

Bobath versus Proprioceptive Neuromuscular Facilitation in retraining of balance and Functional Independence in Activities of Daily Living

Abstract

Aim: To ascertain the comparative efficacy of Bobath and Proprioceptive Neuromuscular Facilitation in retraining of balance and functional independence in activities of daily living.

Study design: Pre-post experimental design

Place and Duration: The study took place at the University of Nigeria Teaching Hospital, Enugu between May and August, 2013.

Methodology: In this study, a total of 50 (29 men and 21 women) stroke survivors with modal age of 60-65years were purposively recruited, examined, treated and re-evaluated four-weekly. This study lasted for 12 weeks. Functional independence in activities of daily living (ADL) and balance were assessed using Barthel Index (BI) and Berg Balance Scale respectively. Gain in function was calculated as the differences between baseline and post-treatment scores. Data was analyzed using SPSS version 23, with $\hat{I}\pm$ set at 0.01.

20 **Results: Comparing gain in functional independence in ADL between Bobath and PNF,**
21 **result shows significantly consistent higher gain with use of Bobath ($P = < .001$, .02 and**
22 **.04). No statistical significant difference was found in balance between Bobath and PNF**
23 **in any of the months ($P = 0.16$, .25 and .08). However, going by clinical important**
24 **difference of 3 on Berg balance scale, Bobath was found to be more efficacious than**
25 **PNF after three months.**

26 **Conclusion: Bobath appears superior to PNF in retraining of balance and functional**
27 **independence in ADL.**

28 **Keywords: Stroke, Bobath, PNF, Balance, Functional Independence, ADL**

29 **1. INTRODUCTION**

30 Stroke is one of the leading causes of death and commonest cause of long term disability in
31 adults [1, 2]. It is third most common cause of death in developed countries [3] and the
32 leading cause of death in nation like China [4]. Global prevalence rate is 5 per 1000 person
33 years, which amounts to 33 million people living with stroke [5]. Approximately two-thirds
34 of stroke patients have long standing neurological deficits and this impedes performance
35 functional independence and hence, activities of daily living [4]. Post-stroke impairment
36 differs from person to person, and it varies chiefly with factor such as the region of the
37 central nervous system that sustained damage [4]. Stroke can result in a large variety of
38 symptoms and signs but the most common and widely recognized impairment caused by
39 stroke is motor impairment, which typically affects control of movement of the face, arm and
40 leg of one side of the body [7]. Motor impairment often leads to balance impairment [8, 9],
41 and impaired postural control and mobility [10].

42 The focus of stroke rehabilitation is largely on the recovery of impaired movements and
43 functions. This is in a bid to reducing stroke-associated disability while facilitating functional
44 independence in activities of daily living. Several factors have been associated with delay in
45 post-stroke functional recovery including choice of therapeutic approach, which is
46 interestingly paramount. In stroke rehabilitation, a number of different physiotherapy
47 approaches such as Bobath approach, motor re-learning approach, Brunnstrom, Rood
48 approach, proprioceptive neuromuscular facilitation have been developed based on different
49 theories about how people recover after a stroke [11]. Of these, the commonly used
50 approaches in this setting are bobath and proprioceptive neuromuscular facilitation [12]. The
51 Bobath concept explained movement dysfunction in hemiplegia from a neurophysiological
52 perspective and states that patients must be active while the therapist assists patients to move
53 using key points of control and reflex-inhibiting patterns [11]. The PNF utilizes
54 proprioceptive, cutaneous and auditory input to produce functional improvement in motor
55 output [13, 14]. The basis for choosing between Bobath and proprioceptive neuromuscular
56 facilitation is, however, poorly understood; there is paucity of evidence in respect of
57 superiority of PNF over Bobath or vice versa. Generally, for optimum functional recovery,
58 therapists commonly engage both approaches in treatment of patients [12]. Lack of man-
59 power and excessive workloads which characterize resource constrained settings pose severe
60 hindrance to combination of approaches [15]. Therapists have often reported burn-out
61 syndrome and this has resulted in poor post-stroke rehabilitation outcomes [16]. Therefore
62 there is need to determine the more efficacious of the two most common approaches utilized
63 in rehabilitation of survivors of stroke in our setting. It was hypothesized that there would be
64 no significant difference between Bobath and PNF in retraining of balance and functional
65 independence in activities of daily living after stroke.

67 2. MATERIALS AND METHODS

68 The study is a pretest-post test experimental study of stroke survivors attending outpatient
69 physiotherapy clinics of the University of Nigeria Teaching Hospital (UNTH) Enugu. A total
70 sample size of 46 (23 per group) was obtained using large effect size of 1.0 at $\beta=0.9$, $\alpha=0.05$
71 0.90 [17]. Participants were purposively recruited, conveniently allocated, evaluated, treated
72 and re-evaluated. Participants were recruited based on the following inclusion criteria: being
73 medically and mentally stable, attendance to outpatient physiotherapy clinic and ≤ 65 years.
74 All the participants had physiotherapy sessions twice weekly. This study lasted for 12 weeks,
75 and participants were reevaluated on monthly basis. The following participants were
76 excluded: participants who received extra physiotherapy outside the clinic during the
77 research period, participants who had severe arthritis, history of mental illness, were
78 pregnant, were on muscle relaxant and/or had cardiovascular complications. Ethical approval
79 was sought and obtained from the Health Research and Ethics Committee of UNTH.
80 Informed consent was sought and obtained from the participants.

81 Considering that the functional requirement of Bobath and those of PNF are different, as
82 validated by difference in baseline scores on each of Barthel Index and Berg balance scale,
83 the study used to functional gain instead of ordinary scores. This was to allow the exact
84 effects of each Bobath and PNF on functional independence in ADL and balance to be
85 estimated with minimal bias. Functional gains were calculated as the difference between
86 baseline and post-treatment scores. Functional independence in activities of daily living
87 (ADL) was assessed using Barthel Index (BI), and balance was assessed using Berg Balance
88 Scale respectively. Participants were age and sex matched.

89 **2.1 Assessment of Functional Independence in Activities of Daily Living**

90 Barthel Index was used for assessment of functional independence in ADL. It contains a total
91 of 10 items describing different activities. The scoring is done by adding individual item
92 score to give a total score ranging from 0 (totally dependent) to 100 (completely
93 independent). Lower scores indicate greater dependency. Scores on Barthel Index were
94 interpreted as 80–100, independent, 60–79 needs minimal help with ADL, 40–59, partially
95 dependent, 20–39 very dependent, and score < 20, totally dependent [18]. It has good internal
96 consistency with a Cronbach's alpha coefficient of 0.98; intrarater and inter-rater reliabilities
97 are high, with a Pearson's *r* score ranging from 0.89 to 0.99 [19]. The instrument has been
98 validated among stroke survivors in Nigeria [20] and used in several Nigerian studies to
99 evaluate functional independence in activities of daily living [21, 22, 23]. The interview
100 guide used in this study was similar to that of Badaru et al. [23].

101 **2.2 Assessment of Balance**

102 Balance was assessed using Berg balance scale. It is a 14 item list with each item consisting
103 of a five-point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function
104 and 4 the highest level of function. A score of 56 indicates functional balance while score <
105 45 indicates individuals may be at greater risk of falling [24]. It has good high intrarater and
106 interrater reliability (ICC = 0.98 and 0.96 respectively [25]. Test-retest reliability in 22 people
107 with hemiparesis is also high (ICC = 0.98) [26]. The Berg balance scale has not been
108 validated among Nigerian stroke survivors; however, it has wide utility among studies
109 focusing on Nigerian stroke survivors [27], Hamzat and Fashoyin, [28] and Ekechukwu et al.
110 [29].

111

112 **2.3 Procedure**

The participants of both groups were involved in baseline assessment by Barthel Index and Berg Balance Scale. Each participant's vital signs were measured to ascertain fitness. Thereafter participants were called for usual treatment by certified therapist following Bobath technique or PNF technique. Bobath technique used in this study is consistent with Kannabiran et al. [11]. Clinical applications assessed were upper limb function, sitting up over the side of bed, balanced sitting, standing up and down, and balanced standing. The PNF patterns in the set used in the study are as described by Knott and Voss [30]. Repetitions of each pattern were done before proceeding to the next pattern, consistent with what was recorded in previous PNF studies [31, 32]. After the set of patterns was completed, it was repeated twice in each treatment session making 3 sets per session. Each participant received treatment twice a week for 12 weeks making 24 sessions in all. At the end of every fourth week, both groups were reevaluated using Barthel Index and Berg Balance Scale.

3. RESULTS AND DISCUSSION

3.1 RESULTS

3.1.1 Demographics

A total of 50 stroke survivors (29 men and 21 women) participated in this study. Result shows that participants in this study were age and sex matched ($P=.66$ and 1.0) respectively (Table 1)

Table 1: Distribution of Participants based on Sex and Age

Demographics	Bobath	PNF	X ²	P
Sex				
Male	14	15	0.774	0.5
Female	11	10		
Age				
40-45yrs	-	2	4.14	0.39
45-50yrs	2	-		
50-55yrs	5	5		
55-60yrs	7	8		
60-65yrs	11	10		

*: significant at $\alpha=0.05$

3.1.2 Comparison of Functional Independence (Barthel Index Score) and Balance (Berg Scale Score)

Results shows significant differences exist between baseline scores on Barthel index and Berg balance scale ($P = .05$ and $.03$ respectively) (Table 1). In order to control for this baseline difference, treatment effect or actual gain (difference between pre-test and post-test scores) in balance and functional independence were calculated. One sample t-test was used to compare gains in balance and functional independence in ADL with the hypothetical clinical important differences (CID) (Barthel index: CID=2; Berg balance scale: CID=3). For Bobath, result shows significant differences between functional gains in ADL and balance in each month and hypothetical value ($P = <.001, <.001, <.001, .02, <.001$ and $<.001$) respectively. As for PNF, significant differences between gain in functional independence and balance in each month and hypothetical values except in this first month ($P = .13, <.001, <.001, 0.18, <.001$ and $<.001$) (Table 2).

Table 2: Baseline Scores on Barthel Index (BI) and Berg Balance Scale (BBS), and Chi-square Test showing Association between sex and treatment approach

	<u>BI score</u>	<u>BBS Score</u>	<u>Age (yrs)</u>	<u>SEX</u>			
	Mean±SD	Mean±SD	Mean±SD	Male	Female	X ²	P
<u>Approach</u>							
Bobath	58.40±16.88	19.36±13.25	58.36±5.06	14	11	0.082	1.00
PNF	68.40±16.88	28.16±14.02	57.68±5.74	15	10		
P	0.047*	0.027*	0.659				

*significant at $\alpha=0.05$, X²: chi-square

3.1.3: Analysis of Variance testing for consistency of the effect of each of Bobath and PNF functional Independence and balance

Analysis of Variance testing was used to test for consistency of the effect of each of Bobath and PNF on balance and functional Independence in ADL. Result shows consistent and significant changes in functional independence and balance with use of Bobath ($P=<.001$) among the three months, with largest and least gains recorded in the third and first month respectively (Table 3). Also, significant changes in functional independence and balance was found with PNF approach among the three months ($P=<.001$) (Table 3). Largest and least gains were recorded in the third and first month respectively.

Table 3: One Sample T-test Illustrating Functional Gains in ADL and Balance with Bobath and PNF Approaches

	<u>Bobath</u>				<u>PNF</u>			
	<u>Gain in ADL</u>		<u>Gain in balance</u>		<u>Gain in ADL</u>		<u>Gain in balance</u>	
	Mean±SD	P	Mean±SD	P	Mean±SD	P	Mean±SD	P
1 st	9.60±6.11	0.000*	6.08±6.23 ^a	0.021*	13.33±12.98	0.126	4.00±3.65 ^a	0.184
2 nd	20.00±9.46	0.000*	17.20±10.18	0.000*	13.20±9.56	0.000	14.48±6.25 ^b	0.000*
3 rd	31.80±13.38	0.000*	24.64±9.07	0.000*	23.60±14.03	0.000	20.00±9.31 ^c	0.000*

*= significant at $\alpha = 0.05$

3.1.4 Comparison of Post-treatment gain in functional independence and Balance between Bobath and PNF

Comparing gain in functional independence between Bobath and PNF, result shows significantly higher functional gain with use of Bobath, in all the three months ($P=<.001$, .015 and .04). No statistical significant difference was found in gain in balance between Bobath and PNF in any month ($P=0.16$, .25 and .08 in each) (Table 4). However, going by minimally clinical important difference of 3 on Berg balance scale, Bobath approach was found to be more efficacious than PNF only in the third month (Table 4). In the light of these findings, the null hypothesis is hereby rejected.

Table 4: Analysis of Variance Comparing Functional Gains in ADL and Balance with each of Bobath and PNF

	<u>Bobath</u>		<u>PNF</u>	
	<u>Gain in FI</u>	<u>Gain in balance</u>	<u>Gain in FI</u>	<u>Gain in balance</u>
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
<u>Month</u>				
1st month	9.60±6.11 ^a	6.08±6.23 ^a	13.33±12.98	4.00±3.65 ^a
2nd month	20.00±9.46 ^b	17.20±10.18 ^b	13.20±9.56	14.48±6.25 ^b
3rd month	31.80±13.38 ^c	24.64±9.07 ^c	23.60±14.03	20.00±9.31 ^c
F-value	30.255	29.155	25.784	35.615
P	0.000*	0.000*	0.000*	0.000*

*significant at $\alpha=0.05$; FI= functional independence

3.2 DISCUSSION

The differences in baseline scores of balance and functional independence in ADL between participants who received Bobath and those who received PNF validate the fact that the functional requirement of Bobath is lesser than that of PNF. This is consistent with the inclusion criteria obtain in previous studies, in which PNF criteria range from having attained Brunnstorm recovery stage IV, being able to walk 10m independently [33, 34], as against Bobath approach which accommodate patients at early recovery stage of stroke [11, 35]. The study shows improvement in balance and functional independence in activities of daily living. This is consistent with findings of Van Vliet et al. [36] and Wang et al. [33], in which effects of Bobath therapy on symmetry of weight distribution over hemiplegic and non-Hemiplegic sides and balance control were found to be positive in within four weeks. Bobath approach aims to regain motor control and function of the hemiparetic side after stroke without promoting compensation. It engages facilitation of normal movement components no matter how small and task-specific practice using specific manual guidance. This early response in balance and functional activities of daily living to Bobath may be due to the fact that Bobath accommodate patients at early recovery stage of stroke [11]. Evidence

opines that early intensification is facilitatory to optimum function recovery. This is supported by theory that there is time window in which to make the greatest gains in function [37]. During this window of neuroplasticity, the subjects must practice therapist-guided task-specific movements, to drive Hebbian plasticity in order to regain lost functions [38].

The finding that PNF caused consistent functional gains in activities of daily living and balance only after four weeks is consistent with findings of Lee et al. [39], Jeong et al. [40] and Kim et al. [34], in which improvements in ADL and/or balance were recorded in the sixth or eight week of PNF application. Chol et al. [41] reported that coordination movement using a tapping and PNF combination pattern enhanced the balance of stroke patients. The mechanism of the effect of PNF on functional independence in ADL and balance is believed to be through stimulation of proprioceptive senses of muscles and tendons and plasticity dependent relearning [42, 43]. The PNF when used as a gradual resistance exercise that employs a diagonal pattern maximizes motor unit recruitment through proprioceptive stimulation [44, 45, 42]. PNF promotes maximum usage of muscle fibers due to the intense circumstances caused by manual resistance; moreover, verbal cues and fine handling act as forms of sensory facilitators stimulating proprioception and thus helping to improve balance and functional independence in ADL [34]. Evidence suggests that active exercises such as PNF when applied after cerebral stroke could lead to neural plasticity in the cerebral cortex, resulting in improved motor function and hence balance and functional independence [43]. A space of at least four weeks was necessary to ensure sufficient plasticity-mediated recruitment of motor units needed for improved balance and performance of activities of daily living.

Comparing functional gains in ADL between Bobath and PNF, result shows Bobath is clinically more efficacious than PNF. Consistent with this finding, Krukowska et al. [46]

shows that compared to the proprioceptive neuromuscular facilitation technique, after 6 weeks of training, Bobath approach is a more effective method improved postural sway and balance [46]. There is paucity of literature in respect of comparison of effects of Bobath and PNF on functional independence in ADL. However the fact that Bobath approach accommodates patients at early recovery stage thereby facilitating spontaneous neuroplasticity and consequent function recovery explains why Bobath therapy is superior to PNF in rehabilitation of patients with stroke. Bobath takes advantage of the window period following stroke through early intensification.

A recognized limitation in this study was the difference in baseline scores on BI and BBS between the two groups. This is expected to confound the actual treatment effect. This limitation was, however, addressed by computing for the treatment effect or actual gain in balance and functional independence in ADL. The baseline difference was as narrow as possible, making the two groups comparable. This is shown by the fact that the Bobath group was, on average, partially dependent, a step below the PNF group which was minimally dependent. The inability to conduct retrospective assessment of stroke severity in addition to omission of subtypes of stroke and duration of stroke constitute limitations to this study.

4 CONCLUSIONS

Bobath appears superior to PNF in retraining of balance and improving functional independence in activities of daily living. We therefore recommend Bobath as the technique of choice when it is not feasible to combine both approaches, especially on account of excessive work load which is common in resource constrained setting.

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