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Case Report

Effectiveness of gait training with lower limb orthosis for a patient with severe Guillain-Barré syndrome at a Kaifukuki rehabilitation ward

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ABSTRACT
Tanaka M, Wada Y, Kawate N. Effectiveness of gait training with lower limb orthosis for a patient with severe Guillain-Barré syndrome at a Kaifukuki rehabilitation ward. Jpn J Compr Rehabil Sci 2021; 12: 48−52.
Introduction: We report the case of a patient with severe Guillain-Barré syndrome (GBS), whose ambulation recovered despite requiring total assistance on admission to a Kaifukuki rehabilitation ward. Gait training using knee-ankle-foot and ankle-foot orthoses was highly effective, based on the improvement in lower extremity muscle strength.
Case: A female in her 20s was previously diagnosed with GBS and was transferred to a Kaifukuki rehabilitation ward on hospitalization day 57. On admission, the lower extremities had a manual muscle test grade of 1, and the functional independence measure motor score (mFIM) was 13. She began training to stand upright using a tilt table and a knee-ankle-foot orthosis. Gait training with an adjustable posterior strut ankle-foot orthosis was initiated from 9 weeks after admission, with the fixed, brake, resistance, and freedom settings of the orthosis for the ankle joint adjusted according to the improvement in lower extremity muscle strength. At discharge, she was ambulatory without assistive devices and foot orthoses, and her mFIM had improved to 91. She returned to work 2 months later.
Discussion: This report describes the effectiveness of standing and gait training with a foot orthosis in improving ambulation in a severe GBS patient admitted to a Kaifukuki rehabilitation ward. Medical management and high-intensity rehabilitation are essential for patients with severe GBS during Kaifukuki rehabilitation.
Key words: Guillain-Barré syndrome, Kaifukuki rehabilitation, lower limb orthoses, gait training

Introduction

Guillain-Barré syndrome (GBS) is an acute immune-mediated polyradiculitis characterized by acute motor axonal neuropathy, which presents with bilateral flaccid paralysis, acute motor and sensory axonal neuropathy, and acute inflammatory demyelinating polyneuropathy, which also involves sensory disorders [1]. In severe cases, dysfunctions persist for a long time [2]. In Japan, rehabilitation studies on GBS patients are mostly case reports [3−7]. In particular, a few studies have focused on foot orthoses in patients with severe GBS.

We encountered a patient with severe GBS, who recovered ambulation despite requiring total assistance in walking on admission to the Kaifukuki rehabilitation ward. Gait training using a knee-ankle-foot orthosis (KAFO) and an ankle-foot orthosis (AFO) was proven effective based on the muscle strength improvement in the lower extremities. This study complied with all specifications of the CARE guidelines [8]. Informed consent was obtained from the patient for the publication of this case report.

Case

Patient: A woman in her 20s.
Diagnosis: GBS (demyelinating type).
History of present illness: Five days prior to consultation, the patient noted numbness in her distal extremities, weakness, vomiting, and diarrhea. She had previously been diagnosed with GBS on physical examination and cerebrospinal fluid analysis in another hospital. She was intubated on admission day 1, and underwent tracheostomy on day 21. She

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received immunoglobulin therapy, plasmapheresis, and immunoadsorption therapy. She was transferred to our Kaifukuki rehabilitation ward on day 57.

Comorbidities and past history: None.

Present illness at the time of transfer: Her vital signs were as follows: blood pressure, 118/75 mmHg; heart rate, 82 beats/min; and SpO_2, 99% (room air). She was alert and conscious. She had spontaneous breathing with a double-cannula tracheostomy tube with a cuff. The manual muscle test (MMT) grades (right/left) were as follows: deltoid 3/2, biceps 3/3, triceps 3/3, extensor carpi radialis 3/3, flexor carpi radialis 3/3, opponens pollicis 3/3, opponens digiti minimi 3/3, iliopsoas 1/1, gluteus medius 1/1, quadriceps femoris 1/1, tibialis anterior 1/1, and triceps surae 1/1. Her superficial sensation was 1/10 in both extremities, distal to the knees. Her proprioception and vibratory sensation were diminished. She had numbness from the pelvis to the distal extremities. Tendon reflexes were decreased in all extremities. She had a limited range of motion (ROM) in both ankle dorsiflexors (−5°). Thus, she required total assistance in getting up and maintaining a sitting position. At this time, her functional independence measure (FIM) was 48 (motor score, 13; cognitive score, 35). She was eating code 4 in the Japanese Dysphagia Diet 2013 (dysphagia diet 4) in a 60° reclining position.

Problems: The problems in body function and structures were as follows: muscle power weakness, sensory disorder, pain, limited ROM, and dysphagia. Meanwhile, problems in activities were as follows: restrictions in motion, transfer, self-care, and communication. Lastly, the problems in participation were as follows: restrictions in home life, community life, and work life.

Hospitalization progress:

We set the patient's rehabilitation treatment goals as follows: to reduce pain in the lower extremities when changing posture and improve the ability to change basic body position and transfer to a wheelchair; to be able to eat using assistive devices; and to communicate verbally. Physical therapy, occupational therapy, and speech-language therapy were initiated at bedside, focusing on muscle strengthen training, ROM training, hand dexterity training, and self-care training. Initially, she had severe muscle weakness; therefore, we started with passive exercise and gradually increased active exercise. We prevented overuse syndrome by adjusting the amount of exercise according to her fatigue and weakness on the day after training and CK on laboratory data. She reported neuropathic pain (Numerical Rating Scale 8) in her lower extremities on changing posture and transferring; thus, she was unable to independently transfer to a wheelchair. Her cannula was changed to a speech cannula at week 1 of admission, and was de-cannulated at week 3. At week 6, she underwent videofluorographic examination, and her dysphagia severity scale score was 7; therefore, we switched her to a regular diet. Pregabalin was gradually increased to 300 mg/d, which provided pain relief and enabled the patient to independently transfer to a reclining wheelchair. At week 5, posture training by standing in an upright position using a tilt table was initiated, while monitoring blood pressure, heart rate, and subjective symptoms. No orthostatic hypotension was observed. At week 7, her ROM limitation in her ankles improved. She began training to stand using a double-bar KAFO (ring-lock knee joint and double-Klenzak ankle joint) with the ankle joint fixed at 0°. At week 8, she underwent a nerve conduction study, which showed prolonged distal latency, conduction delay, and temporal dispersion in compound muscle action potential, and her condition was thus diagnosed as a demyelinating type.

We revised the patient's rehabilitation treatment goals as follows: to walk under supervision using a foot orthosis, to attain mobility with a wheelchair, and to independently perform eating, grooming, and dressing. At week 9, the tibialis anterior and triceps surae MMT grades were 1, and she had loss of tactile and position sensation in the lower extremities and toes, respectively. At this time, she was able to maintain a standing position with a KAFO. For medical treatment, we prescribed an adjustable posterior strut ankle-foot orthosis (APS-AFO; bar: rigid), which is lightweight, esthetic, and adjustable according to fixed, brake, resistance, and freedom settings. We started with gait training and adjusted ankle joint mild dorsiflexion fixed using parallel bars (Figure 1). At week 10, we substituted a walker for the gait training. In the interim, she was able to transfer to a normal wheelchair when eating and grooming; thus, she was no longer bedridden and was able to perform other activities. She required minimal support when getting up from her bed, and so assistance was still required when transferring to a wheelchair. At week 13, she was able to independently transfer to a wheelchair and perform toileting. As her lower extremity support increased, we changed her APS-AFO

Figure 1. Gait training with adjustable posterior strut ankle-foot orthosis using parallel bars.

to a dorsiflexion-free and plantar flexion resistance setting. In addition, nurse-assisted gait training using a walker with APS-AFO was started in the ward. For independent ambulation, muscle strength training of the lower extremities and balance exercises to improve static, dynamic, and gait stability were performed. Meanwhile, she was able to walk on a flat indoor surface with APS-AFO without an assistive device for 80 m continuously. At week 18, she was able to walk on the stairs and on flat and inclined outdoor surfaces with APS-AFO. At this time, she was able to dress herself independently.

Taking into consideration the patient's life post-discharge, we revised the patient's rehabilitation treatment goals as follows: to bathe independently, walk long distances outdoors without assistive devices, climb stairs independently, use public transportation, and cook for herself. Foot drop was no longer observed when walking a short distance, and she thus started gait training without APS-AFO, which was evaluated according to walking distance. For independent long-distance outdoor walking, muscle strength training of the lower extremities for improving muscle endurance and gait training (i.e., changing walking speed and double task training) for improving gait stability were initiated. At week 18, her 6-min walk distance without APS-AFO was 220 m, and the 10-m walk test was 10.2 s. She was able to bathe independently at week 19. At week 20, she engaged in outdoor gait training, public transportation training using trains and buses, and cooking training, all of which she was able to properly perform. Activities of daily living (ADL) at discharge improved to FIM 126 (Figure 2, Tables 1 and 2). Her toe numbness and mild decreased vibratory sensation remained; however, her tactile sensation and proprioception recovered to normal. Gait ability at discharge was defined by a 6-min walk distance of 320 m and a 10-m walk test of 7.0 s, with independent long-distance outdoor walking. She was discharged to her parents' home at week 21.

At 1 month post-discharge, she started living on her own, and was able to independently perform the key activities of daily living, such as shopping, cooking, and cleaning. She returned to work, mainly at a desk, from 2 months after discharge.

Discussion

We report the case of a severe GBS patient who required total assistance for walking on admission to the Kaifukuki rehabilitation ward and who eventually recovered ambulation by gait training using KAFO and AFO based on muscle strength improvement in the lower extremities.

Standing and gait training with lower limb orthoses were effective in improving the walking ability of patients with severe GBS at the Kaifukuki rehabilitation ward. A previous prospective cohort study reported that 60% of GBS patients had foot drop at the start of inpatient rehabilitation, and recommended the use of an AFO [9]. In our case, the patient was a young woman with severe paresis in her extremities. AFO, which is lightweight and adjustable with fixed, brake, resistance, and freedom settings for the ankle joint, was suitable. APS-AFO is a type of AFO that is lightweight, esthetic in appearance, and adjustable with fixed, brake, resistance, and freedom settings for the ankle joint according to improvements in dysfunction [10, 11]. Upon recovery of proximal lower extremity muscle strength, the APS-AFO with a fixed ankle joint was used. When the distal lower extremities recovered, we consequently changed the ankle joint brake, resistance, and freedom. By using foot orthoses, excessive muscle output was suppressed and exercise cost was restricted within the reduction of degrees of freedom, which are advantageous for preventing overuse. In the present case, it was highly likely that gait training by adjusting the function of the foot orthosis improved gait ability.

Medical management and high-intensity rehabilitation for patients with severe GBS undergoing Kaifukuki rehabilitation are important. Khan et al. reported that high-intensity rehabilitation for GBS patients after acute treatment improved FIM compared with those who underwent low-intensity rehabilitation [12]. In Kaifukuki rehabilitation, a maximum of 3 h of rehabilitation can be performed, which is considered to be high-intensity rehabilitation in comparison with other countries. In our case, we performed medical management, namely, preventing overuse, controlling pain, and observing autonomic dysfunction, and we were able to adjust the exercise intensity gradually.

However, several aspects of the prognosis for severe GBS remain unknown. Poor prognostic factors of function for GBS are reported to be as follows: old age (>50 years), prodromal diarrhea, low medical research council sum score in acute period, and need for mechanical ventilation [13−15]. In our case, the patient had prodromal diarrhea, required a ventilator, and had severe muscle weakness in extreme periods; thus, a mild permanent dysfunction was predicted on admission to our hospital. However, unexpectedly, the patient was able to independently perform ADLs and return to work at 8 months from onset. This remarkable recovery may be attributed to the patient's young age, absence of comorbidities, short-term (2 months) mechanical ventilation, and good pain control. Further investigations on prognosis prediction for severe GBS patients who require Kaifukuki rehabilitation are necessary.

In cases where patients have severe paresis in their extremities, recovery may be expected with consistent foot orthoses and gait training using a KAFO and an AFO. Therefore, doctors should focus on the ankle joint function when prescribing foot orthoses. Nevertheless, the physical training and exercise load

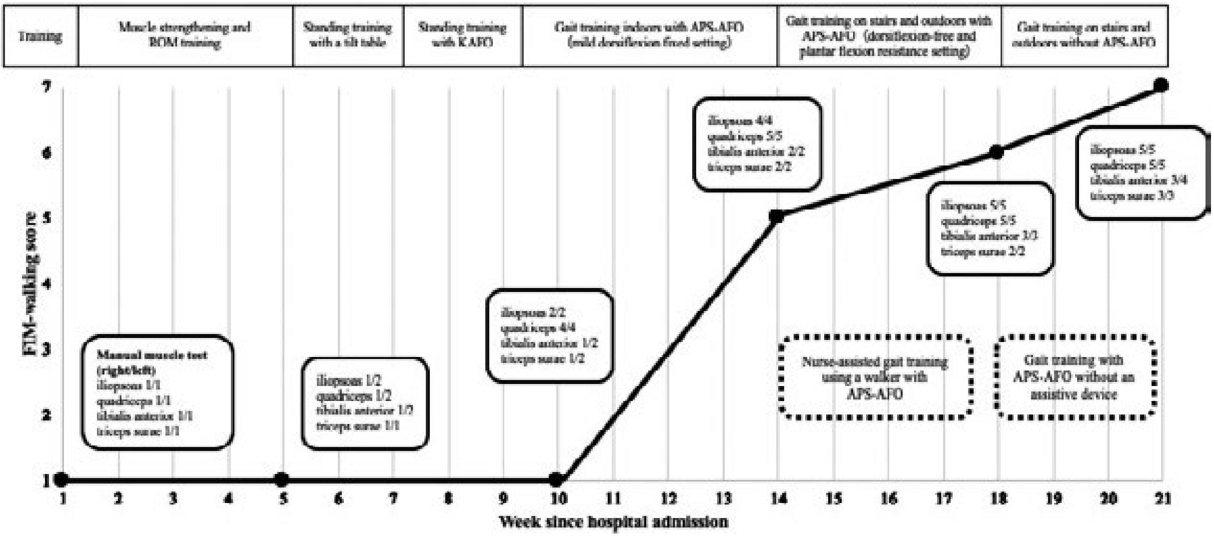

Figure 2. Progression of FIM-walking score, lower extremity muscle strength, and rehabilitation training starting at hospital admission.

Table 1. Changes in the Functional Independence Measure Motor Score.

	Week 1	Week 5	Week 10	Week 14	Week 18	Week 21
Eating	1	1	5	6	6	7
Grooming	1	1	4	4	4	7
Bathing	1	1	1	1	3	7
Dressing upper body	1	1	1	1	6	7
Dressing lower body	1	1	1	1	7	7
Toileting	1	1	1	6	7	7
Bladder management	1	1	1	7	7	7
Bowel management	1	1	1	6	7	7
Transfer (bed)	1	1	1	5	6	7
Transfer (toilet)	1	1	1	5	7	7
Transfer (bath)	1	1	1	2	3	7
Walking	1	1	1	5	6	7
Stairs	1	1	1	1	5	7

Table 2. Changes in Upper Extremity Function.

	Week 1	Week 5	Week 10	Week 14	Week 18	Week 21
MMT (right/left)						
Elbow joint flexion	3/2	4/4	5/5	5/5	5/5	5/5
Elbow joint extension	3/3	4/4	5/4	5/5	5/5	5/5
Wrist joint flexion	3/3	3/3	4/3	5/5	5/5	5/5
Wrist joint extension	3/3	3/3	4/4	5/5	5/5	5/5
Grip strength, kg	0/0	1.5/1	5/3	13.5/6	16.5/10	27/25*
STEF score			76/75	98/96	100/100	

STEF, Simple Test for Evaluating Hand Function; *1 month after discharge.

of GBS patients have not been elucidated. Therefore, the physical training of GBS patients in the Kaifukuki rehabilitation ward, as well as the prognosis in terms of ability to perform ADLs and gait recovery, need to be investigated in the future.

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