

Current Concerns Regarding Gait Rehabilitation in People with Plantar Static Disorders Caused by Neurological Dysfunction

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Abstract

The plantar static disorders we are referring to are caused by foot dorsiflexion deficits. The gait model from which the current research started is the gait of the person with hemiplegia. In these individuals, from a locomotion point of view, the abnormality is represented by the inability of knee flexion and dorsal leg extension and is distinguished by asymmetric gait patterns with compensatory movements of the healthy limb and trunk and inadequate motor coordination. The gait is slow with an asymmetric base of support and the foot performs a circumduction movement during locomotion.

There are many approaches to gait rehabilitation based on different models of motor physiology and yet about a quarter of survivors, even after receiving rehabilitation services, still have residual gait disorders.

Our own study has shown that gait recovery in people with hemiplegia is achieved by applying classical rehabilitation protocols over a long period of time. In 87% of the cases followed, rehabilitation programmes are designed with an emphasis on the foot joint, in 10.7% of cases the knee joint is also addressed and in 3% of cases the hip joint is also addressed. Our proposal involves gait rehabilitation in a reduced time frame by addressing all joints of the lower limb through the use of therapeutic physical exercise, medical devices and neuromuscular taping with a set of impulses to retrain, strengthen and refine the remaining movement capacity.

Keywords: Gait Recovery, Physical Exercise, Dorsiflexion Deficits

Introduction

One of the most significant characteristics of a normal foot can be represented by a correct plantar statics that, during functioning, does not cause the emergence of different tensions in its structure or in the structure of the proximal joints. Plantar statics influences both the distribution of pressure and joint tension, as well as the physiology of walking and body balance. The changes in the static and dynamic aspects of the foot are largely associated with the onset of a condition and are less related to the anatomical shape of the foot.

The ankle-foot joint complex plays a particularly important role in the complete cycle of walking, both through its involvement

in the biomechanics of gait and in terms of maintaining balance. Thus, any condition at this level truly influences the biomechanics of walking and causes balance disorders, and the recovery process must be complex for the results to be successful.

Context

The most serious plantar static disorders are derived from neurological disorders that also influence gait. Dorsiflexion deficiency is a common gait impairment derived from other neurological disorders that manifests as significant weakness of the ankle dorsiflexor muscles.

Dorsiflexion deficit affects the range of motion and is closely related to the biomechanics of the lower limb. A sports health

study conducted in 2022 demonstrated that dorsiflexion deficiency influences knee and hip biomechanics and exposes athletes to an increased risk of injury [9]. There are studies that have focused on the association of gait disturbance and lower limb biomechanics with hip joint dysfunction emphasizing the role of the hip joint in knee biomechanics [1], [6] and less on the importance of the ankle-foot complex. Although there are fewer studies on this aspect, dorsiflexion deficit influences knee joint biomechanics and thus gait physiology. Clinical sagittal measures of reduced dorsiflexion have been associated with reduced hip and knee flexion and are considered to be a consequence of this. In a similar vein, foot dorsiflexion deficit reduces the shock absorbing capacity during walking or running resulting in overuse of the knee joint [8], [4].

Looking at gait methodology as a whole, muscle weakness of the muscles responsible for the dorsiflexion movement of the foot affects the entire chain of movement of the lower limb causing compensatory movements [7]. This deficit restricts gait capacity and induces the development of compensatory strategies such as hip and knee joint hyperflexion and in addition internal rotation of the foot in the transverse plane, all with the aim of disengaging the foot and avoiding tripping.

Compensatory strategies define abnormal gait patterns that, in the long term, result in imbalance of the muscular system and improper loading of the entire skeletal axis. Muscle imbalance reduces mediolateral stability of the foot and causes permanent contraction of the plantar flexor muscles which over time can contribute to Achilles tendon shortening and the development of equinus position of the foot [2].

Materials and Methods

Neurological rehabilitation is an extremely important stage in the healing process due to the functional sequelae we encounter, sequelae of varying severity that can even lead to severe disabilities. The disabilities of a neurological patient can be complex and severe, often involving an inability to move, to perform tasks, to care for oneself, or to integrate socially. Classical theories regarding gait recovery focus on physical therapy, occupational therapy, and the prevention of medical complications, and include concepts such as Bobath, Kabat, and Margaret Rood, which are the most commonly applied [5].

Currently, new rehabilitation strategies are part of the standard care for individuals with motor disabilities and include physical therapy, such as constraint-induced movement therapy, rehabilitation based on high doses of physical activity, goal-specific training, or mirror therapy [3]. Analyzing data on the incidence of stroke in Romania and worldwide, and more specifically data on the forms of neurological manifestation, we aimed to identify the therapeutic strategy for gait recovery in people with post-stroke dorsiflexion deficit. We aimed to highlight the therapeutic means currently used for gait retraining in people with plantar static disorders, people who have a deficit in dorsiflexion movement control of the foot. We also aim to identify the main shortcomings of gait rehabilitation programs and to design a rehabilitation program that meets their needs and requirements.

The aim of the research is to identify the ways in which gait recovery is currently achieved after a stroke during the post-hos-

pitalization period. For this purpose, we conducted a study based on a questionnaire aimed at identifying the recovery strategy and the main aspects that can negatively influence the recovery process. Based on the collected data, we aim to develop a recovery plan focused on the current concerns of the beneficiaries.

Conduct of the Study

The study is aimed at the beneficiaries of medical rehabilitation services. The target group consists of patients who are currently in the walking recovery stage and have benefited from or received medical rehabilitation services in the last 6 months at two rehabilitation clinics in Arad.

The aim of this study was to identify the characteristics of individuals who benefited from walking rehabilitation services and the means by which the process was carried out. We were also interested in the beneficiaries' vision regarding rehabilitation services and their implementation, as well as the difficulties encountered, precisely in order to address their needs by finding new therapeutic strategies that respond to those necessities. For a smooth operation, I created an online questionnaire using the Google Forms platform and distributed it online to individuals who are or have been registered at the two rehabilitation centers in the last 6 months.

The proposed questionnaire consists of 20 questions, 3 of which reflect identification data, while the remaining 17 are multiple-choice or single-answer questions that provide information regarding medical status, the process of medical recovery, and the recovery methods used. There are also questions that provide subjective information regarding how each beneficiary perceived the entire process of gait rehabilitation with dorsiflexion deficit.

Analysis and Interpretation of Results

During the 3 months in which it was distributed, the questionnaire was completed by 93 people, 61 of whom were male (65.5%) and 32 female (34.5%). The background of the people surveyed is an important element, especially knowing that the standard of living and living conditions can become a risk factor and can influence the subsequent neuromotor rehabilitation period. Of the 93 respondents, 55 came from rural areas (59%) and 38 from urban areas (41%). We consider this aspect important because the level of living and the conditions of the environment of origin can influence the way people with special needs can have access to medical rehabilitation services. Typically, people living in urban areas have easier access to rehabilitation services, as rehabilitation centers are often located in urban areas. On the other hand, people living in rural areas are often more active, with various activities around the household, but one impediment is the living conditions, which are often poorer in rural areas.

At the end of the study we have identified information in line with the benchmarks of specialized studies but also particularities of the existing therapeutic approaches that we believe deserve to be improved in order to support people receiving gait retraining services. The plantar static disorders to which we refer are caused by the dorsiflexion deficit of the foot and according to the results indicated by the questionnaire, 92.4% of people with this deficit are diagnosed with hemiplegia as a result of ischemic

stroke (91.8%). Most people identified with this neurological deficit are 65.5% male and 34.5% female and the average age is 53 years, with 53% aged between 50 and 59 years and 32% aged between 40 and 49 years, which is quite low compared to current estimates.

The gait rehabilitation programs currently pursued by medical rehabilitation specialists largely emphasize prioritizing ankle joint restoration (78.55%) through rehabilitation programs built according to the functional status of the patients and the motivation is that 96.4% of patients with post-ischemic stroke sequelae are experiencing foot dorsiflexion deficit. However, there are also specialists who focus on restoring the whole kinetic chain of the lower limb (87.1%) but 68.09% of them follow exclusively classical protocols and do not consider it necessary or useful to try to bring novel elements in gait recovery. Only 18.2% of the specialists consider it necessary to bring also novel elements in gait recovery.

We believe that the desire for innovation in developing new rehabilitation programs is reflected in the professional training of specialists. The more a specialist engages with various information and sources in their field, the better their practice becomes. Regarding the specialists who are part of the respondent group for our questionnaire, 86.7% also have a specialization in massage therapy, 31% are specialists in Vojta therapy, 23.7% are specialists in kinesiointaping, and 16.3% in cupping therapy.

Additionally, the use of medical devices can also be considered another element of novelty. 87.9% of specialists agree with the use of medical devices aimed at improving gait symmetry, ensuring balance, and stabilizing joints; however, according to beneficiaries, only 51% of patients use them in the presence of specialists during rehabilitation programs. Among the most commonly used medical devices are drop foot orthoses, but from the perspective of the beneficiaries, they present a series of disadvantages, including the fact that they do not provide constant support and become uncomfortable if used for an extended period of time. In the opinion of specialists, the most suitable medical devices for gait recovery in individuals with dorsiflexion deficit are the walker and the cane, with only 25.2% of them recommending the use of foot drop orthoses.

Conclusions

Based on these premises, we can conclude that the current therapeutic strategy for gait retraining needs to be improved, based largely on the use of therapeutic ankle and foot exercises and physiotherapy and therapeutic massage procedures. Also, in addition to the fact that current rehabilitation programs are quite simply thought out, through this study we realized that for dorsiflexion-deficient gait retraining the greatest emphasis is placed on ankle joint rehabilitation aimed at improving dorsiflexion motion and less on rehabilitation of the entire kinetic chain of the lower limb. In the case of hemiplegia, due to the dorsiflexion deficit, knee flexion stiffness and compensatory movements of the hip joint occur, which is why we consider it extremely

important that the recovery programs should focus at the same time and with the same effort on the entire kinetic chain of the lower limb.

We consider it useful to propose a new strategy for gait recovery, a program that would reduce the period of functional disability of the affected individuals. In order to meet the current needs we have proposed a recovery program that respects the classical principles and theories of neurological recovery, that fully trains the lower limb and that involves modern means of recovery and the use of orthotic systems. Our proposal for optimizing gait recovery in patients with foot dorsiflexion movement control deficit is to construct a recovery program aimed at improving the quality of life using therapeutic physical exercise concomitant with the application of neuromuscular taping and the use of modern orthotic systems for lower limb orthoses. The current concerns of specialists in rehabilitation medicine must be geared towards updating knowledge and improving medical practice.

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