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Effectiveness of Occupational Therapy Intervention on Sensory Motor Function, Activities of Daily Living and Spasticity of The Lower Limb in Stroke Survivors: A Randomised Control Trial

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ABSTRACT

Stroke is one of the leading causes of disability worldwide, often leaving survivors with motor impairments, spasticity, and limitations in daily functioning. Occupational therapy that incorporates sensory stimulation may enhance neuroplasticity and support better functional recovery. A Randomized control trail study was conducted to analyse the effectiveness of occupational therapy intervention on sensory motor function, activities of daily living and spasticity of the lower limb in stroke survivors. A total 36 participant recruited aged -50 years or older and randomly assigned in one of 2 groups: control group with conventional occupational therapy and experimental group sensory stimulation with conventional occupational therapy. Exercise intervention was conducted for six weeks, four days a week, in 45-minute sessions for all the participants. The outcomes of the intervention were assessed using FMA-LE, Barthel Index, and MAS-LL outcome measure. Improvements were seen in sensory-motor function measured by the Fugl-Meyer Assessment for Lower Extremity ($p < 0.001$), functional independence assessed with the Barthel Index ($p < 0.001$), and reduction of spasticity measured by the Modified Ashworth Scale ($p < 0.001$). These findings suggest that adding sensory stimulation with conventional occupational therapy leads to more meaningful and clinically relevant recovery compared to conventional Occupational Therapy alone in improving motor function, enhancing independence in daily activities, and reducing spasticity in the lower limbs of stroke survivors.

KEY WORDS: EFFECTIVENESS OF OCCUPATIONAL THERAPY INTERVENTION IN STROKE SURVIVORS.

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INTRODUCTION

Stroke, a leading cause of disability and mortality globally, is traditionally defined as a neurological deficit ascribed to an acute focal injury of the central nervous system (CNS) by a vascular cause, such as cerebral infarction, intracerebral haemorrhage (ICH), or subarachnoid haemorrhage (SAH)1.

The Behavioural Risk Factor Surveillance System (BRFSS) reported that the median prevalence of stroke among adults in the United States was 3.4% in 2022. South Dakota and Puerto Rico had the lowest prevalences, at 2.1% and 1.8%, respectively, while Arkansas had the highest prevalences, at 4.8%2.

The study was conducted across twelve villages in Baruipur, West Bengal, along with the urban centres of Mumbai, Trivandrum, Ludhiana, Kolkata, and Punjab. The total reference population comprised 12,479,509 individuals, among whom 11,654 new stroke cases were identified, with a mean of 1,294 (SD ± 1,710). Strokes ranged from 26 to 757 per 100,000 people annually, 108 to 172/100,000, and 18% to 42% in terms of crude frequency, crude incidence, and one-month case fatality rates, respectively3.

Injury to the central nervous system results in abnormal muscle tone and stiffness. Excessive muscle tightness can significantly impact both quality of life and economic. This handicap is common and often co-occurs with motor difficulties following a stroke4. It does, however, recur irregularly over the course of the chronic phase. The prevalence of increased tone in motor deficits ranging from moderate to severe in chronic stroke survivors is still unknown.

Muscle tone can have a detrimental effect on motor control and motor learning after a stroke. Aberrant posture and co-activation of agonist and antagonist muscles are often associated with impaired muscular tone5. The negative impact of increased tone on motor function is more pronounced in single- and multi-joint actions, especially inside spasticity zones. Voluntary motor function may be adversely affected by spasticity. Spasticity is defined as the range of angles in which it is noticed. Importantly, the practice of more coordinated motions and the acquisition of motor abilities are impeded by movement in these regions6. Impairments in motor function that hinder the execution of daily living activities (ADLs) frequently lead to a reduction in overall quality of life7. The lower limb might regain motor function more quickly than the upper limb following a stroke. The primary causes include the degree, frequency, or dosage of lower limb use relative to upper limb use, the existence of spasticity, and its significant impact on the upper limb, however many other factors may also be at play. To improve upper limb motor function, rehabilitation treatments for stroke sufferers should focus on reducing spasticity, particularly in the early post-stroke period, and increasing practice intensity, particularly in real-world scenarios.

Therefore, stroke patients must improve upper limb motor function in order to be able to do ADLs such as eating, cleaning, dressing, grooming, and answering the phone. Similarly, regaining motor function of the lower limbs is essential for walking, which in turn supports daily activities such as shopping, social interaction, and mobility. Furthermore, being able to engage in social activities and carry out ADLs on one's own is essential to achieving a high quality of life8.

It's more important than ever to manage spasticity since it can hinder limb movement and general mobility and increase the risk of additional issues including joint contractures and discomfort, which exacerbate motor weakness and functional limits9.

Numerous sensory modalities are susceptible to strokes. It has been reported that between 65 and 94 percent of stroke victims are no longer able to identify touch sensation10. Proprioception (the ability to sense the location and direction of body parts) damage has also been reported (17% to 52%), as has loss of pinprick feeling (35% to 71%), vibration (44%), and light touch (32% to 89%)10. Kinaesthesia, stereognosis (the sense of identifying or recognising objects by touch), pain, two-point discrimination, and graphesthesia (the sense of recognising writing on the skin by touch) are also affected. Tactile extinction is the term used to describe the inability of an individual with unilateral damage to perceive touch. Light touch, mechanical sensation, sustained pressure, two-point discrimination, kinaesthesia, position sense, shape perception, stereognosis, graphesthesia, pain, and integrated sensory modality evaluation were the mechanisms of sensory impairment examined in the investigations.

Active sensory training, which is founded on learning principles and graded re-education of sensory awareness, and passive sensory stimulation, which uses electrical or thermal stimulation to stimulate afferent inputs, were the two main types of sensory-based interventions that were found. It was shown that strategies for passive sensory stimulation received more attention than active sensory training11.

The present study aims to analyse the effectiveness of occupational therapy intervention on sensory motor function, activities of daily living and spasticity of the lower limb in stroke survivors.

MATERIAL AND METHODS

A randomized control trial study to analyses the effectiveness of occupational therapy intervention on sensory motor

function, activities of daily living and spasticity of the lower limb in stroke survivors. This study was reviewed and approved by the Institutional Ethical Committee of Santosh College of Occupational Therapy (Ref No.-SCOT/NOV-24/ECNeuro-09) and data was collected from the Divya Neuro Rehabilitation Clinic and the Indian NeuroRehab & Physio Centre, Ghaziabad. 36 participants in total were tested using the Screening tools, Montreal Cognitive Assessment (MoCA), Brunnstorm Recovery Stage (BRS), and Monofilament before being randomly assigned.

Using Cochran's formula with a 95% confidence level and 5% margin of error, the minimum sample size was calculated to be approximately 18 participants per group. Participants in the experimental group received sensory stimulation combined with conventional occupational therapy program and control group received only conventional occupational therapy program12. Intervention delivered four days per week in 45-minute sessions for six-weeks to all the participants. Sensory Intervention include Proprioceptive Stimuli - Weight bearing, Heavy joint compression, stretch pressure and Exteroceptive Stimuli – Brushing, icing and stretch pressure. Brushing of lower limb Applied to L3, L4, L5 dermatomes to stimulate knee and ankle extensors and icing to stimulates sensory organs in lower limb13. Conventional Occupational therapy program includes lower extremity range of motion exercises, fine motor movement exercises and strengthening of lower extremity muscles13.

Outcome Measures: The following outcome measurements were taken at baseline and again after 6 weeks of training. The assessment tools included Fugl-Meyer Assessment – Lower Extremity (FMA-LE) a three-point ordinal scale, rating 17 elements is as follows: full is 2, half is 1, and none is 0. Overall score 34 is the maximum score; a score of 34 indicates normal function to assess motor deficits in the lower extremities following stroke. Barthel Index (BI) to determine how well a person can perform essential daily living tasks. It assesses disability, functional independence, and tracks changes in functional status over time14. Modified Ashworth scale (MAS) to measure muscle spasticity by observing resistance to passive motion of the limb15.

RESULTS

Total 36 patients were enrolled in the study and data were gathered through the Fugl-Meyer Assessment for Lower Extremity (FMA-LE), the Barthel Index, and the Modified Ashworth Scale for Lower Limb (MAS-LL). Eighteen subjects were randomly allocated in control and experimental group. Outcomes were analysed by contrasting pre- and post-intervention scores between the control and experimental groups. Paired t-tests were used within each group to compare pre- and post-intervention scores. Independent t-tests were used to compare the post-intervention scores between the experimental and control groups.

All tests were two-tailed with a significance level set at $p < 0.05$. The results across all tests demonstrated statistically significant improvements in the experimental group compared to the control group in all three outcome domains. Findings indicated that the experimental group showed markedly higher gains compared to the control group on all three outcome measures. Group received Sensory stimulation with conventional Occupational therapy program and Control Group received Conventional Occupational Therapy.

Table 1. Baseline characteristic

Outcome Measure	EG				CG				t	P-value
	Mean		SD		Mean		SD			
	Pre test	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test		
Fugl Meyer Assessment-Lower Extremity	35.89	74.78	3.27	5.63	35.89	58.28	3.27	4.85	0.0	1.0
Barthel Index	48.22	81.44	4.77	4.57	48.22	68.94	4.77	5.33	0.0	1.0
Modified Ashworth Scale (Lower Limb)	2.61	1.11	0.50	0.32	2.61	2.11	0.50	0.32	0.0	1.0

CG: Control Group, EG: Experimental Group, SD: Standard deviation

DISCUSSION

The present study focuses on examining how occupational therapy interventions affect sensory–motor function, daily activity performance, and spasticity of the lower limbs in individuals recovering from stroke. Analysis of the FMA-LE revealed improvements in motor function across both groups, with the experimental group showing superior gains. The average baseline score was 35.89 for both groups. After treatment, the experimental group's mean

increased to 74.78, whereas the control group improved more modestly to 58.28. Similar patterns were shown by the Barthel Index, which is used to gauge performance in everyday life tasks. The initial mean score of 48.22 was the same for both groups. After intervention, the control group improved to 68.94, whereas the experimental group reached 81.44.

Findings reveal that the experimental approach significantly improved independence in daily living activities among participants. Spasticity, evaluated using the MAS for lower limbs, was initially the same in both groups (mean = 2.61). Post-intervention, the control group's score declined to 2.11, whereas the experimental group achieved a more pronounced reduction to 1.11. A lower score on this scale indicates reduced spasticity, implying that the intervention was more effective in managing muscle tone abnormalities in the experimental group.

The statistical analysis affirms the observations from the descriptive statistics. For Females, both the experimental ($t = -54.86$, $p = 0.00$) and control ($t = -48.85$, $p = 0.00$) groups showed highly significant pre-post differences. More importantly, the post-intervention comparison between groups ($t = 9.42$, $p = 0.00$) revealed a substantial and statistically significant advantage in the experimental group. The Barthel Index scores showed a significant improvement within both groups as well (experimental: $t = -67.06$, control: $t = -30.68$, both $p = 0.00$).

Table 2. Result of baseline and post test scores of the outcome measures in experimental and control group

Outcome measure	EG		CG	
	T	P	T	P
FMA-LE	-54.86	0.0	-48.85	0.0
Barthel Index	-67.06	0.0	-30.68	0.0
MAS-LL	12.37	0.0	4.12	0.001

EG: Experimental group, CG: Control group

Table 3. Result of post data analysis of the outcome measures, Experimental vs Control group

Scale	t- Value	p- Value
FMA- LE	9.42	0.0
Barthel Index	7.56	0.0
MAS-LL	-9.28	0.0

The impact of the improved intervention was shown by a significant post-intervention difference between groups ($t = 7.56$, $p = 0.00$), which further supported the superiority of the experimental group. Both groups showed a substantial decrease in spasticity for MAS (control: $t = 4.12$, experimental: $t = 12.37$). According to the post-intervention difference ($t = -9.28$, $p = 0.00$), the experimental group saw a considerably greater reduction in spasticity, which is consistent with the clinical objective of enhancing lower limb function and lowering muscular rigidity. The result of our study is similar to the study done by Majlessi KH et al (2023)16 to investigate how occupational therapy affects stroke survivors' motor function and everyday living activities.

The results demonstrate the effectiveness of occupational stroke patients' functional abilities are measured every two weeks using the Barthel index. Data analysis indicates that a group with a larger percentage of discharges to home is defined by an initial score of more than 40 on the Barthel index, while patients with starting scores over 60 had shorter lengths of stay. Additional research indicates that the functional skill development of this population developed predictably; a Barthel score of less than 40 indicates that no one was autonomous in movement abilities, and less than 50% in very basic activities such as feeding, grooming, and sphincter control. With a score of 60, patients appear to move from dependency to assisted independence.

Despite its contributions, this study has some limitations. The sample size was relatively small and limited to a single institution, which may affect the generalizability of the results. The absence of a longitudinal design limits the ability to infer causality. Future studies with larger, more diverse samples and objective assessment tools are recommended to strengthen the evidence base. Future research should be conducted on a larger scale with more diverse demographic groups to improve the generalizability of results. Integration of sensory-based virtual reality or wearable devices could be explored to enhance engagement and precision in therapy.

CONCLUSION

The results of this randomized controlled trial indicate that combining sensory stimulation—through both exteroceptive and proprioceptive techniques—with conventional occupational therapy produces significantly better outcomes in stroke rehabilitation. Participants receiving the combined intervention showed greater improvements in motor function, decreased lower limb spasticity, and enhanced ability to perform activities of daily living (ADLs) compared to those receiving conventional therapy alone. These results support the growing recognition of sensory-based rehabilitation strategies in stroke care and underscore the role of occupational therapy in designing comprehensive, client-centred interventions.

Ethical Clearance:
SCOT/NOV-24/ECNeuro-09,9/11/2024.

Conflict of interest statement - NONE

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Data availability: The data associated with the paper are not publicly available but are available from the corresponding author on reasonable request.

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