PRACTICE OF MECHAOTHERAPEUTIC EXERCISES STIMULATES BRAIN NEUROPLASTICITY IN A POST-ACCIDENT PATIENT BRAIN VASCULAR

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Abstract: Cerebrovascular accident (CVA) is a disease that affects motor functionality and quality of life in patients. This article explores the efficacy and safety of physical therapy approaches through the practice of resistance exercises with mechanotherapeutic equipment in post-stroke rehabilitation, analyzing the current literature to provide a comprehensive and grounded view on the subject.

Keywords: Cerebrovascular Accident, Physical Therapy, Resistance Exercises, Mechanotherapy, Rehabilitation, Effective Treatment.

Introduction

The central nervous system has a complex neural network and to distribute oxygen and nutrients for the proper functioning of this entire area, a vast network of blood vessels is needed that branch throughout this region (BALDIN, 2009).

The consequence of the alteration in the flow of blood to the nervous system, specifically to the brain, causes Cerebrovascular Accident (CVA), which can be ischemic in nature (CVA) or hemorrhagic in nature (ALVES et al., 2022).

In Brazil, it is considered the first cause of death and disability; in the world, it is the second most prevalent neurological disease and also in mortality. In addition, it is the third leading cause of disability (DIENER; HANKEY, 2020).

Depending on the region and extent of the brain injury caused by the stroke, the patient

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presents different motor and cognitive alterations (MAGALHÃES, 2013). Among the 50% of patients who survive, they have limitations in terms of Activities of Daily Living (ADL), reflected in changes in motor skills, speech, emotions and memory, predisposing them to severe impairments of health and quality of life (BRASIL, 2013). Approximately 70% of patients do not resume work, 50% need help with ADL and 30% need help walking (BRAZILIAN SOCIETY OF CEREBROVASCULAR DISEASES, 2018; BENJAMIN et al., 2019).

Stroke is the second leading cause of death and the third leading consequence of disability in the world. It is one of the major global health problems, resulting in permanent disabilities and high hospital costs (DIENER; HANKEY, 2020).

The concept of neuroplasticity leads to the understanding that, in the presence of an injury, the Central Nervous System (CNS), through intact neurons, seeks alternative ways to perform the impaired motor response, performing synapses with neurons that change in relation to their effectiveness and, subsequently, differentiated circuits and nerve paths are sought (MAGALHÃES, 2013).

To this end, there is an area of the nervous tissue, known as the ischemic penumbra zone, located around the lesion, whose blood supply is sufficient for the survival of neurons, but not enough for these cells to perform their function (MORAIS, 2016).

Thus, some neurons remain silent from a functional point of view, but structurally they are intact and potentially usable (DONNAN et al., 2011). If blood flow can be restored in this area, the ischemic penumbral zone is preserved (MORAES, 2016).

This plasticity can occur through the growth of new axon terminals, the organization of dendrites, and the activation of existing synapses whose functions were blocked (PORTER, 2001). It also enables the reorganization of cortical maps, favoring neurological recommunication in the face of a given lesion (ZILLI; DE LIMA, KOBLER, 2014).

Such forms can occur both in existing structures, which in this case will become capable of performing functions in other areas, and they can stimulate neural cells to have a plastic power, recomposing useful and functional connections, thus allowing desired functions to be exercised

(FONSECA, 2008).

Through rehabilitation stimuli, it is possible to stimulate neuroplasticity, as a support for changes in neurological circuits in the gray regions of the sensory and motor areas of the brain identified as the main mediators in post-stroke rehabilitation (GAMBA; CRUZ, 2011; MANG et al., 2013; SAUNDERS; GREIG; MEAD, 2014).

Regarding the rehabilitation plan, it should always be individualized, varying according to the commitment, and the degree to which the patient has developed compensatory strategies. In general, the main treatment objectives consist of adjusting tone, gaining muscle strength, improving sensitivity, training the patient to perform postural transfers and activities of daily living, improving coordination and balance, stimulating standing and gait (Shumway-Cook et al., 2002, Umphred, 2004).

Scientific and technological evolution has provided changes in neurofunctional rehabilitation and contribution to physiotherapy, allowing a greater understanding of brain reorganization and motor control mechanisms (CARR, PASTOR, 2006).

One of the therapeutic resources proposed by the physiotherapist in the prevention of falls to the elderly is mechanotherapy, which is a clinical tool that provides advantages to patients, as it presents a diversity of therapeutic exercises that can be applied in the outpatient and residential environment. It consists of movements with the help of mechanical devices, such as dumbbells, springs, and elastic bands (PIASSAROLI et al., 2012).

Thus, mechanotherapy involving the use of mechanical devices to assist in rehabilitation has achieved results that assist and promote rehabilitation through repetition (GOMES et al., 2022). Devices that perform passive movements to improve circulation and range of motion (COSTA et al., 2021). Equipment that stimulates movement response through technologies that provide real-time response and improve the precision of movements (LIMA et al., 2020).

In this work, data on the subject will be presented, as well as scientific evidence, which document the application and effects of the use of resistance exercise equipment on the functional recovery of post-stroke patients.

METHODOLOGY

It was a literature review, using books and articles. A bibliographic survey was carried out in the following databases: LILACS, MEDLINE, PEDRO and SCIELO. Articles published in Portuguese and English, from 2006 to 2023, which addressed neurological rehabilitation techniques for after stroke, were selected. The descriptors used were: Stroke, Rehabilitation, neuroplasticity, resistance exercises, mechanotherapeutic equipment used in rehabilitation. Articles based on other rehabilitation techniques were excluded, as well as articles that did not present clarity regarding the methods used and results obtained. The texts were analyzed and synthesized in a critical way, in order to discuss the information obtained that corresponded specifically to the theme intended to compose this review.

THEORETICAL FRAMEWORK

Physiotherapy has several therapeutic approaches in post-stroke rehabilitation, each with its particularities and benefits, mechanotherapy is one of them and proves to be an indispensable resource. Approximately 70% of patients do not resume work, 50% need help with ADL and 30% need help walking (BRAZILIAN SOCIETY OF CEREBROVASCULAR DISEASES, 2018; BENJAMIN et al., 2019).

It is recommended that rehabilitation be a multidisciplinary process in order to promote maximum effectiveness and efficiency in treatment (SCHIMIDT et al., 2019). Conventional physical therapy in the rehabilitation of patients with stroke sequelae often becomes limited. Other techniques aimed at promoting the ability to withstand exertion, gait performance and general physical abilities, such as muscle strengthening, should be included (OVANDO et al., 2010; CASTRO et al., 2011)

In view of this, the generating theme of this research, stroke and brain neuroplasticity stimulated by the use of equipment used for the practice of resistance exercises as a resource in the

physiotherapeutic treatment of patients affected by stroke.

Interventions regarding exercises and mechanotherapeutic treatment after stroke are similar to those aimed at the elderly, providing improvement in functional capacity and physical fitness, avoiding immobility and reducing the incidence of fall accidents (MAGALHÃES, 2017; SILVA, 2017).

It is necessary for the physiotherapist to evaluate the general condition of the patient, as well as the pathologies present, the degree of impairment, physical size, history of injuries, level of muscle mobility, physical losses such as muscle mass, blood tests, and the guidance of other professionals to plan the program of activities according to the functionality and capacity of each one, to achieve the proposed objective (CUNHA, 2011; Oliveira et al. 2019;).

Ovando et al. (2010), during a literature review, found that the most used protocols for the execution of muscle strengthening exercises for the lower limbs (LLLL) used in these clients are similar to those used in training for the elderly: exercises with a minimum load of 50% of the maximum load, with 8-12 repetitions. All studies cited by the authors reported positive results in gait speed, the ability to climb stairs, to stand up and to perform ADL.

In the study conducted by Oliveira et al. (2019) evaluated the functional capacity and muscle strength of people with post-stroke hemiplegia who underwent aerobic and weight training exercises, it was found that at the end of the physical conditioning program, all showed a difference in dynamic balance.

Terranova et al. (2012), recommend that resistance exercises for chronic stroke patients be performed in association with other exercises, being practiced three times a week, for at least three months.

The equipment used to perform resistance exercises after stroke can be separated into equipment for upper and lower limbs and devices for the trunk, head and neck.

The purpose and need of mechanotherapy work are identified, primarily, by the characteristics of the type of mobility and muscle contraction desired by the physiotherapist, meeting a certain objective (BRANDT, et al, 2010). The possibilities are vast: Figure 1 below demonstrates an example

of mechanoterapeutic possibilities.

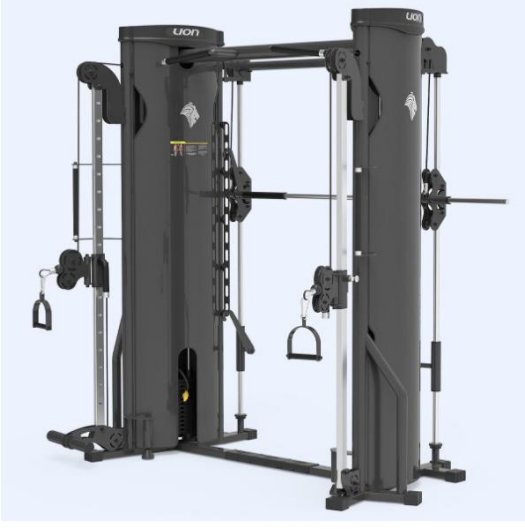

Figure 1: The Cross SmithLFR@ equipment is a professional device that acts on strengthening and defining the muscles. With possibilities in the execution of mobility and body balance exercises.

For this, it is important that the professional always takes into account the individuality of each patient, considering that “the more specific the treatment, the greater the motor learning, and, consequently, the greater the patient’s recovery” (SANTOS; OLIVE TREE; PIEMONTE, 2012).

FINAL CONSIDERATIONS

Physical therapy using mechanotherapy resources are crucial components of post-stroke rehabilitation. The integration of these approaches offers a comprehensive strategy that can significantly improve patients’ functional recovery and quality of life. This is a very dynamic learning mechanism that allows adaptations to different experiences, contributing to learning or motor relearning. Future research should focus on the optimization of treatment protocols and the analysis and use of new mechanotherapeutic devices.

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