A Comparison of Knee-Ankle-Foot Orthoses with Either Metal Struts or an Adjustable Posterior Strut in Hemiplegic Stroke Patients

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Background: We investigated differences in factors affecting judgments regarding the creation of new adjustable posterior strut knee-ankle-foot orthoses (APS-KAFO) and knee-ankle-foot orthoses with metal struts (traditional KAFO) for hemiplegic stroke patients for whom KAFO were created in rehabilitation wards. *Methods:* Subjects were 50 patients with hemiplegia due to new-onset stroke (cerebral infarction: n = 25, cerebral hemorrhage: n = 25) who were prescribed KAFO. Patient ages ranged from 36 to 90 years, and the mean duration from stroke onset to hospitalization was 28.8 ± 13.8 days. Neurologic symptoms, cognitive function, activities of daily living, duration from hospitalization to orthosis creation, hospitalization duration, walking ability at discharge, outcome after discharge, and so forth were compared. *Results:* Fourteen patients were prescribed APS-KAFO, and 36 were prescribed traditional KAFO. Those prescribed APS-KAFO had somewhat milder neurologic symptoms and cognitive dysfunction and a shorter hospitalization duration than those prescribed traditional KAFO. Patients prescribed APS-KAFO also had a higher score and efficiency on functional independence measure at admission and discharge. Walking independence at discharge was seen in 8 of the 14 patients for whom APS-KAFO were created and 8 of the 36 patients for whom traditional KAFO were created. *Conclusions:* APS-KAFO was chosen for patients with a high level of activity in the ward and with a higher likelihood of acquiring walking ability using APS-AFO at discharge, whereas traditional KAFO tended to be chosen for patients with relatively severe symptoms who were not expected to acquire practical walking ability. **Key Words:** Adjustable posterior strut orthoses—knee-ankle-foot orthoses—stroke—hemiplegia.

The use of foot orthoses for hemiplegic stroke patients promotes active rehabilitation and facilitates a quick return home by improving activities of daily living.[1] In the Japanese Guidelines for the Management of Stroke 2009, ankle-foot orthoses (AFO) were recommended for hemiplegic patients with clubfoot to improve walking ability.[2] The use of orthoses with struts allows patients to gain stability in their paralyzed foot and walk with good dynamic balance.[3,4] However, although there are few reports on orthosis therapy for stroke patients exhibiting more severe hemiplegia, knee-ankle-foot

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orthoses (KAFO) have been used in Japan since before World War II.[5-10] These traditional orthoses are AFO with metal struts plus mounted knee joint and thigh cuff, and provide good support even in patients with severe hemiplegia, allowing therapists and others to easily assist the patient with walking.[8-10]

Adjustable posterior strut (APS) orthoses that allow adjustment within a short period of time have recently been developed.[11,12] APS orthoses are usually used as AFO (APS-AFO), although patients with severe paralysis are sometimes prescribed APS-KAFO with an added thigh cuff. However, the criteria for determining the right orthosis for each patient are vague, and the orthotic choice is currently the decision of the prescribing physician. In the present study, we retrospectively investigated the characteristics of hemiplegic stroke patients prescribed KAFO in rehabilitation wards for investigating the different factors affecting judgments regarding the creation of APS-KAFO and traditional KAFO.

Subjects and Methods

Subjects

Subjects were 50 (33 men and 17 women) patients newly prescribed KAFO chosen from 363 patients with hemiplegia from new-onset stroke hospitalized between April 2013 and March 2014. Patient ages ranged from 36 to 90 years (67.9 ± 13.5 years). The underlying disease was cerebral infarction in 25 patients and cerebral hemorrhage in 25 patients. The duration from stroke onset to hospitalization was 28.8 ± 13.8 days. Because of severe hemiplegia and/or sensory impairment, none of the patients could support themselves with their affected lower limb, and they were prescribed KAFO for standing or ambulation exercise.

Indications for Exercise and Orthosis Therapy

Directly after admission, rehabilitation patients are encouraged for ambulation and to start adopting a standing position as soon as possible. KAFO are prescribed when (1) the patient's general condition has stabilized and they are able to start standing or walking training, but the knee and ankle joints are unstable because of severe paralysis; (2) the patient exhibits spasticity patterns predominantly in the flexor muscles and cannot hold their knee in the extended position; and (3) the patient displays abnormal knee joint movement, such as flexion contractures of the knee joint.[6-8] Until the orthosis is casted and completed, orthoses available at the training room are used to initiate standing training. Walking training is performed in patients who show improvement in standing balance from wearing a KAFO, even if support with the affected lower is poor. In patients whose affected lower limb has severe paralysis from the outset, the therapist assists rehabilitation with a KAFO. The knee and ankle joints of the orthosis are adjusted as needed; and if support with the affected lower limb can be achieved and walking is possible without fixing the knee joints, the orthosis is modified (cut down) to an AFO by removing the thigh cuff.

APS-KAFO and Traditional KAFO

APS-AFOs have a good outer appearance because they have a single posterior carbon strut. In addition, they have hinge joints that allow plantar and dorsiflexion range of motion to be adjusted precisely and easily. APS-KAFO are modified APS-AFO, with an added knee joint and a thigh cuff. Its lower portion consists of a foot section, a shank, hinge joints, a posterior strut, and a leg cuff, whereas the thigh portion consists of inner and outer struts, ring locks, a kneepad, and a thigh cuff (Fig 1). APS-KAFO is light (total weight = 1100 g); and because of the nature of the simplified construction, patients using APS-KAFO should not weigh more than 80 kg, but the leg and thigh portions of the apparatus can be easily detached. As a result, patients can use it as a KAFO during walking training and as an AFO at other times. Traditional KAFO are equipped with bilateral metal struts,

Figure 1. *The APS-KAFO and traditional KAFO. Abbreviations: APS, adjustable posterior strut; KAFO, knee-ankle-foot orthoses.*