Effect of visual feedback treadmill walking exercise using FES system for stroke outpatients with hemiplegia. - 2 cases pilot study

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Background and Aims

Treadmill walking exercise is practiced using ankle-foot orthosis for stroke hemiplegic patients with drop foot. This training is reported to be more effective than level walking exercise in the improvement of stable gait pattern and the increase of walking endurance[1)]. Nowadays, walking exercise using functional electrical stimulation system with common peroneal nerve stimulation during swing phase for drop foot is considered more useful in the point of activation to neuromuscular system than the ankle foot orthosis treatment. However, both trainer and the patient could not find the right electrical stimulation timing during usual treadmill walking exercise.

This study examined the effectiveness of visual feedback system on treadmill walking exercise using Welwalk WW-1000™ and a FES system for chronic stroke patients with drop foot.

Subjects and Methods

<Study design>

Prospective observational pilot case study.

<Subjects>

Two chronic hemiplegiic stroke outpatients with drop foot. Age 76 and 78. Subjects can walk with t-cane and ankle foot orthosis under caregivers supervised condition.

<Methods>

Visual feedback treadmill walking exercise with FES were done twice a week for three months. Welwalk WW-1000™ was used as a visual feedback treadmill with a digital monitor displaying a lateral walking image(Fig-1), and WalkAid™ was used as a FES system for drop foot(Fig-2).

Treadmill walking exercise was done for 20 minutes in each 40 minutes physical therapy session.

Results

#1: Visual feedback was useful to get stabilization of walking pattern during FES stimulation (Fig-3).

#2: 10m gait time of two subjects changed from 122.5 to 56.7sec., 33.5 to 28.4 sec. respectively (Fig-4).

#3: 6 minutes walking distance(6MD) increased from 10 to 59 m and 107 to 165m (Fig-4).

This intervention course gained excellent improvement in walking ability with patients satisfaction indicated in Visual Analog Scale; VAS 7 and 8.

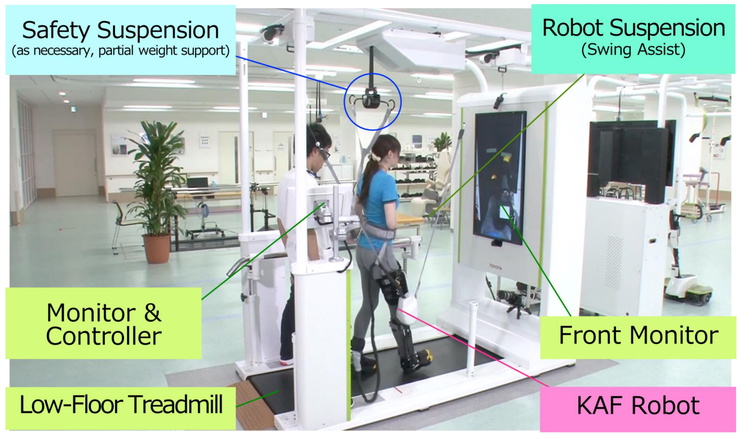
Discussion

This study demonstrated that the visual feedback treadmill walking exercise is useful for improving gait pattern of chronic hemiplegic patients. Welwalk WW-1000™ has a big display front monitor on which both a patient and a physical therapist can watch the lateral view of the patient's walking. The timing of functional electrical stimulation is reported to be an essential key point to facilitate neuro-motor systems[2)], thus our trial of visual feedback treadmill walking exercise using Welwalk WW-1000™ and Walk Aide™ stimulation is considered to be quite useful on the standpoint of Neurorehabilitation.

Conclusions

The visual feedback system that uses a lateral view of the patient's walking, is thought to be useful in treadmill walking exercise with the FES system, particularly for chronic hemiplegic stroke patients with drop foot.

Welwalk WW-1000



Both patient and PT can watch the lateral view of patient's walking on the front monitor

Fig-1. Welwalk WW-1000

For severe hemiplegic patients, knee-ankle-foot orthoses (KAFO) are frequently used to prevent giving way in the stance phase. However, it is very difficult to swing paralytic leg with KAFO. As a result, walking exercise with KAFO requires a high level of assistance and raise low exercise intensity. To solve these problems, Welwalk WW-1000, which has a motor on the knee joint with KAFO-like framework, was developed. Welwalk can extend and flex the knee in appropriate timing. Subacute stroke patients with hemiplegia who had walking exercise using Welwalk WW-1000 showed early improvement in walking independence compared to patients using KAFO [3)].

WalkAide®

The WalkAide® System is an advanced Functional Electrical (FES) Stimulation System for the treatment of Foot Drop caused by **upper motor neuron injury.**

Utilizing a **tilt sensor and accelerometer** technology, the WalkAide stimulates the common peroneal nerve to lift the foot at the right time during the gait cycle, prompting a more natural, efficient, and safe walking pattern. WalkAide users have the freedom to walk with or without footwear, up and down the stairs, and all directions.

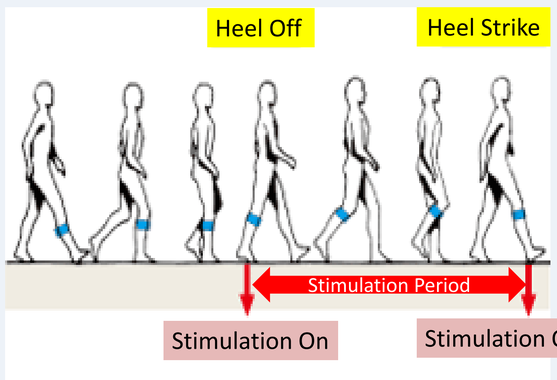


Fig2. Treadmill walking exercise using WalkAde™ Manual stimulation mode during walking

Fig-3. Change of walking pattern between first and final stage in this walking ex. program

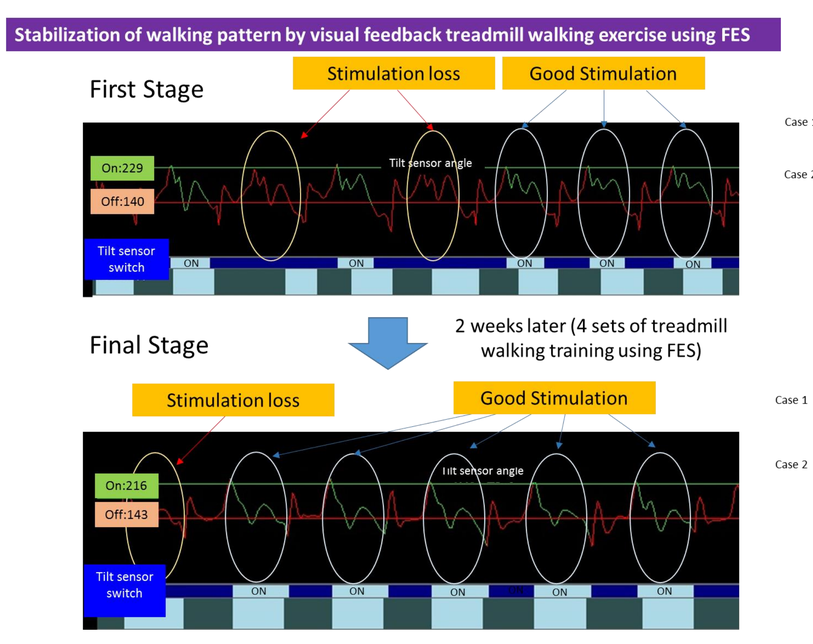
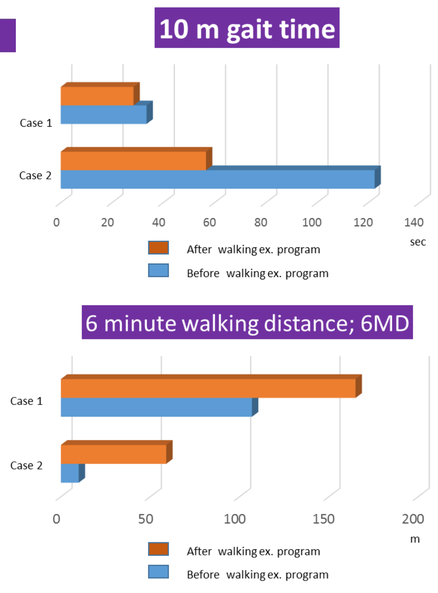


Fig-4. Change of 10m gait time and 6MD



Reference

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2)K.Takeda et al. Review of devices used in neuromuscular electrical stimulation for stroke rehabilitation. Medical Devices 10(2017) 207-213

3)S.Hirano et al.Welwalk facilitate early improvement in walking independence of with hemiplegia:Annals of Physical and Rehabilitation Medicine 61:e93DOI: 10.1016/j.rehab.2018