Research Article

Comparison of Effects of NDT Vs BWSTT On Lower Extremity Among Chronic Stroke Patients

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Abstract

Objective: The purpose of the study is to determine the effect of Neurodevelopment Treatment Vs Body Weight Supported Treadmill Training along with conventional therapy on lower extremity among chronic stroke patients.

Study Design: Randomized Controlled Trial (RCT).

Place and Duration of study: This study took place n Lahore, Pakistan and the duration of the study was 6 months.

Method: This study is a Randomized Controlled Trial utilized a non-probability purposive sampling technique, the primary outcome measure was Berg Balance Scale and Functional Gait Assessment which were used to check the balance and gait. The findings were then statistically analysed by non parametric tests Mann Whitney U Test and Friedman Test were used for between group and within the group comparisons respectively.

Results: A total of 46 patients participated in the study among which after randomized allocation of 23(50%) in NDT and 23(50%) in BWSTT group. NDT group showed better results than the BWSTT group and the p value is 0.000 which is less than 0.05 when compared between the groups for balance at 12 weeks. NDT group showed better results than the BWSTT group and the p value is 0.001 which is less than 0.05 when compared between the groups for mobility at 12 weeks. Therefore, NDT is better than BWSTT for the improvement of both balance and mobility.

Conclusion: Both of the treatment approaches have proven to be effective in treatment of balance and gait among chronic stroke patients but Neurodevelopmental Treatment has proven to be significantly more effective than Body Weight Supported Treadmill Training and has more significant results.

Discussion: In the current study where NDT and BWSTT are compared to each other shows that NDT is highly effective for the treatment of balance in post stroke patients as compared to BWSTT that is only effective within the group but not as effective as NDT. Similarly Grozdek Covcic et.al in 2021 did a research on "Effects of Bobath treatment and specific mobilizations on gait in stroke patients" which indicated that Bobath technique in combination with soft tissue mobilization shows better results for the maintenance of balance and mobility in post-stroke patients. Also the Bobath treatment helped with increased AROM of the patient [1].

Introduction

World Health Organization(WHO) defined stroke as 'a syndrome of quickly growing medical symptoms of focal disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to demise without any apparent reason other than the vascular origin' [2]. Stroke is neurological disorder that is characterized by blockage of the blood vessels. The clot is formed into the brain it can interrupt the flow of the blood, arteries will clogged and it can causing breakage of blood vessels and lead to bleeding, causing the sudden death of the brain cells due to lack of the oxygen [3]. Nowadays stroke is the fifth leading cause of death and one of the main cause of disabilities in people [4]. Most of the disabilities caused by stroke are related to balance and lower extremity motor and sensory function which can cause changes in the speed

of walking, long swing phase followed by short stance phase, decrease in walking ability and the endurance which eventually results in difficulties to perform activities of daily living [5].

Stroke is more common among men worldwide but women are more severely ill. whereas the subarachnoid haemorrhage is more common among the women and intra-cerebral haemorrhage is more among the male. the mean age for first ever stroke is 68.6 and among women is 72.9. Incidence of stroke in male is 33 percent higher and prevalence is 41 percent high than the female [6].

Stroke highly effects our walking ability [7]. In the stroke survivors balance impairment may be present having abnormal gait patterns which can be characterized by decrease in the speed of walking and stride length and it can cause the increase in risk of falling. Balance is one of the essential component of the walking, balance and gait disorders are present in the chronic stage of the stroke [8]. The restoration of balance mainly depends on the degree of impairment and the severity of stroke. Recent studies have shown that patients who have started physiotherapy early after the stroke have improved their motor function and decreased their disability as compared to those who started physiotherapy late after stroke [9].

Different techniques are used for the assessment of balance and lower extremity motor and sensory function in stroke patients. New magnetic resonance technique, Constrained induced movement therapy(CIMT), Proprioceptive Neuromuscular Facilitation(PNF), Motor relearning program (MRP), Neurodevelopmental training(NDT), Robotic neurological rehabilitation, Dry needling(DNHS technique), Body Weight Supported Treadmill training are the most used techniques for the recovery of stroke patient [10-15].

Both Neurodevelopmental training and Body Weight Supported Treadmill training have been studied on their own but both interventions have not been studied side by side. Both of the interventions have been compared with other techniques like Neurodevelopmental training have been compared with Proprioceptive Neuromuscular Facilitation and Body Weight Supported Treadmill training have been compared with Mirror therapy [16, 17]. In this research we will compare both Neurodevelopmental training and Body Weight Supported Treadmill training with each other to understand which one is better for the treatment of balance and lower extremity motor and sensory function in patients with chronic stroke.

Material and Methods
Study design
Study design was a Randomized Control Trial(RCT).

Study population
The study population was chronic ischemic stroke patients

Setting
As per permission of head of department of physiotherapy from superior university I was collecting data from:
• Chaudhary Muhammad Akram Teaching and Research Hospital.
• Shadman Medical Center.

Duration of study
The duration of study was 6 months after the approval of synopsis.

Sampling technique
Non-probability purposive sampling technique was used in this study.

Sample size
The calculated sample size using Berg Balance Scale as outcome measure was 21 in each group after adding 10% dropout the sample size was 21+2=23 in each group.(4)

Sample Size For Comparing Two Means

Input Data

Confidence Interval (2-sided)	95%	
Power	80%	
Ratio of sample size (Group 2/Group 1)	1	

	Group 1	Group 2	Difference*
Mean	50.1	53.1	-3
Standard deviation	3.9	2.9	
Variance	15.21	8.41	

Sample size of Group 1	21
Sample size of Group 2	21
Total sample size	42

$$n = \frac{2\sigma^2(Z_{\alpha/2} + Z_\beta)^2}{(\mu_l - \mu_c)^2}$$

Z1-α/2 Level of significance=95%
μ1 Expected mean change in Group A= 50.1.(4)
μ2 Expected mean change in Group B= 53.1.(4)
δ1 Expected standard deviation in group A= 3.9.(4)
δ2 Expected standard deviation in group B= 2.9.(4)
n Expected sample size in a group= 21.(4)
After adding 10% drop out in each group the sample size was 23.(4)

Eligibility criteria
Inclusion criteria
• Application of M-Cog test for checking patients cognition.(18)
• Chronic ischemic stroke patients.(19)
• Both Male and Female Patients.(20)
•Patients of 45 to 65 years of age.(21)

Exclusion criteria
• Patients with history of recurrent stroke.(19)
• Patients with lower limb fractures or dislocations.(22)
• Patients with Peripheral vascular disease.(23)
• Patients with skin discoloration or skin ulcers.(24)

Ethical Approval and Screening:
• After giving informed signed consent participants had a detailed neurological examination and assessed for eligibility as defined in the inclusion/exclusion criteria. For assessing the eligibility, participants underwent screening and examination. After this, pre-tests (t0) was performed on eligible participants. Berg balance scale was used to assess balance and Functional Gait Assessment (FGA) was used to assess the gait.
• After baseline assessment, eligible patients were randomly assigned to (in a 1:1 ratio) conventional physical therapy protocol with Neurodevelopmental Training for Group A and conventional physical therapy protocol with Body Weight Supported Treadmill Training for Group B. Conventional physical therapy includes application of hot pack for 20 minutes (25), soft tissue mobilization for three minutes on each leg at the specified site (26), facilitation of muscle activity for 15-20 minutes (27), and education of patient. (28)

Randomization:
• Computer generated randomization assignments was designed by an independent statistician and randomization was done by one of the research team members who wasn't involve in patient recruitment or assessment or data analysis. Randomization assignments was kept in opaque, sealed envelopes and unsealed by a researcher after baseline testing. Outcome assessors were unaware of group assignment. The experiment started on the day after randomization. For both groups, the intervention progressed during the regularly scheduled therapy session and all other routine interdisciplinary rehabilitation proceeded as usual. After randomization, study participants were only informed about the content of their allocated program by their therapist, remaining unaware of the intervention in the other group.

Blinding:
• Patient information state that the study purpose is to determine the effects of in addition to routine physical therapy in comparison to Neurodevelopmental Training and Body Weight Supported Treadmill Training along with conventional therapy in chronic stroke patients, without specifying the details of both programs except for similarities across both groups. Both programs were personalized to the patient's abilities to ensure all eligible patients could complete the program. Researchers who were to assess outcomes or do data analyses were masked to group allocation. Patients were instructed not to talk about the content of their exercise program during the post intervention visit and could contact their therapist in case of any problems during trial participation [19-28].

Intervention:
Group A
Group A was given with Conventional Physical Therapy for 45 minutes, with the Neurodevelopmental Training that includes mobilization of muscles and stiff joints, muscle stretch, practice if more normal movement patterns and weight bearing [29]. The intervention will be conducted 3 times a week for a period of 12 weeks.

Group B
Group B received intervention with Conventional Physical therapy for 45 minutes with Body Weight Supported Treadmill Training each session includes four 5-minute walking bouts for a total of 20 minutes (30), 3 times a week for a period of 12 weeks. The interventions will be performed by a trained physiotherapist.

Results:
Normality of Data.
A total of 46 patients participated in the study among which there was a randomized allocation of 23(50%) in NDT and 23(50%) in BWSTT group. The data shows that the Kolmogrov Smirnov Significance in all 3 values of NDT and BWSTT groups are 0.000 which is less than 0.05 suggesting that the data is not normal hence the Manwhitney and FriedMann tests will be used. Table 1.

Table 1: Tests of Normality

Groups		Kolmogorov-Smirnov⁻ᵃ			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
BBS cutoff	NDT group	.322	23	.000	.753	23	.000
	BWSTT group	.325	23	.000	.746	23	.000

Comparison Between the groups for balance.

A total of 46 patients participated in the study among which there was a randomized allocation of 23(50%) in NDT and 23(50%) in BWSTT group. The data shows that there is very minimal mean value difference between the two groups and the p value is 0.767 which is more than 0.05. The data of 6 weeks shows that there is some difference mean value difference between the two groups i.e. NDT group showed better results than the BWSTT group but the p value is 0.133 which is more than 0.05. The data of 12 weeks shows that there is a big difference mean value difference between the two groups i.e. NDT group showed better results than the BW-STT group and the p value is 0.000 which is less than 0.05. Table 2.

Table 2

Groups		N	Mean ranks	Sum of ranks
BBS cuttoff	NDT Group	23	24.00	552.00
	BWSTT Group	23	23.00	529.00
	Total	46		
BBS cutoff 6 weeks	NDT Group	23	21.28	489.50
	BWSTT Group	23	25.72	591.50
	Total	46		
BBS cutoff 12 weeks	NDT Group	23	15.50	356.50
	BWSTT Group	23	31.50	724.50
	Total	46		
Test of Significance.				
BBS cutoff	Mann-Whitney U	253.000		
	Wilcoxon W	529.000		
	Z	-.296		
	Asymp. Sig. (2-tailed)	.767		
BBS cutoff 6 weeks	Mann-Whitney U	213.500		
	Wilcoxon W	489.500		
	Z	-1.503		
	Asymp. Sig. (2-tailed)	.133		
BBS cuttof 12 weeks	Mann-Whitney U	80.500		
	Wilcoxon W	356.500		
	Z	-4.899		
	Asymp. Sig. (2-tailed)	.000		

Comparison Between the groups for mobility

A total of 46 patients participated in the study among which there was a randomized allocation of 23(50%) in NDT and 23(50%) in BWSTT group. The data shows that there is a minimal mean value difference between the two groups and the p value is 0.527 which is more than 0.05. The data of 6 weeks shows that there is some difference mean value difference between the two groups i.e. NDT group showed better results than the BWSTT group but the p value is 0.147 which is more than 0.05. The data shows that there is a big difference mean value difference between the two groups i.e. NDT group showed better results than the BWSTT group and the p value is 0.001 which is less than 0.05. Table 3.

Table 3

Groups		N	Mean ranks	Sum of ranks
FGA cuttoff	NDT group	23	22.39	515.00
	BWSTT group	23	24.61	566.00
	Total	46		
FGA cuttoff 6 weeks	NDT group	23	21.00	483.00
	BWSTT group	23	26.00	598.00
	Total	46		
FGA cuttoff 12 weeks	NDT group	23	18.00	414.00
	BWSTT group	23	29.00	667.00
	Total	46		
Test of Significance.				
FGA cutoff		Mann-Whitney U	239.000	
		Wilcoxon W	515.000	
		Z	-.633	
		Asymp. Sig. (2-tailed)	.527	
FGA cutoff 6 weeks		Mann-Whitney U	207.000	
		Wilcoxon W	483.000	
		Z	-1.451	
		Asymp. Sig (2-tailed)	.147	
FGA cutoff 12 weeks		Mann-Whitney U	138.000	
		Wilcoxon W	414.000	
		Z	-3.422	
		Asymp. SIG. (2-tailed)	.001	

Interval based comparison of balance in the NDT group and BWSTT group

The Chi Square X^2 (df=2, N = 23) =. 40.519, p< 0.05 shows that significant differences exist in the balance improvement across all three assessment intervals. The result shows that there is a significant improvement in balance in the NDT group after 6 weeks of intervention and even greater improvement after 12 weeks interval of treating patients with Neurodevelopmental Treatment. The Chi Square X^2 (df=2, N = 23) =. 29.414, p< 0.05 shows that significant differences exist in the balance improvement across all three assessment intervals. The result shows that there is a significant improvement in balance in the BWSTT group after 6 weeks of intervention and somewhat lesser improvement after 12 weeks interval of treating patients with Body weight support treadmill training. Table 4.

Table 4

Groups		Mean Rank
NDT Group	BBS cutoff	2.87
	BBS cutoff 6 weeks	2.02
	BBS cutoff 12 weeks	1.11
BWSTT Group	BBS cutoff	2.67
	BBS cutoff 6 weeks	1.91
	BBS cutoff 12 weeks	1.41
Test of Significance.		
NDT Group	N	23
	Chi-Square	40.519
	df	2
	Asymp. Sig. (p value)	.000

BWSTT Group	N	23
	Chi-Square	29.414
	df	2
	Asymp. Sig. (p value)	.000

Interval based comparison of Mobility in the NDT group and BWSTT group

The Chi Square X^2 (df=2, N = 23) =. 33.522, p< 0.05 shows that significant differences exist in the mobility improvement across all three assessment intervals. The result shows that there is a significant improvement in mobility in the NDT group. The Chi Square X^2 (df=2, N = 23) =. 30.000, p< 0.05 shows that significant differences exist in the mobility improvement across all three assessment intervals. The result shows that there is an improvement in mobility in the BWSTT. Table 5.

Table 5

Groups		Mean Rank
NDT Group	FGA cutoff	2.74
	FGA cutoff 6 weeks	1.98
	FGA cutoff 12 weeks	1.28
BWSTT Group	FGA cutoff	2.65
	FGA cutoff 6 weeks	2.00
	FGA cutoff 12 weeks	1.35
Test of Significance.		
NDT Group	N	23
	Chi-Square	33.522
	df	2
	Asymp. Sig. (p value)	.000
BWSTT Group	N	23
	Chi-Square	30.000
	df	2
	Asymp. Sig (p value)	.000

Discussion

The current study that is "Comparison of effects of NDT vs BW-STT on lower extremity among chronic stroke patients" shows that there is a higher prevalence of stroke in male gender as compared to females i-e 60.9% males and 39.1% females. Similarly Michał Kuciel et.al. in September 2021 did a research on "Effect of PNF and NDT Bobath Concepts in Improving Trunk Motor Control in Stroke Patients" that also shows that the prevalence of stroke in male gender is higher than females. Current study compares NDT and BWSTT while the study conducted by Michal Kuciel et.al. compares PNF and NDT. The study conducted by Michal Kuciel shows both treatments have significant results while current study shows that NDT have better results than BWSTT [31].

Jan Mehrholz et.al. conducted a research in 2017 i-e "Treadmill training and body weight support for walking after stroke" shows that treadmill training independently is not a very effective treatment for improvement in walking speed after stroke. Where as the current study lshows that BWSTT has significant results within the group but when compared with NDT, NDT has shown better results at 6 weeks and 12 weeks [32].

Rustem Mustafaoglu et.al. in 2018 conducted a study in Istanbul, Turkey and topic of the study was "The effects of body weight-supported treadmill training on static and dynamic balance in stroke patients" which resulted in considerable changes on balance, mobility and fear of fall of the patient when combined with conventional treatment. Also showed that low frequency of BWSTT is much more effective than high frequency in post stroke patients. Whereas current study shows that BWSTT itself doesn't have any remarkable effect on balance nor when combined with conventional therapy. The current study contradicts the research conducted by Rustem Mustafaoglu which shows better results of BWSTT when combined with conventional therapy [33].

In the current study where NDT and BWSTT are compared to each other shows that NDT is highly effective for the treatment of balance in post stroke patients as compared to BWSTT that is only effective within the group but not as effective as NDT. Similarly Grozdek Covcic et.al in 2021 did a research on "Effects of Bobath treatment and specific mobilizations on gait in stroke patients" which indicated that Bobath technique in combination with soft tissue mobilization shows better results for the maintenance of balance and mobility in post-stroke patients. Also the Bobath

treatment helped with increased AROM of the patient.(1)

A study conducted in China by Jian-qiao WANG et.al. in 2019 i-e "Bobath concept in the process of gait rehabilitation for post-stroke patients with hemiplegia" shows that Bobath treatment improves patient's ability to walk and also improves their motor functions. It also helps with postural control of the patient after stroke. Similarly, current study also shows that NDT is helpful for the improvement of gait and mobility of the patient after stroke. NDT is efficient on its on but it shows even better results in combination with other techniques like conventional therapy [34].

The current study and most of the above mentioned studies shows that NDT is highly effective for the treatment of balance and gait in post-stroke patients as compared to BWSTT. BWSTT is effective on its on but when compared with NDT , NDT showed better results than BWSTT.

Limitation
This research has been conducted on the local population of Eastern Asia. Thus people in this area have a different socioeconomic status than that of other regions of the world hence effecting their personal and environmental factors leading to change in recovery time.

Recommendation
The financial resources and time available to us as students were extremely limited due to which study was conducted in Lahore but can be conducted in northern regions of Pakistan where the environmental factors are completely different.

Conclusion
As per the current study which compared the effectiveness of Neurodevelopmental Treatment vs Body Weight Supported Treadmill Training in treatment of balance and gait among chronic stroke patients, both of the treatment approaches have proven to be effective in treatment of balance and gait among chronic stroke patients but Neurodevelopmental Treatment has proven to be significantly more effective than Body Weight Supported Treadmill Training and has more significant results. Hence alternate hypothesis is accepted.

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