International Journal of Health Sciences and Research
[Indexed, Peer-Reviewed Journal]
Volume 15; Issue: 5; May 2025
Website: www.ijhsr.org
ISSN: 2249-9571

Original Research Article

A Comparative Study of Performance of Anterior Ankle Foot Orthosis (A-AFO) vis-à-vis. Posterior Ankle Foot Orthosis (P-AFO) in Terms of Gait Parameters and Energy Expenditure in Hemiplegic Patients with Foot Drop

Mansi Pathak[1], Manoj Kumar Tiwari[2], Haribhau S. Dongre[3]

[1,2,3]Department of Prosthetics and Orthotics, All India Institute of Physical Medicine and Rehabilitation, Mumbai, India.

Corresponding Author: Manoj Kumar Tiwari

DOI: https://doi.org/10.52403/ijhsr.20250505

ABSTRACT

Background: Ankle-Foot Orthosis (AFO) has been used for hemiplegic patients for several decades to provide plantarflexion resistance during the stance phase and prevent toe dragging during the swing phase. The Anterior Support Ankle Foot Orthosis (A-AFO) represents a novel orthotic management intervention. However, research is scarce contrasting the biomechanical efficacy of A-AFO and Posterior Support Ankle Foot Orthosis (P-AFO).
This study aimed to assess the efficacy of A-AFO compared to P-AFO in hemiplegic patients with foot drop, utilizing gait analysis and physiological cost index (PCI).
Methods: This crossover study included hemiplegic foot drop patients who could walk with or without an orthosis. Patients with spasticity greater than grade 2, as assessed by the Modified Ashworth Scale, were excluded. The physiological cost index was measured to calculate energy expenditure. Along with evaluating various gait parameters, a questionnaire about the patient’s preference after four weeks was also administered.
Results: A-AFO was significantly better than P-AFO in terms of PCI and various gait parameters.
Conclusions: A-AFO should also be recommended because it is similar to P-AFO in terms of gait parameters and energy efficiency.

Keywords: Hemiplegia, Ankle Foot Orthosis, Energy Expenditure, Foot Drop, Gait Analysis, Orthotic devices

INTRODUCTION

Hemiplegia, often resulting from neurological conditions such as stroke, traumatic brain injury, or cerebral palsy, is frequently accompanied by significant motor impairments, one of the most common being foot drop. Foot drop is characterized by the inability to dorsiflex the foot due to paralysis of the dorsiflexor muscles, which impairs normal gait and increases the risk of falls. This condition affects mobility and leads to metabolic inefficiencies during walking, contributing to fatigue and further limiting functional independence. Foot drop, therefore, presents a significant challenge in the rehabilitation of individuals with hemiplegia, affecting both their quality of life and overall functional capacity.

Ankle-foot orthoses (AFOs) are crucial for treating and rehabilitating lower extremity conditions such as deformities, central nervous system disorders, and musculoskeletal impairments.[1] These external devices provide structural support, enhance biomechanics, and restore mobility. Widely used for conditions like stroke, cerebral palsy, and multiple sclerosis, AFOs improve motor function, stability, and movement while preventing further decline, making them integral to modern healthcare. [2]

It has been proven through many studies that AFOs have been widely used in stroke patients to assist in safe, energy-efficient walking and improve gait in Hemiplegics. However, most of these AFO studies focused on the effects of Posterior AFOs (P-AFO). [3,4,5,6,7,8]

An anterior ankle foot orthosis (A-AFO) was recently invented to correct foot drops and similar conditions. Specifically, it includes an anterior support, which is adapted to be placed in a position extending generally from the dorsal portion of the foot along the shin to a point below the knee. This permits the heel portion of the foot to be unconstructed and allows the patient to wear standard shoes, eliminating the expense and obviousness of the modified footwear. It is suitable for barefoot walking. More particularly, the foot movement and foot support more closely conform to the muscular and tendon structures of the ankle joint, resulting in a greater degree of comfort and energy conservation during ambulation and a more normal gait.

Many people in some Asian countries, including India, walk barefoot indoors because of hot weather, and P-AFO is unsuitable under such conditions. [9,10] In Taiwan, a low-temperature customized moulded plastic A-AFO, which could be worn barefoot indoors and with shoes, is the principal orthosis for post-stroke foot drop patients. [10-13] It has been well documented that A-AFOs are light, easy to use, and suitable for indoor bare walking. There is a scarcity of research studies relating to A-AFOs, which have been invented relatively recently.

Ankle Foot Orthoses (AFOs) are widely used to address foot drop, primarily aiming to improve gait function and mobility. The Posterior Support AFO (P-AFO) has long been the standard intervention, providing stability and maintaining proper foot alignment during gait. [14,15] However, recent advancements in orthotic design have led to the development of the Anterior Support AFO (A-AFO), a novel approach aimed at addressing foot drop by supporting the foot from the anterior aspect, extending from the dorsal portion of the foot along the shin. This design offers advantages such as promoting a more natural gait, enhancing comfort, and facilitating barefoot walking without heel coverage. This may be particularly beneficial in climates where individuals often prefer walking barefoot indoors. [16,17]

Despite the increasing use of A-AFOs, a substantial lack of research remains regarding their effectiveness, particularly in terms of energy expenditure and gait efficiency, compared to traditional P-AFOs in individuals with hemiplegia. Most studies conducted thus far have focused on gait analysis, subjective preference, and postural stability, with limited attention given to direct comparisons of energy expenditure outcomes between the two orthoses. [18,19] The A-AFO's ability to offer improved comfort, energy conservation, and a more normal gait pattern has yet to be fully substantiated in the literature.

The present study addresses this gap by comparing the efficacy of A-AFOs and P-AFOs in hemiplegic patients with foot drop using energy expenditure and gait analysis. It is hypothesized that A-AFOs may offer comparable or superior benefits over P-AFOs, particularly in improving walking efficiency and gait performance and reducing the energy cost of ambulation. By assessing these parameters, this study aims to provide valuable insights into the potential advantages of A-AFOs as an effective orthotic intervention for managing foot drop in patients with hemiplegia, ultimately informing clinical decision-making and enhancing patient outcomes.

MATERIALS & METHODS

The study duration was 16 months, from April 2023 to August 2024. It was conducted in the Department of Prosthetics and Orthotics (P&O) at All India Institute of Physical Medicine and Rehabilitation (AIIPMR), Mumbai. Patients with "Foot Drop," irrespective of age and sex, who attended the Department of P&O at AIIPMR by themselves and satisfied the inclusion criteria, were included in the study. The author included ten-foot drop patients, who were controls for themselves. Hence, the study was a crossover study. The Institute's ethics committee approved the study before its commencement.

After taking a detailed history and examination to confirm the diagnosis and cause of the foot drop and ensuring that the patient met the inclusion criteria, the test protocol was explained to the subjects, and they were allowed to ask questions. Before testing, written informed consent was obtained, and the study schedule was presented. Each patient was prescribed an A-AFO and a P-AFO. There were two sequences of interventions: testing with A-AFO followed by P-AFO (sequence 1) and testing with A-AFO followed by P-AFO (sequence 2). For each patient, the sequence of intervention was randomized. The patients were assigned random numbers from the random number table using a randomized method. Before starting the test run, patients were allowed to become familiar with the orthosis for approximately 30 minutes by walking with it.

Patients in Sequence 1 were first asked to walk with an A-AFO on Day 1 (Period 1), and three readings were taken, which were averaged to obtain the final reading. Patients were given 15-minute rest periods between each test to allow the metabolic parameters to return to their basal values, as confirmed by the metabolic analyses. A 15-minute rest period was given to the patient, followed by a Gait Analysis. Patients were made to walk 30 meters at a comfortable speed. Three readings were taken, and the average was used to get the final value. They were allowed to rest for 5 minutes in between the tests. On day 2 (Period 2), the same patients were made to repeat the above procedure with the P-AFO. The washout period is defined as the time between the two interventions, during which the effect of the initial interventions is removed to allow the second intervention to take effect. Patients in sequence two underwent the abovementioned procedure with P-AFO on the same day (Period 2), the study's primary outcome measure.

The gait analysis parameters measured for the study were speed, step length, stride length, and cadence. After four weeks, a structured questionnaire was administered over the telephone to assess the patient's subjective experience.

AFO Fabrication

A custom-fabricated AFO mould was prepared to manufacture two types of AFOs (Fig. 1). During the first phase of treatment, a Posterior Ankle Foot Orthosis (P-AFO) was fitted to the patient. An anterior ankle-foot orthosis (A-AFO) was introduced in the second phase, enabling dorsiflexion and offering the patient improved comfort, energy efficiency during ambulation, and a more natural gait. The same orthotist performed these procedures primarily.

Fig.1: Illustration of Posterior Ankle Foot orthosis (P-AFO) and Anterior Ankle Foot orthosis (A-AFO)

Measurements

Temporospatial gait parameters and energy expenditure were evaluated using both types of orthoses.

Gait Analysis

The outcome measures were determined using the paper walk and a 30-meter walkway test. The paper walk method assessed spatiotemporal parameters, viz. step length, stride length, cadence, and speed, using both types of AFOs. The 30-meter walkway test measured the physiological cost index for energy expenditure with each orthosis.

Energy Expenditure

The Physiological Cost Index (PCI) for energy expenditure was assessed using both orthoses. The patient's resting heart rate was initially recorded, followed by a 30-meter walk. After each data collection session, the patient was given a 5-minute rest period. The heart rate was measured after the 30-meter walk using an oximeter.

Physiological Cost Index- The physiological cost index (PCI) uses heart rate to indicate the energy cost of walking. [20]

Physiological Cost Index = $\frac{(walking\ Heart\ Rate - Resting\ Heart\ Rate)}{Speed}$

Formula: PCI = $\frac{WHR-RHR}{SPEED}$

Unit: Beats/meter

STATISTICAL ANALYSIS

The mean and standard deviation of step length, stride length, cadence, speed, and PCI for the PAFO were compared to those of the AAFO and the standard values. These comparisons were conducted using a paired t-test with GraphPad Prism 10.3.1 (Table 1). Data collection took approximately 30 to 45 minutes.

Gait parameters	MEAN		SD	t-value	Remarks
	P-AFO	A-AFO			
STEP LENGTH (m)	0.31	0.46	0.079	6*	P=0.0002 P<0.05
STRIDE LENGTH (m)	0.65	0.90	0.081	9.6*	P=0.000004 P<0.05

CADENCE (step/min)	67.8	80.8	6.12	6.7*	P=0.00008 P<0.05
SPEED (m/sec)	0.22	0.56	0.21	4.83*	P=0.0009 P<0.05
30 METERS WALK TEST (sec)	71.7	62.1	4.16	7.28*	P=0.00004 P<0.05
PHYSIOLOGICAL COST INDEX (PCI) (beats/m)	0.48	0.23	0.26	3.11*	P=0.012 P<0.05

Table 1: p-value of spatiotemporal parameters in the analysis of the efficacy of P-AFO (Posterior Ankle Foot Orthosis) and A-AFO (Anterior Ankle Foot Orthosis) with mean and standard deviation at 95% confidence interval (* significant at p)

RESULT

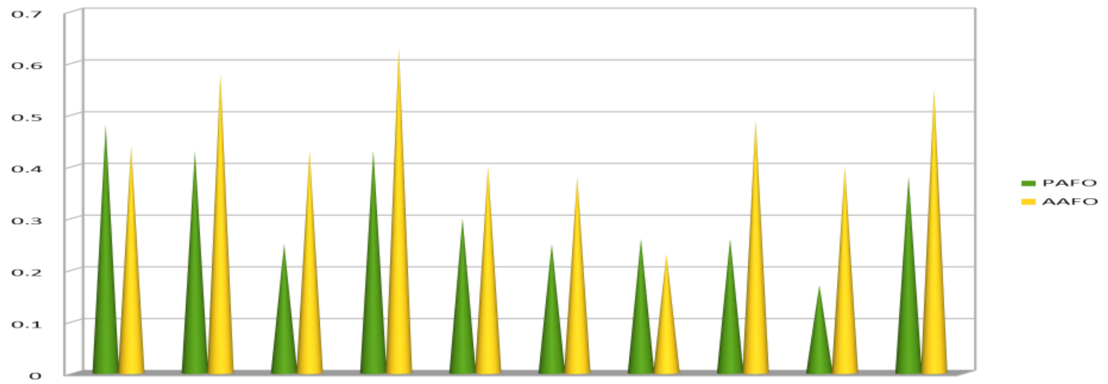
Ten subjects met the selection criteria. Eight were men, and two were women. The mean age of the subjects included was 34 years. Seven had right hemiparesis. In contrast, three had left hemiparesis, and the mean onset duration was 2 years. Patients with spasticity greater than grade 2 were excluded, as assessed by the Modified Ashworth Scale.

The gait parameters studied were Speed, Step Length, Stride Length, and Cadence. Speed data revealed a significant difference (p<0.05) between the two orthoses. The respective means and p-values have been shown in Table 1 for all the above-mentioned gait parameters. Step Length also showed a significant difference between the two orthoses (p<0.05). Similarly, Stride Length data differed significantly between the two orthoses. (p<0.05)

There was a significant difference between patients wearing these two orthoses when interpreting the stance and swing phase duration data. It was also noted that with A-AFO, there was a significant increase (p < 0.05) in speed compared to P-AFO.

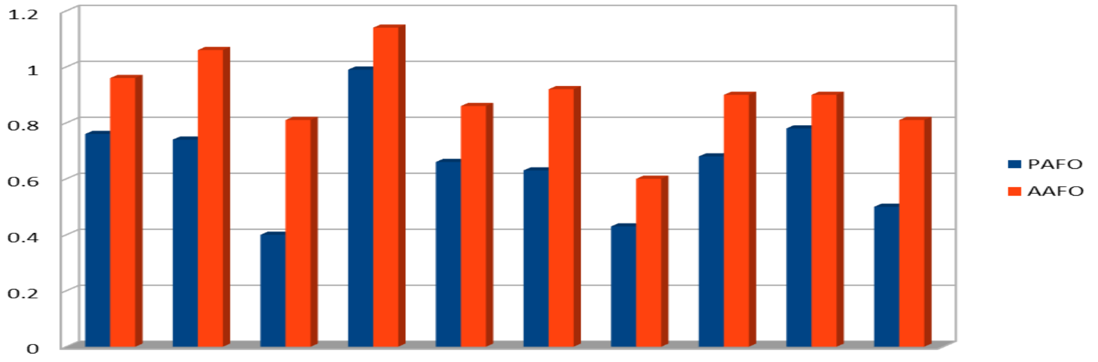
In any muscle group, the remaining spatiotemporal parameters were the fundamental quantitative measures for gait movement. Data from the A-AFO indicated a significant difference in cadence compared to the P-AFO. The A-AFO aligned with the 5-degree dorsiflexion. This dorsiflexion range allowed for sufficient ground clearance during terminal stance, enabling patients to easily lift their foot off the ground and increase their step frequency, resulting in safer and more efficient walking. The increased cadence (Fig. 4) contributed to a significantly faster walking speed (Fig. 5), resulting in improved step length (Fig. 2) and stride length (Fig. 3) supported by the A-AFO.

Fig.2: This chart signifies the effective role of A-AFO in contrast to P-AFO in the step length gait variable.



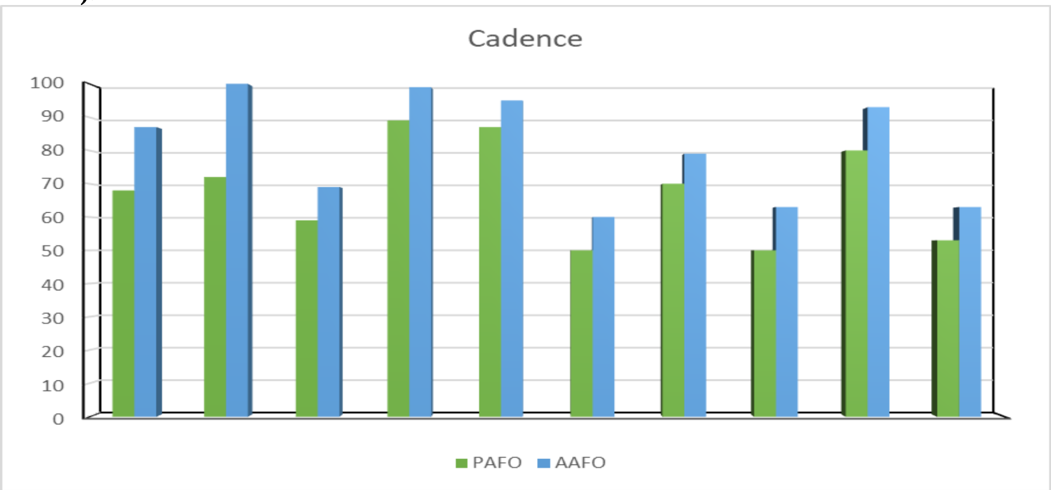
X-Axis: Number of subjects
Y-Axis: Step length with A-AFO (Anterior ankle foot orthosis) and P-AFO (Posterior ankle foot orthosis) at a comfortable walking speed.

Fig.3: This chart signifies the effective role of P-AFO in contrast to A-AFO in the stride length gait variable at comfortable walking speed because spasticity reduced the stride length parameter in the gait cycle with P-AFO



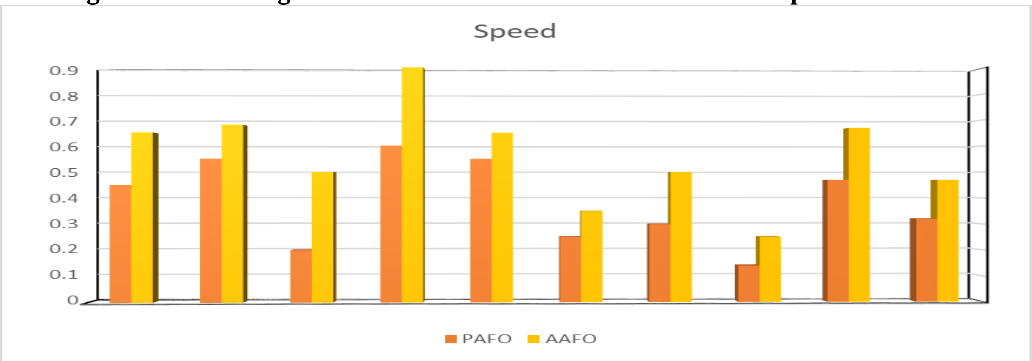
X-Axis: Number of subjects
Y-Axis: Stride length with A-AFO (Anterior ankle foot orthosis) and P-AFO (Posterior ankle foot orthosis) at a comfortable walking speed

Fig. 4: This chart signifies increased cadence because of ease of ground clearance in A-AFO (Anterior Ankle Foot Orthosis).



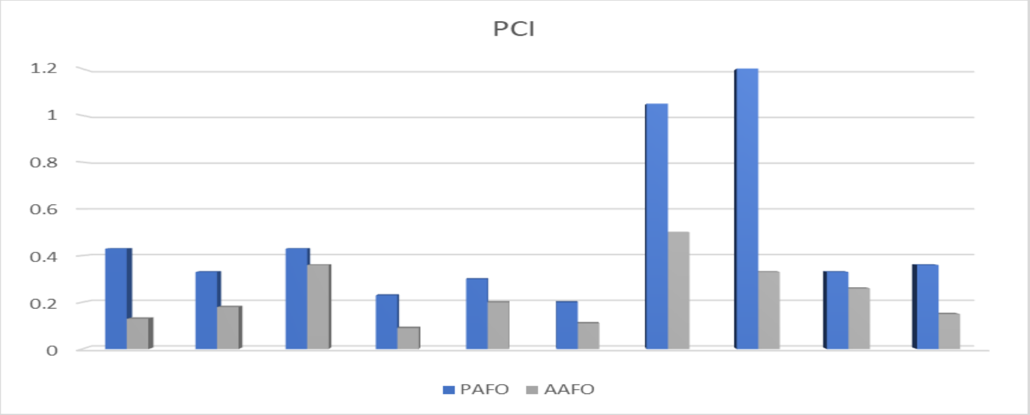
X-Axis: Number of subjects
Y-Axis: Cadence with A-AFO (Anterior ankle foot orthosis) and P-AFO (Posterior ankle foot orthosis) at a comfortable walking speed.

Fig.5: This chart signifies that increased cadence enhanced the speed in A-AFO.



X-Axis: Number of subjects
Y-Axis: Speed with A-AFO (Anterior ankle foot orthosis) and P-AFO (Posterior ankle foot orthosis) at a comfortable walking speed.

Fig.6: This chart of PCI (Physiological Cost Index) signifies less energy consumption in A-AFO (Anterior Ankle Foot Orthosis)



X-Axis: Number of subjects
Y-Axis: PCI (Physiological Cost Index) with A-AFO (Anterior ankle foot orthosis) and P-AFO (Posterior ankle foot orthosis) at a comfortable walking speed.

Stability was directly linked to balance, with the physiological cost index showing a positive result favouring the A-AFO (Fig. 6). A paired t-test comparison of the AFOs revealed that the P-AFO required more energy expenditure. In feedback about orthotic use and patient satisfaction, patients offered varying responses. Most felt confident, safe, and stable when walking with the A-AFO due to the restoration of smooth tibial progression over the foot during various stages of the gait cycle. In contrast, the PAFO's restricted movement was perceived as heavy and tiring. However, during the initial phase of treatment, the P-AFO provided safety and stability by preventing foot drop. Visual analysis of gait with the anterior AFO revealed that the patient landed on the heel rather than the toes, replicating normal walking patterns. The dorsiflexion moment generated during the midstance-to-push-off phase facilitated forward propulsion.

Patients also reported feeling more comfortable and stable while walking with the A-AFO, which requires less energy. They could walk less fearfully and found the A-AFO lighter than the P-AFO. They could cover the same distance in less time and with greater freedom of movement, replicating functional mobility closer to normal human walking.

The orthosis helped restore all three rockers of the gait cycle. During the heel rocker (first rocker), the heel strike was restored; during the ankle rocker (second rocker), dorsiflexion occurred from midstance to the push-off phase; and the toe rocker (third rocker), involving heel-off, was restored at the metatarsal break area. The A-AFO also helped reduce knee hyperextension during the stance phase.

DISCUSSION

Stroke patients typically exhibit gait abnormalities, including slower walking speed, shorter step length, and reduced stride length. Additionally, issues such as foot-dragging, circumduction, and high-steppage gait are often present due to weakened dorsiflexion of the ankle, extensor spasticity in the affected lower extremity, and compensatory movements to counteract foot-dragging. The results of the current study highlight the significant impact of A-AFOs (Anterior Ankle–Foot Orthoses) on the hemiplegic population compared to P-AFOs (Posterior Ankle-Foot Orthoses). A-AFOs demonstrated improvements in step and stride lengths at a comfortable walking speed, consistent with findings from other studies. [21, 22]

Using A-AFOs provided the patient with 5 degrees of dorsiflexion, which enhanced the heel-to-toe gait, restored the initial contact phase of the gait cycle, improved symmetry, and promoted a smoother, more natural gait pattern. The dorsiflexion in the A-AFO facilitated greater activation of the tibialis anterior muscle rather than the tibialis posterior. This made tibial translation over the foot easier while maintaining mediolateral ankle stability. This movement resulted in a statistically significant decrease in oxygen consumption, reducing energy expenditure. ($P<0.005$) [23]

The A-AFO significantly improved the locomotor gait pattern, optimizing stability during the stance phase of the gait cycle on the hemiplegic side. Other studies have similarly concluded that A-AFOs provide excellent stability for patients with hemiplegia, thereby reducing the risk of falls. When evaluating speed, it was found that A-AFOs increased walking speed, contributing to a more rapid gait and achieving a cadence closer to normal. In contrast, the P-AFO resulted in a lower cadence. These analyses and patient feedback suggest that A-AFOs offer a more efficient solution for hemiplegic patients. During discussions with the patients regarding their experience with AFOs, all ten reported feeling confident, safe, and stable while walking with the A-AFO.

We can deduce that wearing A-AFO is more or as energy efficient as wearing P-AFO, as is also evident from Dufek et al. This could be because when using unilateral P-AFO, there could be differences in the length of the limb, making the centre of gravity have more excursion; secondly, patients trying to adjust their limb inside the P-AFO since the contact area of the P-AFO is different compared to the natural foot while making contact with the ground. Hence, the patient consumed more energy.

The improved biomechanical effectiveness of A-AFO compared to P-AFO is achieved by attaching the A-AFO to the dorsal area of the foot, where foot movement and foot support more closely conform to the muscular and tendon structures of the ankle joint, resulting in a greater degree of comfort and energy conservation during ambulation.

Many patients have found A-AFOs to be lighter than P-AFOs, which can be considered one of the reasons why patients require less energy when using A-AFOs. This has been supported by Jane S. Dufek et al., who concluded that mechanically adding mass to any system requires greater energy to perform work, i.e., to move the body or system. [24] This fact is in accordance with the Newtonian relationship of Work = force × distance. This is a simple argument against using a heavier support system to correct lower limb dysfunction. [24, 25]

Federica Menotti et al. have concluded that gait spatiotemporal parameters were higher with A-AFO than with P-AFO and with P-AFO or shoes only. Walking energy cost per unit of distance was lower with anterior than posterior ankle-foot orthosis or shoes only (5.53 ± 1.00 vs 3.94 ± 1.27 and 3.98 ± 1.53 $J.kg^{-1}.m^{-1}$ respectively; $p<0.05$) and level of perceived comfort was higher with anterior (8.00 ± 1.32) than posterior ankle-foot orthosis (4.52 ± 2.57; $p<0.05$). This study also conforms to the above findings.

Comparing the gait analysis of patients wearing A-AO and P-AFO in our study, we found significant differences in step length, stride length, cadence, and speed. There was a significant difference ($p<0.05$) between the two orthoses in terms of speed. Stride Length ($p<0.05$) increased significantly when patients walked with A-AFO. It was also observed that, with A-AFO, there was a significant increase ($p<0.05$) in step length as compared to P-AFO.

The stride time decreases in the second period, irrespective of the orthosis. This can be explained by the fact that as the patient gets accustomed to the orthosis, the velocity increases, as already mentioned, and the stride time decreases. Similar results were found by Park et al., who observed increased walking speed, stride length, and velocity with both ankle foot orthosis, i.e., Anterior and Posterior AFO, as compared to barefoot walking. ($p<0.05$) However, there was no significant difference between the two. Hence, they concluded that wearing Anterior

AFO was as useful as Posterior for correcting hemiplegic gait, which is in accordance with the findings of this study. Chen et al. and Wong et al. further confirmed that A-AFO was as effective as P-AFO for improving gait in patients with hemiplegia.

A-AFO is comparable to P-AFO in terms of proprioception and balance-related requirements, as is evident in our Subjective Questionnaire results, and a Japanese study has documented this.

Hence, the study supported the hypothesis that A-AFO is comparable in energy efficiency and various gait parameters to P-AFO. The study's strengths included its appropriate methodology and statistics, the low number of dropouts, and the minimal loss to follow-up. A limitation of this study was that it did not employ blinding.

CONCLUSION

There is a significant difference between anterior and posterior AFOs in terms of the various gait parameters we measured, except for double support time, which decreased with the A-AFO. Functionality-wise, A-AFO is as good as the Posterior AFO.

A-AFO is better than a Posterior one in terms of cosmesis, ADL, donning, and doffing, as shown by subjective preference.

This study aimed to evaluate and compare the performance of Posterior Ankle Foot Orthoses (P-AFOs) and Anterior Ankle Foot Orthoses (A-AFOs) in improving gait parameters in patients with hemiplegia. The results demonstrated a comprehensive understanding of the effectiveness of A-AFO, particularly in enhancing gait function. The comparison demonstrated that A-AFO offers a significant advantage in managing hemiplegia, as it improved spatiotemporal gait parameters and contributed to better functional ambulation than P-AFO.

Our research underlined the critical importance of selecting biomechanically appropriate orthotic devices to optimize rehabilitation outcomes by preventing the progression of deformities and reducing the number of patients requiring invasive treatments. A-AFO plays a vital role in the rehabilitation process. Although our initial hypothesis suggested no notable difference between P-AFO and A-AFO in terms of functional ambulation, the data analysis and observational findings revealed that A-AFO had a measurable, positive impact on gait characteristics, including walking speed, step length, stride length, and PCI.

In conclusion, this study supports the idea that A-AFO significantly improves the gait pattern of hemiplegic patients, making it a valuable tool in their rehabilitation. The findings encourage clinicians to consider prescribing A-AFOs for patients with hemiplegia, as they enhance mobility and reduce the risk of further complications related to gait abnormalities.

Declaration by Authors

Ethical Approval: Approved

Acknowledgment: We would like to express our sincere gratitude to all the patients who participated in this study and Dr. Anil Kumar Gaur, Director, for granting permission to conduct the research. The authors thank Mr. Ajay Sonavane for his assistance in editing the manuscript.

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Kirker S. Orthoses for neurological ankles. J Pract. Neurol. 2022;22: 311-316.
2. Daryabor A, Arazpour M et al. Effects of different designs of ankle-foot orthoses on gait in patients with stroke: a systematic review. J Gait Posture. 2018; 62:268-279.
3. Tyson SF, Thornton HA. The effect of a hinged ankle foot orthosis on hemiplegic gait: objective measures and users' opinions. J Clin Rehabil. 2001;15(1):53-58
4. Corcoran PJ. Effects of plastic and metal leg braces on speed and energy cost of hemiparetic ambulation. J Arch Phys Med Rehabil. 1970; 51:69-77.
5. Chen CL, Young KT et al. Anterior ankle-foot orthosis effects on postural stability in hemiplegic patients. J Arch Phys Med Rehabil. 1999; 80(12) :1587-1592.

6. Lehman JF, Esselman PC et al. Plastic ankle-foot orthoses: evaluation of function. J Arch Phys Med Rehabil. 1983; 64(9):402-407.
7. Wang RY, Lin PY et al. Gait and balance performance improvements attributed to ankle-foot orthosis in subjects with hemiparesis. Am J Physical Med Rehabil. 2007; 86(7):556-562.
8. Holden MK, Gill KM et al, Gait assessment for the neurologically impaired patients: standards for outcome assessment. J Physical Therapy. 1986;66(10):1530-1539.
9. Park JH, Chun MH et al. Comparison of gait analysis between anterior and posterior ankle foot orthosis in hemiplegic patients. Am J Physical Med Rehabil. 2009; 88(8): 630-634. J Am J Physical Med Rehabil. 2009; 88(8): 630-634.
10. Chan CK, Hong WH et al. Effects of an anterior ankle-foot orthosis on postural stability in stroke patients with hemiplegia. Am J Physical Med Rehabil. 2008; 87(10): 815-820.
11. Wong AM, Tang FT et al. Clinical trial of a low-temperature plastic anterior ankle foot orthosis. Am J Physical Med Rehabil.1992; 71(1): 41-43.
12. Chen C, Yeung K et al. Effects of an anterior ankle-foot orthosis on hemiplegic gait. J Rehabil Med Assoc ROC. 1998; 119-127.
13. Chang JJ, Su CY. A low-temperature plastic anterior encased ankle foot orthosis: construction and preliminary clinical results. Kaohsiung J Medica Sci. 2000; 16(1): 47-52.
14. Geertzen JHB, Dijkstra PU. Ankle foot orthoses for patients with stroke: A review. J Neurorehabilitation and Neural Repair. 2005;19(2):122-132.
15. McDonnel D, Gautheir P. The effectiveness of posterior AFOs in post-stroke rehabilitation: A meta-analysis. Stroke Rehabilitation Journal. 2006;23 (5):62-69.
16. Chen SF, Lee YT. The benefits of anterior support AFO for individuals with foot drop. A Case Study. Journal of Clinical Orthotics. 2007;30(4):154-162.
17. Lin YL, Chan CK. Efficacy of the anterior support ankle foot orthosis in patients with hemiplegic foot drop. Journal of Stroke and Cerebrovascular Diseases. 2009;18(6):398-402.
18. Linder M, Krosshaug T. Metabolic efficiency of ankle foot orthosis in stroke patients: A Systematic Review. J Clinical Biomechanics. 2013;28 (5):591-599.
19. Hsu YW, Wu CH. Comparison of gait and metabolic outcomes of posterior and anterior AFOs in foot drop patients. Archives of Physical Medicine and Rehabilitation. 2011;92(8):1244-1250.
20. Perry J, Burnfield JM. Gait Analysis: Normal and Pathological Function. 2nd ed. CA: Slack;2018.
21. Daryabor A, Arazpour M et al. Design and evaluation of an articulated ankle foot orthosis with plantarflexion resistance on the gait: a case series of 2 patients with hemiplegia. J Biomed Phys Eng 2020; 10(1): 119-128.
22. Luiz Alfredo Braun Ferreira, Hugo Pasini Neto et al. Effect of ankle foot orthosis on gait velocity and cadence of stroke patients: A systematic review. J Phys Ther Sci. 2013; 25(11): 1503-1508.
23. Birol Balaban, Evren Yasar et al. The effect of hinged ankle foot orthosis on gait and energy expenditure in spastic hemiplegic cerebral palsy. J Disability Rehabilitation. 2007; 29(2): 139-144.
24. Dufek JS, Mareer JA et al. Metabolic cost during submaximal walking with a rigid rotational control ankle foot orthosis: A preliminary investigation. J Prosthet Ortho.1997; 9(4): 152-156.
25. Nielsen DH, Shurr DG et al. Comparison of walking energy cost and gait efficiency during ambulation in below-knee amputees using different prosthetic feet- A preliminary report. J Prosthet Ortho.1988; 1(1): 24-31.

How to cite this article: Mansi Pathak, Manoj Kumar Tiwari, Haribhau S. Dongre. A comparative study of performance of anterior ankle foot orthosis (A-AFO) vis-à-vis. posterior ankle foot orthosis (P-AFO) in terms of gait parameters and energy expenditure in hemiplegic patients with foot drop. *Int J Health Sci Res.* 2025; 15(5):39-48.
DOI: *https://doi.org/10.52403/ijhsr.20250505*

******