

Antigravity Treadmill for Rehabilitation of Stroke Survivors

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Abstract

Stroke is a disabling global health-care problem, and rehabilitation is a major part of patient care. By 4 years after the event, more than 30% of stroke survivors report participation restrictions. Up to 70% of patients present fall during the first 6 months, the reason may be due to impairments in balance, gait, motor control, perception and vision contribute to an increment in fear of falling. This can lead to reduced levels of activity and loss of independence. Some of the affected areas include the balance, because of alteration of sensory and motor networks; this contributes to difficulty in activity daily living (ADLs). This is the reason of balance training must be performed. Another sequelae are loss or difficulty with ambulation, and restoration of gait is one of the primary goals in rehabilitation; limitation in gait is another factor that contributes to an increase in fall risk. Recurrence of stroke has been found to vary by sex: 24% of women and 42% of men experience a recurrence within 5 years of onset.

Keywords: Antigravity treadmill; Rehabilitation; Stroke

Introduction

In Mexico in 2008, cerebrovascular diseases were reported as the third cause of death in general (30,212), and the rate has increased since 2000 in people younger than 65 years old, and mortality has been reported in 28.3/100,000 [1-3]. According to the WHO, stroke is the second global cause of dead. The recurrence rate is 10% to 22% at 2 years, but it can be diminished up to 80% with lifestyle modifications [3].

Stroke is a leading cause of death and disability in developed countries, there is an increase in the number of incident strokes, survivors and disability stroke-related. Scrutinio et al. showed that functional status at 6 months predicts long-term mortality [4]. Some other factors have been described (age, initial stroke severity, and functional status at rehabilitation admission) as the most informative predictors of functional outcome. It can be manifested as different types; each one of them can have many clinical manifestations, different approach and treatments [4].

Because of the aging population, and an increment in life expectancy after stroke, the demand for stroke rehabilitation, as well as the economic, social, and family burden of stroke, is expected to increase in the coming years. There is evidence of the efficacy of post-acute rehabilitation in reducing mortality and dependency of stroke patients [5].

Early stroke rehabilitation has been associated with a lower risk of mortality, after accounting for age and sex [6]. Among the main sequels that a patient with a cerebral vascular event presents, there has been reported disturbances in balance and gait; therefore, one of the main objectives in rehabilitation is their treatment [7]. It is estimated that two out of three patients who suffered a cerebral vascular event will experience functional limitations. Among the main alterations in the gait secondary to hemiplegia is the decrease in the speed of gait, distance and efficiency, which generates a limitation in performance.

Abnormal gait generates an increment in energy cost and an increase in fall risk [8,15]. There is also an asymmetry in the step length, support phase (greater support in the non-paretic leg), asymmetry in the swing phase and in the range of mobility of the joints of the lower limbs. One of the main objectives of rehabilitation is the recovery of a safe and effective walking pattern [8].

Mansfield et al. reports that methods to increase daily waking activity during inpatient stroke rehabilitation should be explored, feedback is important because we can stablish progress towards goals, increasing motivation, some authors have used accelerometers for this purpose reporting that intensity can be increased associated with better function and quality of life; and suggest that additional feedback could improve other gait characteristics [9].

In general terms, recovery and a return to a full life or a previous stroke state, following stroke are the main goal for stroke survivors, their families and the health professionals [10]. Stroke rehabilitation interventions are complex and commonly multi-faceted, containing many inter-related components, focused on specific post-stroke problems [10]. Patients need assessment for determining the severity of neurological deficits and for establishing the prognosis, goals and the rehabilitation program [11].

Physical rehabilitation aims to improve the functional recovery through active/passive/ assisted movement, neurophysiological and cardiopulmonary interventions, strengthening program, neurorehabilitation techniques, assistive devices and modalities. Evidence suggests that high-volume, task-specific rehabilitation delivered early post-stroke improves function [9,11]. Treadmill training, with or without bodyweight support, might re-educate walk, improve walking speed and walking endurance in patients who are able to walk after stroke [11].

Due to the important sequelae that a stroke patient may present, it is important to grant a timely and comprehensive treatment that allows an adequate rehabilitation of the patient allowing an optimal incorporation into their activities (in all levels), and to improve their function [12]. The antigravity treadmill uses differential air pressure

technology that allows to reduce the gravitational forces; managing to remove up to 80% of the body weight, having various benefits, joint, cardiovascular and in the gait pattern; It also has a monitoring equipment where the characteristics of the gait are observed (cadence, % body weight support, step length), which allows visual feedback in real time [13].

The device also has a simple interface that the user or medical staff can adjust settings on the treadmill's control panel to select a desired percentage of body weight at which to walk or run [14]. Gait analyses with body weight support using harnesses have revealed a reduction in both vertical ground reaction forces and metabolic work when compared to similar velocities and workloads without support. Body weight support training may assist in rehabilitation without oversteering the individual [15].

The pressurized chamber allows to move the inferior extremities more easily due to less gravitational force, with decreased downward forces acting on their musculoskeletal system. One advantage of this is a reduction in ground reaction forces, which from a rehabilitative perspective, is favourable for individuals who are experiencing injuries such as Achilles tendinitis, plantar fasciitis or other overuse or weight bearing injuries [15,16].

Some cases have been reported in the United States where the antigravity treadmill has been used in stroke patients with sequelae, where a positive result has been found in relation to speed, length of walk, and decrease in the risk of falls. Gait speed and endurance have been described as predictors of independence, mobility and participation [16]. Training with a pressure-controlled treadmill was associated with improved gait parameters, reduced fall risk, improved participation, and reduced the self-perceived negative impact in an individual with chronic stroke. The outcomes suggest that a pressure-controlled treadmill may be an alternative to traditional body-weight-supported locomotor training [16].

Popp et al. compared conventional therapy versus treatment in antigravity treadmill reporting a positive response and improvement in gait and endurance in the antigravity treadmill group on a chronic stroke community [17].

Conclusions

Early stroke rehabilitation is an essential treatment in survivors, and it requires a sustained and coordinated effort from a large team, because of the main sequelae population may present, in this review we focused on the gait abnormalities and the positive impact of antigravity treadmill. Antigravity treadmill supports a safe environment where the patient can re-educate its gait and improve the balance through a positive biofeedback. There are some case reports about the positive effect of antigravity treadmills in this population, but we have to study larger populations. Treatment approaches that are

effective must be implemented in routine clinical practice to have a positive impact on the health of the population.

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