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The Effect of Using Emg-based Luna Neurorobotics for Strengthening of Affected Side in Chronic Stroke Patients - Retrospective Study

Authors : Surbhi Kaura, Sachin Kandhari, Shahiduz Zafar

Abstract : Chronic stroke, characterized by persistent motor deficits, often necessitates comprehensive rehabilitation interventions to improve functional outcomes and mitigate long-term dependency. Luna neurorobotic devices, integrated with EMG feedback systems, provide an innovative platform for facilitating neuroplasticity and functional improvement in stroke survivors. This retrospective study aims to investigate the impact of EMG-based Luna neurorobotic interventions on the strengthening of the affected side in chronic stroke patients. In rehabilitation, active patient participation significantly activates the sensorimotor network during motor control, unlike passive movement. Stroke is a debilitating condition that, when not effectively treated, can result in significant deficits and lifelong dependency. Common issues like neglecting the use of limbs can lead to weakness in chronic stroke cases. In rehabilitation, active patient participation significantly activates the sensorimotor network during motor control, unlike passive movement. This study aims to assess how electromyographic triggering (EMG-triggered) robotic treatments affect walking, ankle muscle force after an ischemic stroke, and the coactivation of agonist and antagonist muscles, which contributes to neuroplasticity with the assistance of biofeedback using robotics. Methods: The study utilized robotic techniques based on electromyography (EMG) for daily rehabilitation in long-term stroke patients, offering feedback and monitoring progress. Each patient received one session per day for two weeks, with the intervention group undergoing 45 minutes of robot-assisted training and exercise at the hospital, while the control group performed exercises at home. Eight participants with impaired motor function and gait after stroke were involved in the study. EMG-based biofeedback exercises were administered through the LUNA neuro-robotic machine, progressing from trigger and release mode to trigger and hold, and later transitioning to dynamic mode. Assessments were conducted at baseline and after two weeks, including the Timed Up and Go (TUG) test, a 10-meter walk test (10m), Berg Balance Scale (BBG), and gait parameters like cadence, step length, upper limb strength measured by EMG threshold in microvolts, and force in Newton meters. Results: The study utilized a scale to assess motor strength and balance, illustrating the benefits of EMG-biofeedback following LUNA robotic therapy. In the analysis of the left hemiparetic group, an increase in strength post-rehabilitation was observed. The pre-TUG mean value was 72.4, which decreased to 42.4 ± 0.03880133 seconds post-rehabilitation, with a significant difference indicated by a p-value below 0.05, reflecting a reduced task completion time. Similarly, in the force-based task, the pre-knee dynamic force in Newton meters was 18.2NM, which increased to 31.26NM during knee extension post-rehabilitation. The post-student t-test showed a p-value of 0.026, signifying a significant difference. This indicated an increase in the strength of knee extensor muscles after LUNA robotic rehabilitation. Lastly, at baseline, the EMG value for ankle dorsiflexion was 5.11 (μV), which increased to 43.4 ± 0.06 μV post-rehabilitation, signifying an increase in the threshold and the patient's ability to generate more motor units during left ankle dorsiflexion. Conclusion: This study aimed to evaluate the impact of EMG and dynamic force-based rehabilitation devices on walking and strength of the affected side in chronic stroke patients without nominal data comparisons among stroke patients. Additionally, it provides insights into the inclusion of EMG-triggered neurorehabilitation robots in the daily rehabilitation of patients.

Keywords : neurorehabilitation, robotic therapy, stroke, strength, paralysis
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