A randomised control trial on the use of bioinstrumentation and rehabilitation technology in hemiplegic patients

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Abstract

Stroke is a serious cerebrovascular disease characterized by sudden and acute onset and rapid neurological deficits, which is the world’s leading cause of disability and the second leading cause of death, leaving 80% of patients having varying degrees of lifetime neurological deficits. As the global aging problem is getting worse, the positive correlation between stroke and age means that the incidence of stroke will only continue to rise. Stroke incidence is also trending toward even younger patients due to factors such as irregular work life and infrequent rest, a growing sense of pressure and anxiety, poor eating habits, and many other reasons. Hemiplegia is one of the most common symptoms of stroke and significantly affects the patient’s quality of life by reducing their ability to perform activities of daily living. While the rehabilitation of hemiplegic stroke patients has commanded considerable attention in society and medicine, a severe shortage of rehabilitation therapists leads to inconsistent traditional rehabilitation training results. Thus, new treatments borne out of interdisciplinary medicine and engineering methods offer the potential to provide superior care for hemiplegic stroke patients. Such methods can not only promote the recovery of the patient by stimulating nerve remodeling, but also reduce physician workload. Bioinstruments use a variety of measurement modalities that are combined in a robotic hardware-based real-time acquisition and control environment and interpreted with the help of a computational model.

Keywords: Bioinstrumentation, rehabilitation technique, upperlimb, hemiplegia

INTRODUCTION

Stroke is defined as the sudden onset of clinical indications of localised or global brain function impairment that lasts more than 24 hours or results in death, with no other obvious cause other than vascular origin. Hemiplegia is a paralysis of one side of the body, affecting one upper and one lower extremity. Hemiplegia is a term that is typically used to refer to a wide range of motor impairments that can occur as a result of a stroke. The severity of neurological abnormalities in a particular patient is determined by the location and extent of brain injury, the amount of collateral blood flow, and the treatment of early acute care. As the swelling in the brain reduces, the impairments may recover on their own, usually within 3 weeks. Residual neurological deficits last longer than three weeks and can lead to lifelong disability. Functional daily living activities can be divided into two types namely basic activities of daily living (BADL) and instrumental activities of daily living (IADL). 8 BADL includes basic self-care tasks, such as grooming, bathing, feeding and dressing, and other daily activities such as ambulating, transferring and communicating. The most prevalent disabling deficiency following a stroke is upper limb (UL) dysfunction. 5 For several months after a stroke, about 55 to 75 percent of stroke survivors were unable to use their damaged hand, and this residual arm dysfunction may induce dependency in performing functional daily living activities, resulting in a lower quality of life among survivors. In light of the necessity of physical rehabilitation for stroke patients, an analytical evaluation has been created in which several therapies, such as functional electric stimulation, have been evaluated for their efficacy.
For the rehabilitation of upper extremity motor impairment, researchers used functional electrical stimulation (FES), noninvasive brain stimulation (NIBS), including transcranial direct current stimulation (t-DCS) and transcranial magnetic stimulation (t-MS), invasive epidural cortical stimulation, virtual reality (VR) rehabilitation, task-oriented therapy, robot-assisted training, tele rehabilitation, and cerebral plasticity. New therapeutic rehabilitation techniques, such as virtual reality, are also being researched.

The effects of robot-assisted (RA) virtual reality (VR) intervention on motor function (MF) and nerve function (NF) in patients with cerebral stroke (CS) were investigated in 60 patients with cerebral apoplexy hemiplegia at the convalescence stage (30 patients in each group). The CG underwent normal rehabilitation training (RT), while the EG had RT using robot VR technology. Upper limb (UL) function was assessed using the Brunnstrom classification and the Fugl-meyer score.2

A thorough literature search was conducted to find articles that contained measures for assessing arm-hand skillful performance in stroke and cerebral palsy patients. Instruments were identified and classified as capacity, perceived performance, and actual performance. A second search was conducted to learn more about the content and psychometrics of the candidates.

Twenty-six different rehabilitation treatment modalities were included, and the following search phrases were used to find them: Motor skill learning, constraint induced movement, mirror therapy, motor imagery, motor imitation, movement observation, transcutaneous electrical nerve stimulation, neuromuscular electrical stimulation, positional feedback, repetitive transcranial magnetic stimulation, transcranial direct current stimulation, deep brain stimulation, paired associa.4

Patients with hemiplegic stroke were randomly assigned to one of two groups: VFT or CTL. For eight weeks, sixteen patients in the VFT group had CR and VFT, while 15 patients in the CTL group received only CR. At baseline and the eighth week of the recovery training period, the Barthel Index (BI) was utilised to evaluate daily living activities. To test the recovery effect of the training therapies, researchers used the Fugl–Meyer assessment (FMA) scale, somatosensory evoked potential (SEP), and fMRI. N9 and N20 latencies and amplitudes were measured. All patients in the VFT and CTL groups had their fMRIs done prior to recovery training. In addition, 2 months following treatment, 17 patients (9 in the VFT group and 8 in the CTL group) had fMRI for follow-up.5

In this application, variables such joint angular accelerations and angular velocities must be obtained in order to close control loops aimed at achieving specified goals. These sensors should have certain features, such as a small size and a long battery life., the ability to extract a widerange of parameters from human motion, easy adaptability to an orthotic frame, suitable bandwidth and other preferred features. These characteristics made Micro Electro-mechanical Systems (MEMS) inertial sensors attractive for the rehabilitation robotics field.7. The field of rehabilitation robotics [7-26] is a good fit for sensors. These sensors, such as accelerometers, gyroscopes, and magnetometers, can aggregate their measurements with the help of an Inertial Measurement Unit (IMU) to obtain kinematic data measures, such as acceleration, speed, position, and orientation.6

This randomised controlled experiment included twenty-five ischemic acute/subacute stroke patients. The experimental group received low frequency (LF) rTMS to the unaffected side's primary motor cortex plus physical therapy (PT), which included activities to improve strength, flexibility, transfers, posture, balance, coordination, and activities of daily living, with a focus on upper limb movements; the experimental group 2 received the same protocol plus NMES to the hand extensor muscles, and the control group received only PT. The activity or inhibition of the afflicted and unaffected primary motor cortex was evaluated using a functional magnetic resonance imaging (fMRI) scan.27-35

The rehabilitation system used in this study was the FELXO-Arm1 system manufactured by Shanghai Electric GeniKIT Medical Science and Technology Co., Ltd. and comprises hardware and software componentFELXO-Arm1 has five degrees of freedom, which is uncommon in rehabilitative therapeutic devices, and is used to help stroke patients recover UL function. It has three passive joints in the horizontal plane and two active joints in the sagittal plane, comprising a motor and gear, which could provide additional assistance to patients undergoing rehabilitative training. The encoder and the torque sensor have different functions. Whereas the former is used for recording angular measurements of joints, the latter is utilized to obtain human–robot interactive torque measurement
CONCLUSION

It’s tough to design controlled trials to evaluate a health-care service like rehabilitation. 35 In a scenario where numerous variables are interacting, valid outcome criteria must be developed. Stroke rehabilitation should be performed in the most cost-efficient and effective manner feasible, and to the biggest number of patients imaginable. Only one thing is undeniably and painfully evident from our current knowledge, or rather from its lack thereof: “Controlled clinical trials are necessary if the role of rehabilitation, its indications, and its contraindications are to be better understood.”

REFERENCES

25. Taksande, Vaishali Deoraogi, Priyanka Anil Ashtankar, Chetna Rajendra Bansod, Ashwini Vilas Bawane, Pratiksha Sankal Burchunde, Dichka Vinayak


