A Walker with a Device of Partial Suspension for Patients with Gait Disturbance: Body Weight Supported Walker

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Abstract: We developed a walker, the Body Weight Supported (BWS) Walker, with a device of partial suspension for patients with gait disturbance. It consists of a light frame with casters, a harness, and a winch system. One therapist alone can perform gait training safely with the BWS Walker without any additional physical load, even if a patient has severe gait disturbance, and the therapist can concentrate on evaluating and improving the patient’s standing balance and gait pattern. Because the BWS Walker is less expensive, simpler, and easier to operate than other BWS systems, we believe the BWS Walker can be widely applicable in training for patients with severe and moderate gait disturbance.

Key words: stroke, gait training, walker, body weight-supported training, rehabilitation.

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Introduction

A stroke patient with severe gait disturbance may require intensive and safe gait training from the acute stage, to gain a successful result in rehabilitation. Recently, several researchers have reported that manual-assisted or robotic-assisted body weight-supported (BWS) treadmill training enhanced the gait function of patients suffering from spinal cord injury, stroke, or other neurological conditions [1]. Although the manual-assisted BWS treadmill training has benefits of functional recovery and independence of gait, the physical burden on the therapist is considerably heavy, and a patient cannot walk freely on the floor. Robotic-assisted BWS devices reduce the burden, but they are too big and too expensive. A gait training device which is less expensive, simpler, and easier to operate is desirable, but there are few reports about such a device [2]. We therefore developed a walker with an apparatus of partial suspension for patients with gait disturbance, the BWS Walker.
BWS Walker

The BWS Walker consists of a frame made of aluminum with four locking casters, a parachute harness, and a winch system (Fig. 1). It is 900 mm wide, 1,000 mm deep, 1,800—2,200 mm high and weighs 24.5 kg. The height of the BWS Walker is adjustable, and the frame and winch system can endure the weight of patients up to 100 kg. A weight measure is attached to the winch system, by which we can easily measure the suspended body weight. The frame has a horizontal bar and a central bar (Fig. 2), which support the upper extremities. The central bar is removable, and the horizontal bar is adjustable. The harness is also adjustable to fit the waist and hips. The BWS Walker costs about $3,000, and is far less expensive than robotic devices.

Fig. 1. Body Weight Supported (BWS) walker. The BWS walker consists of a frame made of aluminum with four locking casters, a parachute harness, and a winch system. It is 900 mm wide, 1,000 mm deep, and 1,800—2,200 mm high, and weighs 24.5 kg.

Fig. 2. Central bar and horizontal bar. A patient grasps the bars to keep his/her body straight. The central bar is removable, and the horizontal bar is adjustable.
Patients

We used the BWS Walker for 12 stroke patients with severe gait disturbance who could hardly train themselves for gait because of the severity of their hemiplegia or agnosia (e.g. Pusher syndrome). It took about five minutes to put on the harness the first time, but took less time from the second time on. The rate of unloaded body weight, which was preferable from 0 to 40%, was adjusted based on the weight measure in relation to the patients' ability to swing their paretic limbs. While a therapist controlled the BWS Walker, a patient could walk freely on the floor at his own comfortable speed.

All patients could stand in a symmetrical posture with the BWS Walker, could walk straight on the floor for more than 10 m comfortably, and could turn smoothly. They did not complain of pain in their waist or inguinal areas because the harness fitted well. Ten of those using the BWS Walker could swing their paretic limb with the assistance of a therapist even if they couldn’t swing it with a knee ankle foot orthosis (KAFO) or ankle foot orthosis (AFO) in the parallel bars with a therapist’s assistance.

There were no accidents of falling down while the patients walked with the BWS Walker. One therapist alone could perform gait training with the BWS Walker on the floor safely, and could concentrate on evaluating and improving the stand and gait pattern.

Discussion

We developed the BWS Walker, which may be just as useful as a BWS treadmill for training a patient with gait disturbance and is definitely less expensive than a manual-assisted BWS treadmill or robotic-assisted BWS gait trainer [3, 4].

Because the BWS Walker has a structure as simple as ordinary walkers and is not equipped with a personal computer or complicated control unit, it is very easy for all physical therapists to operate the BWS Walker during gait training. The BWS treadmill or robotic-assisted BWS gait trainer can be operated properly only by specialists in the field of physical therapy and rehabilitation engineering. On the other hand nurses in the ward, assistants in welfare facilities, or even family members at home can fit the BWS Walker to a patient within a few minutes and manage it with ease. All the patients in this study could perform gait training comfortably, freely and safely with the BWS Walker, and gait training with the BWS Walker was not limited to a fixed place in the training room. When a patient puts on the BWS Walker by his bed in the ward, he can walk comfortably with the BWS Walker in the corridor, freely get in and out of an elevator, and safely arrive at the training room on a different floor. The features of the BWS Walker are comfort, freedom of movement, and safety in gait training.

The BWS Walker has two bars to support the upper extremities: a central bar and a hori-
zontal bar. We set the central bar to the BWS Walker for patients who have a less stable standing balance; for example, a patient with pusher syndrome or visuospatial neglect. In this study, a patient with pusher syndrome who could barely stand still and walk in the parallel bars without putting a heavy physical burden on a therapist could stand still in a symmetrical posture with the BWS Walker, holding the central bar, and could walk safely having his paretic lower extremity swung by a physical therapist. The central bar is also a good mark for a patient with visuospatial neglect, indicating the center of field, because the patient is asked to grasp the central bar and look at it during gait.

Although the BWS Walker has several advantages compared with BWS treadmill or robotic-assisted BWS gait trainer, one disadvantage is that the BWS Walker has no system to control the paretic lower extremity. If a patient suffers from complete paralysis of both lower extremities, the BWS Walker is less applicable, and a robotic-assisted BWS gait trainer may be superior for such a patient. When a patient cannot walk volitionally or cannot follow commands, the BWS Walker is not useful.

We consider that the BWS Walker is useful for hemiplegic patients with severe or moderate gait disturbance and with agnosia, ataxia, or rigidity, but this remains to be further studied, because there are no data indicating that gait training by using the BWS Walker is objectively superior to ordinary gait training without any assistant device, BWS treadmills, or robotic-assisted BWS gait trainers.

**Conclusion**

We developed the BWS Walker, which consists of a frame made of aluminum with four locking casters, a parachute harness, and a winch system for partial body weight suspension. The BWS Walker is less expensive, simpler, and easier to operate than other BWS systems.

**References**

歩行障害患者のための懸垂機構付き歩行器の開発

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要旨：懸垂機構付きの部分免荷歩行器（Body Weight Supported (BWS) walker）を開発した。
BWS walkerはアルミ製の軽量フレーム、キャスター4個、ハーネス、ウィンチを用いた懸垂機構からなり、1人の療法士でハーネスの装着、ウィンチによる懸垂、歩行器を操作しながら歩行訓練を行うことができ、重度の歩行障害をもつ患者に安全に歩行訓練を行うことができ、かつ訓練を担当する療法士の負担が少ない。この歩行器による歩行訓練では、介助をすることよりも起立歩行の評価や指導に、より集中することができ、既存の部分免荷システムに比べ簡便かつ安価であり、扱いやすい点が優れてくる。重度から中等度の歩行障害患者に広く適応があると考えている。

キーワード：脳卒中、リハビリテーション、歩行器、歩行訓練、部分免荷歩行訓練。

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