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Effect of Vibration Stimulus on Balance and Gait in Stroke Patients

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A B S T R A C T

Introduction: The patients with certain kinds of neurological defecits Vibration Stimulus has been reported to improve overall function. Our main aim was to find out the effects of vibration Stimulus stimulus on both balance and gait in stroke patients.
Methods: Sixty post-stroke patients were divided into two groups. Group A received vibration Stimulus stimulus plus conventional Physiotherapy on affected side dorsiflexors and Quadriceps muscle while Group B received conventional Physiotherapy only. All patients participated in a conventional rehabilitation program for two weeks 45-55 minutes for 6 times per week while the vibration Stimulus group also received vibration Stimulus stimulus for additional 5 minutes. Patients balance and walking performance were evaluated using the Single leg standing (SLS), Timed Up and Go Test (TUG) and gait parameters for both the lower limbs by step length, step time, cadence and gait velocity by paper walkway method.
Results: The median (range) age of all patients was 51.00 (18–66) years. After intervention, significant improvements were found in the Vibration Stimulus group for SLS score (p=0.004), TUG score (p=0.035), step length (p=0.004) and Gait velocity(p=0.031) , when compared to the controls.
Conclusion: vibration Stimulus stimulus is effective in the improvement of gait and balance in stroke patients.

Keywords: Stroke, vibration Stimulus stimulus, gait, balance

1. Introduction

Vibration Stimulus therapy is used to treat upper limb motor functions in stroke patients. The use of vibration Stimulus therapy is nowadays used extensively for the treatment of various conditions owing to their neurological nature and origin.

Vibration Stimulus Stimulus is defined as production of alternating waves that transmitting vertical sinusoidal oscillations via the point of application over the body part (1). Vibration Stimulus therapy is nowadays used to enhance athletic performance in athletes by its beneficial effects on motor activity, thereby improving both muscle strength and power (1–3). Enhanced neuromuscular activation during Vibration Stimulus Stimulus thus enhance muscle strength and thereby its power generated. The main reason for this enhancement is the tonic vibration Stimulus reflex (TVR) that results in an enhancement in electrical impulse activity in the muscles (4, 5).

Various researches have proved the beneficial effects of vibration Stimulus stimulus in other neurological conditions like SCI, Taebes dorsalis, Parkinsons disease etc (6–11). But there is a dearth of information that is present pertaining to the use of vibration Stimulus stimulus on improvement of balance and gait in post stroke hemiplegic patients. Therefore the main aim of the research was to find out the effect of vibration Stimulus stimulus on improvement of balance and gait in stroke patients.

2. Methods

Sixty patients with stroke were included in the study as study participants. The patients were then allocated to two groups, Group A (Vibration Stimulus plus conventional Physiotherapy Group) with total 30 subjects and Group B (Conventional Physiotherapy group) with total 30 subjects. Inclusion criteria included:1) Both male and female post stroke hemiplegic patients; 2) Age: 40 – 70 years; 3)Increased muscle tone of the affected lower limb hamstring and plantar flexor muscles (Modified Ashworth Scale score between grades 1+ and 2); 4) Receiving constant medications

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throughout the treatment; 5) No peripheral nerve injury of lower limbs; 6) Patient not having uncontrolled diabetes mellitus; 7) Is able to follow and obey commands; 8) Is able to stand.[24], The exclusion criteria included 1) Onset of stroke < 4 weeks previously till 1 year ; 2) Patient present with perceptual and cognitive disorder and 3) Dementia.

All The Subjects incorporated in the treatment underwent pre treatment assessment of balance and gait parameters. The gait parameters were assessed for both the lower limbs by step length , Step time, cadence, and gait velocity by paper walkway method. The balance was assessed by Timed Up and Go test and single leg standing test of both legs. After a brief introduction about study, treatment commenced in both groups. Group A subjects received conventional physiotherapy plus vibration Stimulus and Group B subjects received conventional physiotherapy alone. The conventional physiotherapy was given for 45-55 minutes to both the groups i.e. Group A and B, whereas the vibration Stimulus therapy was only given in Group A for 5 minutes, 6 times /week for 2 weeks over the affected side Quadriceps and Dorsiflexors muscles. After the end of the two weeks of treatment protocol, both the groups again were assessed for balance and gait parameters

3. Results

A total 46 patients were included in the study. Three patients in the Group B were excluded from our analysis because they discontinued the study due to social reasons. A total of 43 patients (vibration Stimulus group n=26, Group B n=17) completed the study. There were no significant demographic differences between the groups (see Table 1). No significant differences were found between the two groups in the pre-treatment evaluation based on the SLS and TUG scores (p=0.687 and p=0.289, respectively). After treatment, statistically significant improvements were found in the Group A for both the SLS (p=0.004) and TUG (p=0.035) scores when compared to the Group B. The pre- treatment and post-treatment SLS and TUG scores of the participants are shown in Table2.

On gait analysis, statistically significant differences between the two groups were observed in two of the parameters assessed. Significant increases in step length (p=0.004) and Gait velocity(p=0.031) were observed in the Group A. The gait analysis results of the patients are presented in Table3.

Table1. Comparison of patient demographic data between the Group A and Group B

	Group A (n=30)	**Group B (n=30)**	**p**
Mean age ± SD* (years)	46.8±15	51.6±10	0.451
Gender n (%)	14 (53.8%) F 12 (46.2%) M	9 (52.9%) F 8 (47.1%) M	0.409
Hemiplegic side n (%)	17 (65.4%) R 9 (34.6%) L	11 (64.7%) R 6 (35.3%) L	0.473
Mean±SD* duration since stroke (months)	34.5±25	35.5±20	0.520

*SD: Standard Deviation

Table 2. Comparison of SLS and TUG scores between the Group A and Group B before and after treatment

		Pre-treatment	**Post-treatment**	**p****
SLS	Group A (Mean score ± SD)	25.7±4.9	36.9±5.2	<0.001
	Group B (Mean score ± SD)	24.0±10.9	26.4±11.0	<0.001
	p*	0.687	0.004	
TUG	Group A (Mean score ± SD)	17.5±4.0	10.7±3.1	<0.001
	Group B (Mean score ± SD)	19.5±3.6	13.2±3.7	<0.001
	p*	0.298	0.035	

* Statistically not significant

** Statistically significant

SLS: Single Leg Standing, TUG: Time Up AND Go Test

Table 3. Comparison of gait analysis parameters between the Group A and Group B, before and after treatment

Gait Analysis		Before Treatment	After Treatment	p**
Cadence (steps/min)	Group A	78.30±18.15	89.42±20.86	0.000
	Group B	80.41±22.38	79.94±21.32	0.413
	p*	0.931	0.223	
Single support (seconds)	Group A	0.47±0.12	0.44±0.09	0.239
	Group B	0.45±0.06	0.44±0.07	0.307
	p*	0.565	0.601	
Double support (seconds)	Group A	0.60±0.41	0.49±0.39	0.000
	Group B	0.65±0.45	0.62±0.38	0.711
	p*	0.784	0.196	
Step length (meter)	Group A	0.44±0.08	0.52±0.07	0.000
	Group B	0.38±0.13	0.41±0.13	0.209
	p*	0.117	0.004	
Step time (seconds)	Group A	0.95±0.54	0.84±0.40	0.001
	Group B	0.84±0.25	0.83±0.24	0.484
	p*	0.950	0.411	
Gait velocity(m/s)	Group A	0.58±0.14	0.74±0.21	0.000
	Group B	0.59±0.21	0.61±0.18	0.049

All data are shown as mean ± SD

* Statistically not significant

** Statistically significant

4. Discussion

This study aimed to investigate the effect of vibration stimulus on balance and gait in stroke patients. We hypothesized that vibration stimulus would result in significant improvement in balance and gait performance in stroke patients. Indeed, we found statistically significant differences between the vibration Stimulus and Group Bs with respect to several parameters. Significant improvements were recorded in the SLS scores, TUG scores, step length and walking speed. Our results support our initial hypothesis that vibration stimulus would be an effective adjunct therapy to conventional rehabilitation therapies in stroke patients.

No patients withdrew from the vibration stimulus study group as the intervention was of short duration, simple to perform and did not cause any adverse reactions. All participants in both groups continued to perform their conventional training, which included stretching exercises, strengthening exercises and ambulation training.

We have shown that balance and some gait parameters improved significantly after vibration stimulus treatment in comparison to the Group B. The improvement in balance in the Group A, which is subjected to disturbances in ankle proprioception input, may have occurred because of both increased muscle strength and improved proprioception feedback as a direct result of vibration Stimulus training. vibration stimulus is reported to stimulate proprioception and to result in long-lasting postural improvement (21). vibration stimulus has also been reported to result in modification of correction movements and increased postural sway. The application of vibration stimulus with its standardized stimuli can enhance the physiological effect of patient therapy (7).

Choi et al. examined the effect of vibration stimulus in stroke patients in terms of postural control and neuromuscular function (16). they examined the effect of vibration stimulus on both static and dynamic sitting balance while performing a range of task-oriented actions. After the intervention, the vibration Stimulus group showed significantly better scores in the Modified Functional Reach Test (16). In another study, Tankisheva et al. reported significant improvements in muscle strength and balance in chronic stroke patients after a six week vibration stimulus training program. The authors suggested that intensive vibration stimulus could be useful for improving both leg muscle strength and postural control in stroke patients (17).

Liao LR et al. showed in a systematic review that vibration stimulus has no consistent benefits for skeletal remodeling, leg motor function and mobility, balance and fall rate or for improvement in normal daily activities. However, adverse events as a result of vibration stimulus were minor (22). Another systematic review and meta-analysis conducted by Yang et al. claimed that there was no clear evidence suggesting that vibration stimulus produces beneficial effects with respect to balance, mobility and gait performance in stroke patients (23).

Our study has two limitations. First, the patient cohort was small and larger, randomized controlled trials would be required to confirm our findings which suggest a beneficial effect in the rehabilitation of some stroke patients. Second, neither the subjects nor the researcher were blinded to the vibration stimulus and Group Bs, as the same researcher supervised all sessions and all measurements.

This is the first Turkish study investigating the effect of vibration stimulus on stroke patients using computerized gait analysis. In conclusion, we have shown that vibration stimulus treatment significantly improves both balance and walking ability in stroke patients when used in tandem with conventional rehabilitation therapies. These results have shown that vibration stimulus treatment can provide additional benefits to conventional therapy in stroke rehabilitation and is easily tolerated by the patients. Further study with larger groups, duplicating the intervention used here, would provide more data on the benefits of this form of intervention in balance and gait in adult stroke patients. We hypothesis that, given the striking improvements obtained in this study, vibration stimulus may have a role to play in the rehabilitation and treatment of other neuromuscular patient groups such as Parkinson

Disease, Multiple Sclerosis and Cerebral Palsy patients.

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