Left	2.7	3.4	0.25-11	0.37

Table 4: Factors that could affect the outcome of a MP+CP using the Fisher exact test.

RR: Relative Risk; CI: Confidence Interval.

Patients that had lesion on the left cerebral hemisphere of the brain had a better prognosis outcome for mental practice combined with conventional physiotherapy 2.7 times better than patients with lesion on the right cerebral hemisphere. Table 4 also remarks that adjusting relative risk (RR) factor with age or if we consider only people of the same ages, patients with lesion on the left part of the brain will respond to treatment 3.4 times to MP+CP. Nevertheless, 2.7 were obtained as relative risk but the real relative risk in the general population was found between 0.25 - 11(P = 0.37). Thus, p-value is >0.05.

Scale (score)	Control group [n = 05]	Intervention group [n = 08]	
	Sub-acute	Sub-acute	P-value
Pre-WMFT	28.9	40	0.51
Post-WMFT	41.5	56.3	
Difference	12.6	16.3	

Table 5a: Comparing the mean scores from the WMFT before and after intervention for sub-acute post-stroke hemiplegic patients in the control and intervention groups using the Mann-Whitney test.

WMFT: Wolf Motor Function Test.

We noted that the mean scores of the sub-acute patients in the intervention and control groups both increased after 5 weeks of therapy from 40 - 56.3 and 28.9 - 41.5 respectively using the WMFT UE function evaluation scale, with no statistical significant difference (P-value = 0.51). Nevertheless, the sub-acute patients in the intervention group showed a slight increase in the mean score than those of the control group which wasn't statistically significant as compared with the Mann Whitney test (P-value = 0.21).

Scale (score)	Control group [n = 04]	Intervention group [n = 03]	
	Chronic	chronic	P-value
Pre-WMFT	33	38.5	0.47
Post-WMFT	27.5	36.4	
Difference	-5.5	-2.1	

Table 5b: Comparing the mean scores from the WMFT before and after intervention for chronic post-stroke hemiplegic patients in the control and intervention groups using the Mann Whitney test.

WMFT: Wolf Motor Function Test.

Also, looking at table 5b above, the mean scores of the chronic patients both in the control and intervention groups either slightly dropped with the WMFT. Using the Mann-Whitney test to compare the values before and after treatment in both groups, there was no significant difference (P-value = 0.47).

Scale (score)	Control group [n = 04]	Intervention group [n = 03]	
	Sub-acute	Sub-acute	P-value
Pre-FAI	22.5	28.4	0.50
Post-FAI	25.3	33.2	
Difference	3.1	4.8	

Table 6a: Comparing the mean scores from the FAI before and after intervention for the sub-acute post-stroke hemiplegic patients in the control and intervention groups using the Mann-Whitney test.

The mean score of sub-acute patients both in the control and intervention groups using the FAI increased from 22.4 - 25.3 and 28.4 - 33.2 respectively, (P-value = 0.50 as compared with the Mann Whitney test).

Scale (score)	Control group [n = 04]	Intervention group [n = 03]	
	Chronic	Chronic	P-value
Pre-FAI	28.4	24.5	0.38
Post-FAI	26	26.5	
Difference	-2.4	2	

Table 6b: Comparing the mean scores from the FAI before and after intervention for chronic post-stroke hemiplegic patients in the control and intervention groups using the Mann-Whitney test.

FAI: Frenchay Activity Index.

Additionally, there was also a slight increase in the mean score (24.5 - 26.5) of the chronic stroke patients in the intervention group with the FAI but a corresponding drop of the mean score (28.4 - 26) of the chronic stroke patients in the control group using the same evaluation scale after five weeks of treatment. After five weeks of treatment, there was no significant difference in both the control and intervention groups (P-value = 0.38) as compare with the Mann Whitney test.

Discussion

Similar studies have been carried out in many parts of the world particularly in Asia, Europe and America, to evaluate the effect of mental practice (MP) combined with conventional physiotherapy (CP) to, improve upper extremity (UE) function and activity of daily performance (ADP) [8,10,12,14,17]. Our methodology was similar to other studies particularly to those of Page and his collaborators in 2005 and Yoo and his collaborators in 2001 [12,18], with the difference that their studies were randomized and evaluation tools adapted to their context. The WMFT was used to evaluate UE function before and after intervention while the FAI was used to evaluate the activity of daily performance, same as a study carried out in 2008 by Verbunt and collaborators to evaluate mental practice [19]. Our final result showed that there was a slide increase in the mean score of sub-acute patients in both groups after five weeks of therapy. But those of the intervention group had a mean score slightly higher than those of the control group after five weeks of therapy using the evaluation tools WMFT and FAI. Comparison between groups was done with the Mann-Whitney test.

A greater percentage of our study population were males (65%) similar with the findings of Mohr and his collaborators in 2004 [20]. Also, we noted in our study that ischemic stroke (80%) was the predominant stroke type, and a higher percentage of patients had an associated high blood pressure (80%) and diabetes (20%). These results are similar to those obtained by Mapoure and collaborators in 2014 in Cameroon [21]. Furthermore, the results of this study showed that using the contingency table, with adjusted relative risk (with age), gender, stroke type and lesion side of the brain could influence the outcome of Mental Practice (MP) combined with Conventional Physiotherapy (CP) to improve upper extremity (UE) function and Activity of Daily Performance (ADP) of post-stroke hemiplegic patients.

Using the Mann Whitney test to compare both groups variables and P-value estimation, our results showed that: the mean score of sub-acute patients both in the control and intervention groups slightly increases five weeks after therapy from 28.9 to 41.5 and 40 to 56.3 respectively as evaluated with the WMFT, with the intervention group having a slightly higher mean score difference of 16.3 (P-value = 0.21). This result is different from the findings on Mental Practice by Page and collaborators in 2001 in a randomized study [22]. This could be due to smaller sample size, none randomization, treatment duration, and evaluation scales used in both studies.

Also, we noted that the mean scores of chronic post-stroke hemiplegic patients both in the control and intervention groups slightly dropped from 33 to 27.5 and 38.5 to 36.4 respectively after five weeks of therapy with the WMFT. Comparing results of both

groups with the Mann-Whitney test, there was no significant difference (P-value= 0.47). This does not agree with the results obtained by Page and collaborators in 2007 who had a sample size of 32 chronic stroke patients with significant result at P = 0.001 in a randomized study [23]. This difference could be attributed to; differences in sampling methods used in both studies, the differences of stroke phases included in our study, smaller sample size of our study participants, reliability of the evaluation scales used in this studies, compliance of patients to the treatment techniques, power of the statistical test used in these studies.

Considering the Frenchay Activity Index (FAI), for the sub-acute patients, FAI increased from 28.4 - 33.2 in the Intervention group and 22.4 - 25.3 in the control group after five weeks of treatment (P-value = 0.50). On the other hand, there was a corresponding increase of the mean score from 24.5 to 26.5 of the chronic stroke patients in the intervention group after five weeks of therapy. We noticed a small drop of the mean score of FAI (28.4 - 26.0) in the control group. Comparing both groups with the Mann-Whitney test; these changes were not statistically significant (P-value = 0.38). Thus, disagreeing with the randomized study on Mental Practice in 2005 by Page and collaborators who registered significant results (P = 0.004) [18]. This may be due to; sampling methods used, reliability of the evaluation scale used, smaller sample size, increasing spasticity, lack of motivation, and patient's compliance to therapy.

Limitations of the Study

This study is limited by the following aspects: The time length and sample size of our study was small, this may have affected the results of our findings. Also, the lack of randomization in this study could leads to problems of representation of the entire study population, lower chances of equal comparable groups, and lower level of generalization of our results; loss of follow up of some participants who dropped out of the study for different reasons could have affected the strength of our findings. More so, we did not control for the multitude of treatments (medical treatments) that are co-administered during a typical inpatient rehabilitative stay, which could constitute a contaminant and likely threat to our findings. Lastly, the fact that sub-acute and chronic patients were considered in this study and spasticity wasn't controlled in this study; this could have posed a major problem in the evolution of these patients using the treatment protocol.

Conclusion

Mental Practice associated with Conventional Physiotherapy, was found to be more effective at improving UE function and ADP in post-stroke hemiplegic patients than Conventional Physiotherapy alone using the evaluation scales WMFT and FAI together with the statistical test (Mann-Whitney test) used in this study for comparing both groups and P-value estimation. More so, our results revealed that MP combined with CP could be more effective in the sub-acute phase after stroke as shown in this study. These results were however not statistically significant using the Mann-Whitney test for P-value estimation. Further studies with larger sample sizes and longer durations in this same sitting should be undertaken.

We recommend that controlled random sampling methods should be used in future studies to maximize the chances of having comparable equal study groups. We also recommend that, other studies should be carried out recruiting only patients with the same socio-demographic and stroke related medical variables, such as only patients of the same age group, gender, stroke type and lesion side including control of spasticity to maximize the outcome of the research treatment protocol.

Lastly, we recommend that physiotherapists should integrate the use of mental (remove) MP into the rehabilitation programs of post-stroke hemiplegic patients in their respective treatment centers, attend seminars on the use of MP and its importance in rehabilitation programs. Specialist (Physicians) should refer patients early enough for rehabilitation for better follow up and to maximize the chances of recovery.

Compliance with Ethical Guidelines

The study design and Methodology were approved by the Scientific Committee of the Dschang University, Cameroon. To conduct this study, we had permission from the Regional representation of the minister of public health, and Ethical Committee of Research for Human Health of Cameroon.

Consent for Publication

Not applicable.

Availability of Data and Materials

Most data generated or analyzed during this study are included in this published article. Please contact authors for raw data requests.

Conflict of Interest

The authors certify there is no conflict of interest.

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Annex

Description of mental practice approach used in this study.

Figure a: Teach MP technique.

Figure b: Develop self-generated treatment.

Bibliography

1. Juhyung P., *et al*. "Effects of mental practice on stroke patients' upper extremity function and daily activity performance". *Journal of Physical Therapy Science* 27.4 (2015): 1075.

2. Kwakkel G., *et al*. "Probability of regaining dexterity in the flaccid upper limb: Impact of severity of paresis and time since onset in acute stroke". *Stroke* 34.9 (2003): 2181-2186.

3. Timmermans A A., *et al*. "Effect of mental practice on the improvement of function and daily activity performance of the upper extremity in patients with sub-acute stroke: a randomized clinical trial". *Journal of America Medical Direction Association* 14 (2013) 204-212.

4. Stephen J. "Page and Healther Peters. Applying mental practice and neuroplasticity principles to increase upper extremity function". *Stroke* 45 (2014): 3454-3460.

5. Maselko J., *et al*. "The intersection of sex, marital status, and cardiovascular risk factors in shaping stroke incidence: Results from the health and retirement study". Department of Psychiatry and Behavioral Sciences, Duke University, Durham 57.12 (2009): 2293-2299.

6. Liu KP., *et al*. "Mental imagery for promoting relearning for people after stroke: A randomized controlled trial". *Archives of Physical Medical Rehabilitation* 85.9 (2004): 1403-1408.

7. Page SJ., *et al*. "Cortical plasticity following motor skill learning during mental practice in stroke". *Neurorehahabilitation Neural Repair* 23.4 (2009): 382-388.

8. Yoshino Jaime OTS. "The effectiveness of mental imagery on the functional rehabilitation of stroke patients with hemiparesis". *Physical function CATs* (2010).

9. Hua Lui., *et al*. "Mental practice combined with physical practice to enhance hand recovery in stroke patients". *Behavioral Neurology* (2014): 876416.

10. D Garcia Carrrasco and J Aboitiz Cantalapiedra. "Effectiveness of motor imagery or mental practice in functional recovery after stroke: a systematic review". *Neurology* (2016): 43-52.

11. Butler A J and Page S J. "Mental practice with motor imagery: Evidence for motor recovery and cortical reorganization after stroke". *Archives of Physical Medicine Rehabilitation* 87 (2006): S2-11.

12. Yoo E., *et al*. "Mental practice effect on line-tracing accuracy in persons with hemiparetic stroke: A preliminary study". *Archives of Physical Medicine Rehabilitation* 82.9 (2001): 1213-1218.

13. Smania N., *et al*. "Vasomotor imagery and rehabilitation of neglect". *Archives Physical Medicine Rehabilitation* 78.4 (1997). 430-436.

14. Braun S M., *et al*. "The effects of mental practice in stroke rehabilitation: A systematic review". *Archives of Physical Medicine Rehabilitation* 87.6 (2006): 842-852.

15. National stroke foundation Clinical Guidelines for Stroke Management. Melbourne Australia (2010).

16. Kumar C and Monika. "Effectiveness of mental practice combined with conventional physiotherapy in the treatment of post stroke patients". *Journal of Novel Physiotherapy* 4 (2014): 216.

17. Cha Y J., *et al*. "Effect of functional task training with mental practice in stroke: A meta-analysis". *Neurological Rehabilitation* 30.3 (2012): 239-246.

18. Page S J., *et al*. "Effects of mental practice on affected limb use and function in chronic stroke". *Archives of Physical Medicine Rehabilitation* 86 (2005): 399-402.

19. Verbunt A., *et al*. "Mental practice-based rehabilitation training to improve arm function and daily activity performance in stroke patients: A randomized clinical trial". *Licensee* 8 (2008): 7.

20. Mohr Dennis C., *et al*. "Stroke: Pathophysiology, Diagnosis, and Management". New York: Churchill Livingstone (2004).

21. Yacouba N M., *et al*. "Stroke epidemiology in Douala: three years prospective study in a teaching hospital in Cameroon". *Journal of Neuroscience* 4 (2014): 406-414.

22. Page S J., *et al*. "A randomized efficacy and feasibility study of imagery in acute stroke". *Clinical Rehabilitation* 15.3 (2001): 233-240.

23. Page S J., *et al*. "Mental practice in chronic stroke: Results of a randomized, placebo-controlled trial". *Stroke* 38.4 (2007): 1293-1297.