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Effect of dynamic neural mobilization on upper limb motor function and functional mobility in subjects with subacute stroke

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Abstract
Background: Neural Mobilization improves mobility and elasticity of the nervous system. Existing literature suggests the use of neural mobilization in stroke subjects on spasticity, muscle flexibility and balance and is seen to be effective in the lower limb rehabilitation.
Objectives: To study the effect of Dynamic Neural Mobilization on upper limb motor function and functional mobility in subjects with subacute stroke.
Method: 30 subjects were randomly allotted to experimental and control groups, 15 to each group. Experimental group received Dynamic Neural Mobilization with conventional therapy while the control group received only conventional therapy. Treatment sessions were planned for 1 hour per day, 5 times a week, for 4 weeks. All subjects were assessed for upper extremity motor function and functional mobility using Fugl-Meyer Assessment – Upper Extremity (FMA-UE) and Chedoke Arm and Hand Activity Inventory (CAHAI) prior to and post-intervention.
Results: Both groups improved from pre to post-test scores of FMA-UE and CAHAI individually, but when post test scores were compared between groups, no significant difference was observed ($p>0.05$).
Conclusion: It can be concluded that there was no significant effect of Dynamic Neural Mobilization on upper limb motor function and functional mobility in subjects with stroke.

Keywords: subacute stroke, dynamic neural mobilization, neurodynamics, upper extremity motor function, functional mobility

Introduction

Worldwide, stroke is seen to be the second leading cause of death and the third leading cause of disability [1]. It can lead to various motor, sensory, cognitive, perceptual and language impairments. Motor impairment is the most recognizable and debilitating one affecting muscle control and mobility [2]. Recovery of lost upper limb function depends greatly on the degree of impairment, side affected and the age of the individuals [3]. The recovery rate is seen to be higher in the 1st week after stroke and later spasticity, pain, contractures and disabilities take over with time [4].

Neural mobilization helps in restoring normal neurodynamics when nerve sliding is affected due to adverse tension caused by the damaged nerves and thus affecting the adaptation capacity of the entire body and not just the affected area [5, 6]. The cross-sectional area of the nerve is decreased gradually affecting the intraneural microvascular flow, bringing about improvement in the neural function [7]. The affected arm shows delayed improvement in the fine movements owing to problems with mechanical receptors and functional impairment. Dynamic Neural Mobilization which is an advanced version of the neural mobilization was seen to be better than conventional neural mobilization as the dynamic movement is performed in the distal area of the affected arm which improves the viscoelasticity in peripheral nervous system and stimulates the mechanical receptors in distal arm [8].

The upper limb is more complex than the lower limb because of the functional activities involved. Post-stroke, recovery of upper limb that includes both gross and fine motor functions lag behind when compared to the lower limb recovery. Hence, the present study aims at finding the effect of Dynamic Neural Mobilization on upper limb motor function and functional mobility in subacute stroke subjects.

Materials and Methods

Subjects with 3 to 6 months post-stroke duration, aged 40 to 55 years, both gender, MMSE Score of 24 or above, spasticity grading of 1 to 2 using the Modified Ashworth Scale, Brunnstrom grading for motor recovery of 3 and 4 were included in the study. Unco-operative individuals and subjects with unilateral neglect, subluxated shoulder, musculoskeletal injuries and any other neurological or unstable medical conditions were excluded from the study. Participants were recruited from a Tertiary Care Centre in Bangalore. Institutional Ethical Committee permission was obtained and informed written consent was taken from all the individuals who agreed to participate in the study.

30 subjects were randomly assigned to two groups, 15 in each group. All subjects were assessed using the Fugl-Meyer Assessment – Upper Extremity Subscale (FMA-UE) and the Chedoke Arm and Hand Activity Inventory (CAHAI) prior to and post intervention. FMA-UE and CAHAI are reliable and valid performance based tools used to measure motor function and functional mobility of upper extremity in stroke subjects [9, 10, 11, 12, 13].

The experimental group received Dynamic Neural Mobilization on the affected extremity for radial nerve,

median nerve and ulnar nerve [14] along with conventional therapy.

For Radial Nerve

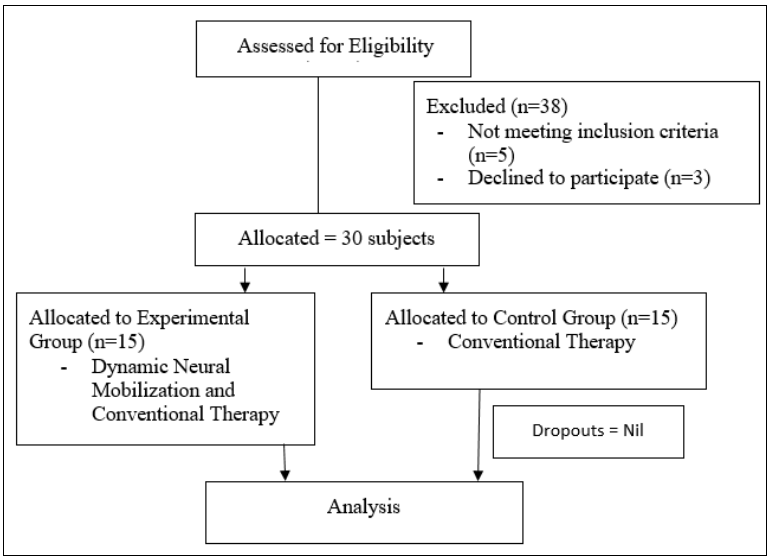
For Dynamic Neural Mobilization of the Radial nerve, subject was in the supine position. The therapist lowered the shoulder toward the closer leg while internally rotating the upper arm shoulder joint, extending the elbow joint, and pronating the lower arm. The subject's neck was laterally flexed to the opposite side. The therapist then performed the dynamic hyper-inner rotation of the subject's wrist every 2s.

For Median Nerve

For the Dynamic Neural Mobilization of the Median nerve, the subject was in the supine position with the shoulder joint open at approximately 90°, the elbow joint flexed at 90°, and the wrist joint in dorsal flexion. The therapist fixed the subject's shoulder with one arm while externally rotating his shoulder, extending the elbow joint, supinating the lower arm, and completely extending the fingers and wrist. The subject's neck was laterally flexed to the opposite side. The therapist then performed dynamic hyperextension of the distal area of the subject's arm every 2s.

For Ulnar Nerve

For Dynamic Neural Mobilization of Ulnar nerve, the subject was in the same position as the median nerve mobilization. The therapist externally rotated the subject's shoulder joint as much as possible while pronating the lower arm, completely extending fingers and wrist, and the subject laterally flexed the neck to the opposite side. The therapist performed dynamic hyperextension of the subject's wrist, once every 2s. Subjects in the control group were given conventional therapy which included self-assisted exercises, resisted exercises, gait training, stretching exercises, peg board and gripping exercises. Exercise duration for both the groups was 1 hour per session, 5 days a week and for 4 weeks.



Consort Flow Diagram

Results

Table 1: Distribution of subjects in both groups according to their age, gender, side affected, duration of stroke and BMI.

S. No.	Variables	Experimental Group	Control Group
		Mean ± SD	Mean ± SD
1	Age (in Years)	49.80±4.68	47.60±6.06
2	Gender (M / Fe)	9 (60.0%) / 6 (40.0%)	10 (66.7%) / 5 (33.3%)
3	Side Affected (L / R)	4 (26.7%) / 11 (73.3%)	5 (33.3%) / 10 (66.7%)
4	Duration of stroke (in Months)	3.47±1.88	3.73±1.83
5	BMI	25.05±2.62	26.81±2.73

Table 2: Pre-test and post-test FMA-UE and CAHAI scores of subjects in the Experimental Group

S. No.	Outcome Measures	Experimental Group		Wilcoxon test	p-value
		Pre-test	Post-test		
		Mean ±SD	Mean ±SD		
1	FMA-UE	33.80±7.15	41.80±7.07	z=3.413*	p<0.001
2	CAHAI	21.60±5.05	28.67± 5.65	z=3.432*	p<0.001

Note: * denotes – Significant (p<0.05)

Table 3: Pre-test and post-test FMA-UE and CAHAI scores of subjects in Control Group

S. No.	Outcome measures	Control Group		Wilcoxon test	p-value
		Pre-test	Post-test		
		Mean ±SD	Mean ±SD		
1	FMA – UE	32.60±9.85	40.87±9.88	z=3.416*	p<0.001
2	CAHAI	23.73±5.83	32.67± 6.94	z=3.422*	p<0.001

Note: * denotes – Significant (p<0.05)

Table 4: Pre and post-test FMA-UE and CAHAI scores of subjects in between the groups

S.no	Outcome measures	Pre-test		Post- test	
		Exp Group	Control Group	Exp Group	Control Group
		Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
1	FMA-UE	33.80±7.15	32.60±9.85	41.80±7.07	40.87±9.88
2	CAHAI	21.60±5.05	23.73±5.83	28.67± 5.65	32.67± 6.94
Between group comparison: Mann Whitney U test		▪ FMA: z=0.212 p>0.05, NS ▪ CAHAI: z=1.105, p>0.05, NS		▪ FMA: z=1.083, p>0.05, NS ▪ CAHAI, z=1.768, p>0.05, NS	

Note: NS – Not significant (p>0.05)

Discussion

Dynamic Neural Mobilization helps in increasing β-waves in C3 areas of brain and decrease the μ-rhythm. These waves reflect the extent of upper limb recovery after stroke. Dynamic Neural Mobilization can help in enhancing the level of motor function in stroke subjects by affecting the premotor areas of the brain directly [15]. This study aimed to determine the effect of DNM on upper limb motor function and functional mobility in stroke subjects. Subjects in both the groups were homogenous in nature prior to the intervention. Participants of the experimental group improved in both FMA-UE and CAHAI scores from pretest to post-test. Jessica Castilho *et al*., in their study concluded that there was improvement in motor effects by EMG activity and reduction in pain was observed with neural mobilization of the upper limb. Retrograde axoplasmic flow also improves with neural mobilization which is affected in the spastic limb [7]. Providing neural tension to the limb and thereby reducing the restrictions and adhesions of the nerve with surrounding tissues, recruitment of muscle fibres, muscle activity can be improved. Dynamic neural recruitment improves the mechanical susceptibility of the peripheral nervous system. This is a nerve protection mechanism after any injury or injury. It is clear that nerve mobility affects limb function more than muscle length. Researchers have concluded that this technique may be beneficial in increasing limb muscle activity by improving neural function [9]. Another study states that it improves range of motion, flexibility and nerve conduction velocity in the affected limb. It can also reduce pain in the limb [16]. This evidence is in line with the result of the study that Dynamic Neural Mobilization can be an effective exercise intervention which can promote functional recovery by directly stimulating the peripheral nervous system. Control group which received the conventional therapy also improved significantly when compared to the pre-intervention scores. This could be due to the multidimensional approach that works on different mechanisms like muscle stretching and viscoelastic properties of the muscle-tendon units [17]. Though both the groups improved with the given interventions, there was no difference observed between the groups, when the post-test scores were compared. Jakob Lorentzen and colleagues have claimed that neural tissue tension techniques and random passive exercises could be less dependent on the type of exercise or stretching intervention, but more dependent on the exercise itself [17]. Since participants in both the groups were given conventional therapy, the results seen in the experimental group can be attributed to the conventional therapy. To understand the individual effect of Dynamic Neural Mobilization, further studies can concentrate on comparing the effect of Dynamic Neural Mobilization with conventional therapy.

Conclusion

Based on the results of the study, it can concluded that there is no significant effect of Dynamic Neural Mobilization on upper limb motor function and functional mobility in subjects with subacute stroke.

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Conflict of Interest

NIL

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