Robot-Assisted Gait Training for Hereditary Spastic Paraplegia

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***Abstract*— Robot-assisted gait training has been investigated for restoring walking through activity-dependent neuroplasticity in various neurological disorders. This case report presents the outcome of robot-assisted gait training combined with physiotherapy in a 28-year-old man with pure hereditary spastic paraplegia. The patient participated in 25 training sessions over 6 weeks. Improvements were noted in his walking speed and balance after the training. Gait kinematics and kinetics showed no remarkable changes before and after the training. Therefore, robot-assisted gait training may be useful for providing intensive gait training in patients with hereditary spastic paraplegia.**

Keywords—gait, robot, spasticity, paraplegia, rehabilitation

I. Introduction

Hereditary spastic paraplegia (HSP) is a neurological condition with progressive distal axonopathy involving the corticospinal tract leading to lower limb spasticity and gait disturbance. Intensive rehabilitation, Botulinum toxin injection, and application of orthosis are mainstay of treatment for gait disturbance in HSP. However, efficacy of robot-assisted gait training for HSP has not been evaluated. We investigated the effect of robot-assisted gait training in a patient with HSP whose gait was deteriorating even with conventional treatments.

II. Case Presentation

A 28-year-old man with pure HSP was diagnosed with SPG4 deletion (exon 5-17 and part of the SLC30A6 gene) by a genetic study. The patient had undergone bilateral Achilles tendon lengthening at 6 years of age and bilateral distal hamstring lengthening, rectus femoris transfer to gracilis, and gastrocnemius lengthening at age 26. Although he could walk without assistance using a single cane and bilateral ankle-foot orthoses, his gait gradually deteriorated. The patient had been taking baclofen (20 mg bid) to reduce spasticity and was performing home-based exercises regularly.

III. Robot-Assisted Gait Training

The daily training session included 30 min of robot-assisted walking using an exoskeleton-type gait robot with partial body weight support (Walkbot_S; P&S Mechanics, Seoul, Korea), 30 min of gait training on the ground, and 30 min of upper extremity exercises with functional training. He underwent 25 training sessions during 6 weeks.

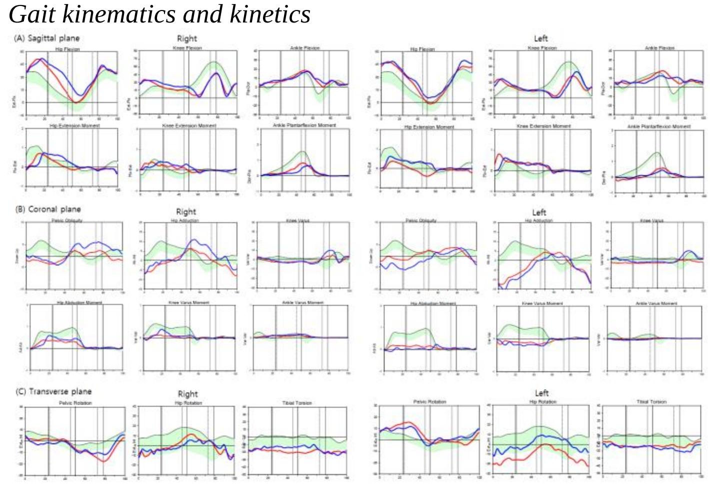
The gait robot replicated a normal gait pattern on a treadmill by controlling movements of the hip, knee, and ankle joints on both sides. The speed of the robot-assisted walking was increased from 1.2 to 1.8 km/h at each session. The amount of body weight support was gradually lowered from 25% to 0% during the course of the training sessions.

IV. Results

A. Clinical Outcome

Functional assessments	Before	After
10 meter Walk (sec)	12.6	10.9
6 min Walk Test (m)	249	236
Time Up & Go (sec)	23.8	20.5
Berg Balance Scale	39	43

B. Gait kinematics and kinetics



Red and blue lines represent gait parameters before and after the training, respectively. Green shadow represents normal range of each parameter.