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ORIGINAL RESEARCH ARTICLE

Long-Term Effect of an Anterior Ankle-Foot Orthosis on Functional Walking Ability of Chronic Stroke Patients

ABSTRACT

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Objectives: The objectives of this study are to investigate the long-term effect of anterior ankle-foot orthosis on the functional walking ability of chronic stroke patients and their subjective perception and to identify the type of chronic stroke patients who are better responders to the wearing of anterior ankle-foot orthosis.

Design: This is a cross-sectional cohort comparison study. Fifty-two stroke patients wearing an anterior ankle-foot orthosis for at least 5 mos were evaluated using the modified Emory Functional Ambulation Profile and the 6-min walking test with and without an anterior ankle-foot orthosis. Falls Efficacy Scale-International and a self-designed questionnaire were administered to assess subjective perceptions.

Results: All modified Emory Functional Ambulation Profile subscores significantly decreased with the anterior ankle-foot orthosis; the mean difference in favor of the anterior ankle-foot orthosis on the floor was −2.88 secs; the carpet, −5.44 secs; "up and go," −5.09 secs; obstacle, −8.42 secs; stairs, −6.45 secs; and in the 6-min walking test, 19.75 m (all $P < 0.01$). Patients who were of younger age or with low walking ability or both would have more benefits. The total scores of Falls Efficacy Scale-International were significantly lower with anterior ankle-foot orthosis as compared with that without anterior ankle-foot orthosis (31.57 ± 12.79 *vs.* 39.51 ± 12.65). Around 90% participants perceived that their walking performance improved with the anterior ankle-foot orthosis either indoors or outdoors, and they would recommend the anterior ankle-foot orthosis to other stroke patients. The greatest disadvantage of anterior ankle-foot orthosis is the difficulty in donning and doffing.

Conclusions: The effects of the anterior ankle-foot orthosis on stroke patients' functional walking ability and fall efficacy were significant. Patients who were of younger age or with low walking ability or both were more suitable for using the anterior ankle-foot orthosis.

Key Words: Stroke, Anterior Ankle-Foot Orthosis, Walking Activity

Intervention to improve walking ability is one of the main issues in stroke rehabilitation. Although a majority of stroke patients can walk independently, some of them cannot walk with sufficient speed and endurance to accomplish daily activities.[1–3] Patients with hemiparesis usually have foot dorsiflexion or eversion weakness or both, which result in an inefficient and unstable gait pattern. Ankle-foot orthoses (AFOs) are commonly prescribed to correct gait abnormalities. It is clinically accepted that an AFO can compensate for motor impairment and improves gait in stroke patients. However, major AFO studies in the past focused on the effects of posterior AFOs (P-AFO).[4–8] Because of hot weather, people in some Asian countries used to walk with bare feet indoors, and P-AFO is not suitable under such conditions.[9,10] In Taiwan, a low-temperature customized molded plastic anterior AFO (A-AFO) (Fig. 1), which could be worn barefoot indoors as well as with shoes, is the principal orthotic intervention for residual ankle weakness poststroke.[9,11–14] Despite its widespread usage, only three studies searching for the ambulation-related effect have been conducted thus far.[10,13,14] All these studies focused on gait analysis, which represented the level of body function only. Walking has been identified as one of the most important components of activity and participation domains[1]; ambulation assessment should include variables in the patients' daily living environment.[15,16] Moreover, for brain lesion patients with mild to moderate disabilities, not only walking speed but also endurance are suggested to be measured.[17,18] A person's confidence in performing activities without falling is as important as real walking capacity in situations of daily living. In addition, when considering the value for clinical recommendations, the long-term effect of orthosis is more helpful than the immediate effect. Identifying patients who might benefit from the intervention will provide more information for clinical applications. The users' opinion and level of satisfaction are also quite important. The above information regarding A-AFO was lacking and needed to be addressed.

Therefore, the purposes of this study were (1) to determine whether long-term wearing A-AFO has positive effect on the functional walking ability in chronic stroke patients by using valid and reliable clinical measures, (2) to identify patients who are most likely to benefit from A-AFO, and (3) to evaluate the subjective perception of A-AFO, including self-efficacy.

METHODS

Participants

Participants were recruited from the department of rehabilitation of a medical center in southern Taiwan. The criteria for selection were as follows: (1) diagnosis of unilateral hemiparesis secondary to stroke that lasted for >6 mos; (2) gait instability with evidence of dorsiflexion/eversion weakness (less than fair grade) or with mild-moderate plantarflexion/inversion spasticity or both (grade 1+ to 2 on the modified Ashworth scale), which caused the physician or therapist to suggest the use of a low-temperature thermoplastic A-AFO (potential participants had to wear the orthosis for at least 5 mos before the study); (3) the ability to walk for 10 m with or without an assistive device; (4) the ability to follow simple verbal commands or instructions; and (5) no

FIGURE 1 *Anterior ankle foot orthosis—anterior and lateral views.*

history of significant orthopedic problems, concomitant neurological diagnoses, or medical instability that would interfere with performing the test.

The hospital ethics research committee approved this study. Each participant provided written informed consent before participation. Fifty-two patients were recruited sequentially.

Pretest Assessment

Information on diagnosis, age, sex, affected side, and onset time of hemiparesis was obtained via interviews with the patients and from their medical charts. To characterize the participants, each patient was evaluated without an AFO before the outcome measurement sessions (basic clinical data).

The muscle strength in the affected ankle plantarflexor/dorsiflexor of each participant was tested by manual muscle testing and graded from 0 to 5 on the Medical Research Council scale (grade 5: full active ROM and normal muscle resistance; grade 0: no active ROM and no palpable muscle contraction). For further analysis, we defined muscle strength of grade 0 and 1 as "without motion." A grade >1 was referred to as "with motion." The modified Ashworth scale[19] was used to evaluate the spasticity of the ankle plantarflexors. Sensation was measured in the affected lower limb. Sensory deficiency was based on subjective light touch measurement and was rated on a dichotomous scale (normal and impaired). Basic walking ability was assessed by a timed 10-m walking test with self-selected speed[3] and self-reported the walking distance at one time.[20] The walking velocity was calculated as the distance (10 m) divided by the time (seconds). Three choices, 10-50 m (e.g., walking around the house), 50–500 m (e.g., walking around the neighborhood), >500 m (e.g., walking around the park or sports ground), were given as the self-reported walking distance in one go. Only three subjects walked <50 m in one go and then we divided the subjects into two groups ≤500 and >500 m. Balance ability was evaluated using the Berg Balance Scale rating performance from 0 (cannot perform) to 4 (normal performance) on 14 different tasks.[21] The total highest score was 56 on the Berg Balance Scale.

Outcome Measures

The primary outcome measures were collected in the modified Emory Functional Ambulation Profile (mEFAP)[22] and 6-min walking test (6MWT).[23] Every test followed the original description. Participants performed all measurement tests while wearing their A-AFO in their usual footwear and also while wearing their footwear alone. We did not do the assessments on barefoot condition for three reasons. First, the floor in hospital was not as clean as the patient's home; second, two tasks (walking on a carpeted surface and cross-obstacle) in mEFAP and the 6MWT are similar to outdoor activities; third, some participants usually did not wear the A-AFO with barefoot. The testing sequences were randomized. Randomization was provided with sealed and numbered envelopes. The mEFAP test was measured twice. The mean of the two measurements was used for further analysis. Adequate rest was given between the two test series. The rest time varied from 10 to 30 mins depending on the condition of participants. All measurements were performed on the same day.

Modified Emory Functional Ambulation Profile

The mEFAP is a clinical test that measures the time to ambulate through five common environmental terrains with or without an assistive device.[22] It has been demonstrated to have a high interrater and test-retest reliability as a measure of gait capacity and functional ambulation in the poststroke patient population.[22] The mEFAP comprises five timed tasks: (1) a 5-m walk on a hard floor; (2) a 5-m walk on a carpeted surface; (3) to rise from a chair, a 3-m walk, and return to a seated position (the timed "up-and-go" test); (4) a standardized obstacle course; and (5) to ascent and descent five stairs. In this study, a four-step ascent/descent test was used to minimize the participants' fatigue. The five timed subscores were adjusted by a multiplier for any necessary assistive device and then added together to derive a composite score. Only the unadjusted raw subscores were used in this study. We also used the percentage changes to assess the magnitude of the changes of walking ability. The percentage changes were calculated as follows: percentage change = (measurement with A-AFO − measurement without A-AFO/measurement without A-AFO) 100(%). To analyze the predictive indices of efficacy, we defined the percentage changes in the mEFAP as the sum of percentage changes of the five tasks of the mEFAP divided by five. For the participant who could not complete all tasks, the percentage changes in mEFAP will be the sum of percentage changes of the tasks the participant completed divided by the number of tasks completed.

Six-Minute Walking Test

Walking endurance was evaluated by the 6MWT.[18,23] The 6MWT is commonly used to assess

patients' cardiovascular or respiratory problems and is regarded as a submaximal test of aerobic capacity.[23–26] It is now commonly used in stroke patients and is highly reliable in this group.[18] The maximum distance covered on a 20-m walkway in 6 mins is recorded.

As considering the reliability of the two tests, random measurement error was quantified by absolute reliability indices, standard error of measurement (SEM).[27] Twenty stroke patients (8 women; mean age, 52 ± 12 yrs) participated in the reliability test before the study. The mEFAP and 6MWT were administered twice with bare feet and shoes, 7 days apart, by the same research assistant. The SEMs of the mEFAP subscores and 6MWT were on the floor, 0.94 secs; on the carpet, 0.79 secs; "up and go" test, 1.36 secs; obstacles, 1.63 secs; stairs, 1.04 secs; and 6MWT, 4.55 m.

Patients' Perception

We constructed a questionnaire specifically for this study to obtain feedback about the client's perception of the A-AFO. The questions concerned the frequency of use, changes in the indoor and outdoor walking ability, acceptance, and negative features of the orthosis. For changes in indoor and outdoor walking ability, each question was ranked as follows: (1) much worse, (2) worse, (3) neutral, (4) better, and (5) much better.

We also used Falls Efficacy Scale-International (FES-I) to discriminate the differences regarding concern about falling when doing 16 physical activities with or without an A-AFO. The 16-item FES-I was developed by the Prevention of Falls Network Europe group[28] to assess the level of concern about falling when carrying out each activity on a four-point scale (1 = not at all concerned; 4 = very concerned). The FES-I has excellent psychometric properties, and these have been demonstrated both in English and in a cross-cultural context.[29,30] The questionnaires were administered to the participants in the form of an interview and served as the secondary outcome measure.

Statistical Analysis

Descriptive statistics were performed. Variables were evaluated for normality using the Kolmogorov-Smirnov test, and all variables were normally distributed. A series of paired *t* tests were done to compare the five raw subscores of the mEFAP, the distance in the 6MWT, and the FES-I scores between the two conditions (with and without an A-AFO).

TABLE 1 Demographic and clinical characteristics of the participants

Variables	
Sex, male/female (*n*)	35/17
Age, median (25, 75 percentiles), yrs	54.50 (43, 65)
Time after stroke, median (25, 75 percentiles), mos	33.50 (15, 75)
Affected side, right/left (*n*)	29/23
Type of stroke, infarction/hemorrhage (*n*)	22/28
No. stroke, first/recurrent (*n*)	48/6
Sensory deficit, impaired/normal (*n*)	26/26
Muscle strength	
Affected ankle dorsiflexion, impossible/with motion (*n*)	32/20
Affected ankle plantarflexion, impossible/with motion (*n*)	30/22
Spasticity of ankle plantarflexor MAS < 2/MAS = 2 (*n*)	31/21
Indoor walking aid Quadricane/cane/none (*n*)	26/6/20
Outdoor walking aid Quadricane/cane/none (*n*)	27/14/11
Walking distance in one go 10–50/50–500/>500 m (*n*)	3/19/30
Self-selected walking speed, median (25, 75 percentiles), m/secs	0.29 (0.21, 0.54)
Berg score, median (25, 75 percentiles)	46.00 (40, 51)

MAS, modified Ashworth scale.

Univariate analysis was performed to examine the relationship between the participants' characteristics and the percentage changes in mEFAP and 6MWT. The *t* tests were used for categorical variables, and Pearson correlation tests were used for continuous variables. Only the potential predictors that showed a significant univariate association ($P < 0.05$) were selected and entered in the linear multivariable regression analysis. Multiple backward linear regression analyses were performed for each of the percentage changes in mEFAP and 6MWT. The data were analyzed using SPSS 12.0 (SPSS Inc., Chicago, IL), with statistical significance set at the 0.05 level.

RESULTS

The basic characteristics of the 52 participants are shown in Table 1.

Primary Outcome Measure

Table 2 shows the results of mEFAP subscore and 6MWT under two test conditions (with and without an A-AFO). In general, all mEFAP subscores decreased with the A-AFO significantly. The mean difference in favor of the A-AFO on

TABLE 2 Comparisons of time to walk in different terrains of mEFAP and distance of 6MWT between without/with A-AFO

	n	Without A-AFO, Mean (SD)	With A-AFO, Mean (SD)	Paired Differences, Mean (SD)	*P*
Floor, secs	52	19.18 (11.19)	16.29 (10.18)	−2.88 (3.73)	<0.01
Carpet, secs	49	22.62 (15.79)	17.17 (10.91)	−5.44 (9.42)	<0.01
Up and go, secs	52	35.30 (20.50)	30.21 (17.41)	−5.09 (6.99)	<0.01
Obstacles, secs	45	53.79 (31.64)	45.37 (23.37)	−8.42 (11.52)	<0.01
Stairs, secs	49	39.09 (21.64)	32.54 (16.14)	−6.45 (9.75)	<0.01
6MWT, m	52	121.73 (78.22)	141.48 (86.06)	19.75 (20.80)	<0.01

mEFAP, modified Emory functional ambulation profile; 6MWT, 6-min walking test; A-AFO, anterior ankle-foot orthosis.

the floor was −2.88 secs (95% confidence interval [CI]: −3.92 to −1.84); on the carpet, −5.44 secs (95% CI: −8.16 to −2.74); "up and go" test, −5.09 secs (95% CI: −7.04 to −3.14); obstacles, −8.42 secs (95% CI: −11.89 to −4.96); and stairs, −6.45 secs (95% CI: −9.35 to −3.75). Three participants could not walk on the carpet without the A-AFO but were able to do so with the A-AFO. Seven participants could not step over obstacles without the A-AFO, but five of them could do so when wearing the A-AFO. Three participants could not climb stairs without the A-AFO, but one of them could climb with the A-AFO. The A-AFO also increased the walking distance in the 6MWT compared with no A-AFO (mean difference, 19.75 m; 95% CI: 13.96–25.54). According to our reliability study, all mean change

TABLE 3 Relationship of subject characteristic and change percentage in mEFAP and 6MWT

		Change Percentage in mEFAP		Change Percentage in 6MWT	
Variables	*n*	Mean (SD)	*P*	Mean (SD)	*P*
Sex					
Male	35	−12.58 (12.12)	0.111	17.72 (16.95)	0.501
Female	17	−18.11 (11.05)		21.58 (23.45)	
Type of stroke					
Infarction	22	−10.88 (9.92)	0.070	13.20 (11.89)	0.062
Hemorrhage	30	−16.96 (12.82)		23.22 (22.35)	
Affected side					
Right	29	−13.66 (12.44)	0.630	18.31 (18.39)	0.780
Left	23	−15.29 (11.55)		19.82 (20.49)	
No. stroke					
First	46	−15.62 (11.98)	0.038	20.00 (19.94)	0.291
Recurrent	6	−4.90 (6.80)		11.14 (9.25)	
Indoor walking aid					
Yes	32	−16.02 (11.84)	0.271	20.23 (23.04)	0.494
No	20	−11.77 (12.00)		16.98 (10.63)	
Outdoor walking aid					
Yes	41	−15.78 (12.28)	0.104	20.05 (20.89)	0.443
No	11	−9.18 (9.46)		15.00 (10.33)	
Strength of affected ADF					
Impossible	32	−15.84 (12.70)	0.272	21.21 (20.09)	0.292
With motion	20	−12.06 (10.59)		15.40 (17.49)	
Strength of affected APF					
Impossible	30	−14.26 (11.95)	0.933	20.41 (20.51)	0.533
With motion	22	−14.55 (12.27)		17.02 (17.44)	
Spasticity of ankle APF					
MAS < 2	31	−12.45 (9.05)	0.202	16.12 (13.90)	0.195
MAS ≥ 2	21	−17.25 (15.10)		23.19 (24.81)	
Walking distance in one go					
≤500 m	22	−19.85 (14.06)	0.008	25.53 (23.15)	0.033
>500 m	30	−10.37 (8.33)		14.17 (14.19)	

mEFAP, modified Emory functional ambulation profile; 6MWT, 6-min walking test; ADF, ankle dorsiflexion; APF, ankle plantarflexion; MAS, modified Ashworth scale.

TABLE 4 Correlations between subject characteristics and change percentage in mEFAP and 6MWT

	Change Percentage in mEFAP		Change Percentage in 6MWT	
Variables	*r*	*P*	*r*	*P*
Age	0.369	0.007	−0.326	0.018
Time from stroke	0.285	0.041	−0.268	0.054
Self-selected walking speed	0.332	0.016	−0.186	0.186
Berg score	0.161	0.259	−0.162	0.257
6MWT	0.269	0.053	−0.228	0.104

mEFAP, modified Emory functional ambulation profile; 6MWT, 6-min walking test.

scores were bigger than their corresponding SEM values.

Associations with Percentage Change

The following parameters were significantly associated with the percentage changes in the mEFAP ($P < 0.05$): the number of strokes and the walking distance in one go; 6MWT: the walking distance in one go (Table 3). Table 4 shows that the percentage change in the mEFAP was significantly correlated with age ($P = 0.007$), time from stroke ($P = 0.041$), and self-selected walking speed ($P = 0.016$). The age was also significantly correlated with the percentage change in the 6MWT ($P = 0.018$). Table 5 shows the results of the multivariate regression analysis on the mEFAP and 6MWT. Better responders in mEFAP were predicted by younger age and lower walking speed. Participants who were younger in age and with a walking distance <500 m benefited more from the A-AFO in the 6MWT. The multiple regression analysis shows 44.0% of the variance of change in the mEFAP and 20.8% in the 6MWT.

Secondary Outcome Measure

All participants wore the A-AFO for outdoor activities but 22 participants (42%) usually did not wear the A-AFO at home. Forty-six participants (88%) would recommend the A-AFO to other stroke patients with the same problem. Forty-three participants (83%) stated that their indoor walking performance improved while wearing the A-AFO, and 49 participants (94%) showed improvements with regard to their outdoor walking performance. Twenty-seven participants (52%) perceived difficulty in donning and doffing, 8 participants (15%) complained nondurable, 5 participants (10%) felt uncomfortable when wearing the A-AFO, and 3 participants (6%) felt that the appearance of the A-AFO is not good.

The total scores of FES-I were significantly lower with an A-AFO as compared with without an A-AFO (31.57 ± 12.79 *vs.* 39.51 ± 12.65, $P < 0.001$). All the activities favored with A-AFO significantly except preparing simple meals and taking a bath or shower (Table 6).

DISCUSSION

The present results confirmed the potential ambulatory benefits of the A-AFO. The use of A-AFO resulted in an improvement in the mean timed ambulation through the five tasks of the mEFAP and increased the walking distance in the 6MWT. The A-AFO also decreased the participants' fear of falling while doing physical activities.

A variety of tests had been described for the assessment of walking capacity after stroke. However, many tests are fairly extensive and require sophisticated laboratory equipment. In this study, the tests, mEFAP and 6MWT, were selected as they are easy to perform and meaningful to the participants. In addition, these tests cover various aspects of the walking capacity, including velocity,

TABLE 5 Multivariable linear regression for determinants of change percentage in mEFAP and 6MWT

Variables	R^2	*P*	Regression Coefficients (95% CI)
Change percentage in mEFAP	0.440		
No. stroke		0.057	0.080 (−0.002 to 0.162)
Walking distance in one go		0.052	0.060 (−0.001 to 0.120)
Self-selected walking speed		0.013	0.173 (0.038 to 0.309)
Age		0.000	0.004 (0.002 to 0.007)
Change percentage in 6MWT	0.208		
Walking distance in one go		0.016	−0.123 (−0.221 to −0.024)
Age		0.009	−0.005 (−0.009 to −0.001)

mEFAP, modified Emory functional ambulation profile; 6MWT, 6-min walking test; CI, confidence interval.

TABLE 6 Comparisons of FES-I scores between without/with A-AFO

FES-I item	Without A-AFO, Mean (SD)	With A-AFO, Mean (SD)	Paired Differences, Mean (SD)	*P*
1. Cleaning the house	2.67 (1.37)	2.31 (1.36)	0.35 (0.69)	0.001
2. Getting dressed/undressed	1.96 (1.20)	1.71 (1.15)	0.26 (0.60)	0.004
3. Preparing simple meals	2.84 (1.41)	2.71 (1.42)	0.14 (0.57)	0.090
4. Taking a bath or shower	2.41 (1.34)	2.24 (1.34)	0.18 (0.68)	0.071
5. Going to the shop	2.84 (1.16)	1.82 (1.09)	1.02 (0.97)	0.000
6. Getting in or out of chair	1.37 (0.80)	1.22 (0.67)	0.16 (0.37)	0.004
7. Going up and down stairs	2.45 (1.27)	1.76 (1.07)	0.69 (0.93)	0.000
8. Walking around outside	2.16 (1.14)	1.47 (0.81)	0.69 (0.88)	0.000
9. Reaching up or bending down	1.65 (1.04)	1.53 (1.01)	0.12 (0.33)	0.013
10. Answering the telephone	1.61 (1.04)	1.43 (0.83)	0.18 (0.56)	0.028
11. Walking on a slippery surface	2.80 (1.22)	2.18 (1.26)	0.63 (0.92)	0.000
12. Visiting a friend/relative	2.39 (1.27)	1.78 (1.12)	0.61 (1.00)	0.000
13. Going to a place with crowds	3.02 (1.24)	2.41 (1.34)	0.61 (0.96)	0.000
14. Walking on an uneven surface	3.39 (0.98)	2.55 (1.29)	0.84 (1.05)	0.000
15. Walking up or down a slope	3.16 (1.07)	2.33 (1.21)	0.82 (1.03)	0.000
16. Going out to a social event	2.78 (1.22)	2.12 (1.24)	0.67 (0.89)	0.000
Total scores	39.51 (12.65)	31.57 (12.79)	7.94 (6.55)	0.000

FES-I, Falls Efficacy Scale-International; A-AFO, anterior ankle-foot orthosis.

endurance, and complexity of the walking environments (such as stair-climbing and walking over uneven surfaces), thereby providing a comprehensive picture of the walking abilities and a better simulation of real-life mobility scenarios.

Fear of falling has been shown to exist in community-dwelling people with stroke;[31] low falls efficacy can lead to deconditioning and compromise social interaction.[32,33] We found A-AFO decreased the fear of falling in stroke patients especially when doing outdoor activities.

In consideration of the possibility of measurement errors caused by repeated measurements, we used the SEM as reference points. All the mean change scores of mEFAP and 6MWT were bigger than their corresponding SEM values. Moreover, there were three participants who could not walk on the carpet without the A-AFO but were able to do so with the A-AFO, five for stepping over obstacles, and one for climbing stairs. These findings indicate a real improvement in functional ambulation for this group with an A-AFO.

Because the P-AFO is commonly used in stroke patients in Western countries, it is always interesting to see whether there is any difference in effectiveness between A-AFO and P-AFO. Wong et al.[13] and Park et al.[10] observed no significant difference between the A-AFO and P-AFO in increasing walking speed, stride strength, and velocity. Sheffler et al.[34] found that stroke patients with the P-AFOs improved significantly (relative to no device) in the floor, the carpet, and the "up and go" tasks and a trend toward significantly in the obstacle and stair tasks of mEFAP. de Wit et al.[35] proved that the P-AFOs had a significant effect on the "time up, go" test in stroke patients who had worn the P-AFOs for at least 6 mos. In our study, the A-AFO had significantly positive effects in all five tasks of the mEFAP. Because of a different study design, the issue of superiority or equivalence of the A-AFO relative to the P-AFO in functional walking ability cannot be answered from the above studies. In our study, more cases were recruited, and our subjects had lower functional status as compared with the study of Sheffler.[34] Head-to-head comparative studies between A-AFO and P-AFO in the functional walking ability are needed.

Geboers et al.[36] studied the effect of the use of the P-AFO on patients with dorsiflexor paresis. They found that the 6MWT with a cognitive task tended to show a significant improvement when the P-AFO was used. Our study showed that stroke patients with the A-AFO improved walking distance at 6MWT. It seems that no matter what the cause of dorsiflexor paresis is, walking-induced fatigue could be diminished by either the use of the P-AFO or A-AFO.

To improve the selection of patients who are most likely to benefit from the A-AFO, we aimed to identify good responders. We found that younger patients improved more. This might indicate that it is easier for younger patients to adapt to the orthosis and subsequently to apply new motor skills. We also found that the A-AFO might be more advantageous in patients whose walking ability is compromised. This is in line with the result of previous P-AFO study.[35]

Despite high satisfaction about the A-AFO in indoor walking performance and the suitability of barefoot walking with A-AFO, ~40% of the participants did not wear the A-AFO at home. When asked why they were not wearing the A-AFO at home, most participants responded that they would compromise the gait disturbance at home, and they did not want to use any device, if possible. This phenomenon reveals that the benefit of the A-AFO at short distance ground walking is more easily outweighed by the traditional reluctant attitude to assistive devices.

There were some disadvantages of the A-AFO. Inconvenience of donning and doffing is the major complain. Reinstruction of the wearing procedures by occupational therapists could decrease the problem, but wearing AFOs cannot be as convenient as wearing shoes eventually. In the study by Tyson,[8] only 64% stroke patients found that hinged P-AFO is easy to put on and take off. The modification of design would be indicated to increase acceptance. Low durability is another common disadvantage. For more active, obese patients or those with severe spasticity, such thermoplastic orthosis is not suitable, and thermoset material should be considered.

This study had a number of limitations. Generalization of our results should be limited to patients with stroke who can walk for 10 m with or without an assistive device. A double-blinded study was not feasible because of the AFO treatment, which may have biased the study in favor of the A-AFO. Because the outcome evaluation relied on clinical measures only, those results do not allow the determination of the mechanism by which the A-AFO increases the functional walking ability in chronic stroke patients. The last limitation worth noting was that we could not collect an adequate number of cases for the comparison between P-AFO and A-AFO. More studies are needed to address the above issues.

CONCLUSION

This study provided some valuable information in clinical practice. Using an A-AFO could improve the walking performance in various environmental terrains and reduce the fear of potential falls while doing daily activities; therefore, such benefits might help to achieve the optimal rehabilitation goal of participating community activities. Giving an A-AFO to younger stroke patients or to those with a more compromised walking ability may provide better outcomes. As some patients did not like to wear an AFO at home, the issue of walking barefoot indoors could not be concerned when prescribing an AFO to such patients. The modification of the A-AFO design for convenience of wearing should be developed to increase the acceptance of the A-AFO.

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