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Task Specific Training Effect on Upper Extremity Performance in Hemiparetic Patients: A Narrative Review

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ABSTRACT

Background: Hemiparesis, which is defined as partial or total weakness or paralysis on one side of the body, affects approximately 65 percent of stroke patients and is one of the most prevalent neurological deficits during the recovery period. The inability to perform basic tasks due to impaired hand function is a common outcome of stroke that significantly impairs independence and quality of life. **Objective:** This review aimed to determine the effectiveness of task specific training on upper extremity performance in hemiparetic patients.

Methods: The Cochrane controlled trials register on task specific training on upper extremity performance in hemiparetic patients was searched without regard to when it was conducted. Between August 2025 and the launch date, the Google, Science Direct, and PubMed databases were used. Only works written in English were included in the literature search. Abstracts from smaller scientific studies, conference papers, dissertations, oral presentations, and unpublished articles were not included.

Conclusion: Task-specific training has been shown to be an effective therapeutic strategy for improving upper extremity function in hemiparetic patients. Despite the encouraging results of the current evidence, more carefully planned clinical research is necessary to solidify the body of knowledge and to determine the intervention's long-term therapeutic effects.

Keywords: Hemiparesis, Task specific training, Upper extremity performance.

INTRODUCTION

Stroke is defined clinically as an acute, localized neurological impairment brought on by vascular damage to the central nervous system, either by hemorrhage or infarction. It poses a significant public health burden as the second most common cause of death and disability globally. Stroke is a group of conditions resulting from various risk factors, pathophysiological processes, and underlying mechanisms rather than a single disease entity [(1)]. The ability to carry out activities of daily living (ADLs) is severely compromised by hemiparesis, which lowers independence and overall quality of life. It is most frequently caused by stroke or other types of brain damage, and it is linked to long-term impairments in upper and lower limb function that significantly impair patients' ability to take care of themselves [(2)].

Both positive and negative motor signs can be present in hemiparesis. Weakness and poor motor control (loss of dexterity) are negative indicators, whereas spasticity, odd sleeping positions, and involuntary movement synergies brought on by unusual muscle co-activation during voluntary movement are positive indicators. It is still unclear how these positive and negative manifestations interact with one another and how much they might be caused by the same underlying theory [(3)].

Upper-extremity function limitations affect between 55 and 85 percent of people with acute or chronic hemiparesis. Particularly, impairment of hand function limits the capacity to carry out necessary functions like opening doors, controlling a steering wheel while driving, or drinking from a glass. Independence and quality of life are seriously impaired by these deficiencies [(4)].

A wide range of interventions are included in upper limb rehabilitation after a stroke. Patients, caregivers, and the rehabilitation team usually need to work closely together. The use of specialized equipment or therapeutic techniques, task-specific training, and structured exercise programs are a few examples of these interventions. In certain instances, pharmacological methods are also used to enhance arm function and promote motor recovery [(5)]. According to earlier studies, one of the best strategies for upper limb rehabilitation following a stroke is task-specific training. Through repeated practice of functionally relevant tasks, this approach helps patients relearn tasks that are directly applicable to their everyday lives. Task-specific training places more emphasis on completing meaningful tasks in realistic settings than impairment-based training, which focuses mainly on muscle weakness or range-of-motion limitations. This promotes greater functional recovery and independence [(6)].

Patients' capacity to carry out activities of daily living (ADLs) has been demonstrated to improve with task specific training. Functional rehabilitation techniques are the focus of this approach, which is based on the systems theory of motor control, which explains how the nervous system plans and controls movement. In addition to improving motor performance, patients who concentrate on repeatedly practicing meaningful tasks develop task-specific skills that help them adapt to dynamic and changing environments [(7)].

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Pathophysiology of hemiparesis

A stroke is a sudden, localized neurological impairment brought on by vascular damage to the central nervous system, which can be caused by hemorrhage or infarction. It is a diverse clinical syndrome that results from a number of risk factors, pathophysiological processes and underlying mechanisms rather than a single disease entity [(8)].

Ischemic stroke can be caused by embolic or thrombotic events that impair blood flow to the brain. An obstruction within a cerebral vessel, most frequently a thrombus linked to atherosclerotic disease, arterial dissection and fibromuscular dysplasia, or inflammatory conditions cause thrombotic stroke. A cerebral artery becomes occluded by circulating material, such as a blood clot or other debris that originates elsewhere in the body and migrates there disrupting regional perfusion. This is the opposite of an embolic stroke [(9)].

A cerebral blood vessel rupture that causes bleeding into the brain is known as a hemorrhagic stroke. Usually, it is divided into two subtypes: Subarachnoid hemorrhage (SAH) and intracerebral hemorrhage (ICH). There is a strong correlation between hemorrhagic stroke's clinical progression and worse functional outcomes, as well as significant morbidity and high mortality [(10)].

Task specific training

The goal of task-specific training, an activity-centered rehabilitation strategy, is to improve performance and encourage successful task completion through repeated practice of functional tasks. Structured task analysis, feedback, constant repetition and adaptation to environmental demands all support its efficacy by promoting motor learning and functional recovery [(11)].

The practice of goal-directed, practical, and context-specific tasks that have intrinsic and/or extrinsic value for the person is the focus of task-specific training, a progressive rehabilitation approach. This method seeks to improve functional independence and performance in activities of daily living by coordinating therapy with meaningful daily activities. Although the quality of the available data is low to moderate, it indicates that task-specific training can help stroke survivors improve their upper limb motor function [(12)].

Task-specific training integrates everyday living activities, like holding a cup, into organized rehabilitation regimens. In order to improve performance and aid in the reacquisition of functional skills necessary for independence, the method places a strong emphasis on motor tasks practiced through goal-directed repetition [(13)].

Concept of task specific training

Task-specific training is a patient-centered rehabilitation approach based on motor control and motor learning principles, with intensive practice and intermittent feedback. It engages patients in meaningful, real-world activities (such as walking and cooking) to reestablish functional skills. Unlike impairment-based interventions that target isolated deficits, task-specific training addresses activity limitations by focusing on whole-task performance in contexts relevant to the activity [(14)].

Within a highly customized, patient-centered rehabilitation framework, task-specific training applies the principles of motor learning and motor control through intense, varied practice and the provision of intermittent feedback. In order to meet functional demands, the method emphasizes repetitive performance of grasp-and-release exercises and prioritizes functional tasks related to self-care, work, or leisure. It also addresses strength development and spasticity management [(15)].

Effect of task specific training on upper limb performance

Task-specific training has been shown to be effective in upper limb rehabilitation following stroke, according to evidence from recent clinical trials and systematic reviews. A thorough meta-analysis conducted by **Rozevink *et al.*** [(16)], which comprised 55 studies, showed steady improvements in a range of motor function and impairment metrics, independent of the patients' subacute or chronic phases. Notably, the analysis indicated that since intervention groups showed greater improvements than controls, task-specific training might be more beneficial in the subacute stage.

Similarly, a randomized clinical trial comparing task-specific training with standard care for post-stroke arm and hand function was carried out by **Van Vliet *et al.*** [(17)]. In order to pinpoint important movement elements and establish personalized performance objectives. The therapists in this study methodically examined the target task, such as reach-to-grasp. The results showed that task-specific training significantly improved upper limb function and quality of life, outperforming standard care.

Randomized controlled trials that concentrate on the subacute phase of stroke recovery provide additional support. In a study involving forty-three participants, **Marryam and Umar** [(18)] found that task-specific exercises were very successful in improving upper limb function when implemented during the subacute phase. Accordingly, T**hant *et al.*** [(19)] looked at 28 stroke patients who had subacute strokes and discovered that, in comparison with traditional exercise regimens, task-specific training resulted in noticeably higher functional gains in the paretic upper extremities. Interestingly, these gains were noticeable and clinically significant after just ten hours of training spread over two weeks.

Further investigations into the underlying mechanisms have supported these findings. **Sethy *et al.***

[20] found that neuromuscular adaptations were facilitated by task-specific training, which enhanced motor skills, strength, and overall functional recovery. Likewise, **Alwhaibi *et al.*** [21] underlined that task-specific training promotes progress via consistent, realistic, and goal-oriented practice. Significant improvements in the affected upper limb's functional ability were demonstrated by their study, highlighting the value of involving patients in activities that are directly related to their everyday lives.

When combined, the data clearly shows that task-specific training is a successful rehabilitation approach for enhancing functional independence and upper limb motor performance following a stroke. The benefit seems to be most noticeable during the subacute phase, underscoring the significance of prompt and well-planned intervention in stroke rehabilitation.

CONCLUSION

Task-specific training has proven to be a very successful intervention for hemiparetic patients, consistently improving upper limb motor performance and functional recovery.

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