

Effects of carbon versus plastic ankle foot orthoses on gait outcomes and energy cost in patients with chronic stroke - MECASPRY study

Diana RIMAUD, Rodolphe TESTA, Guillaume Y. MILLET and Paul CALMELS. *Journal of rehabilitation medicine*. 2024.56; 1-9

METHODS

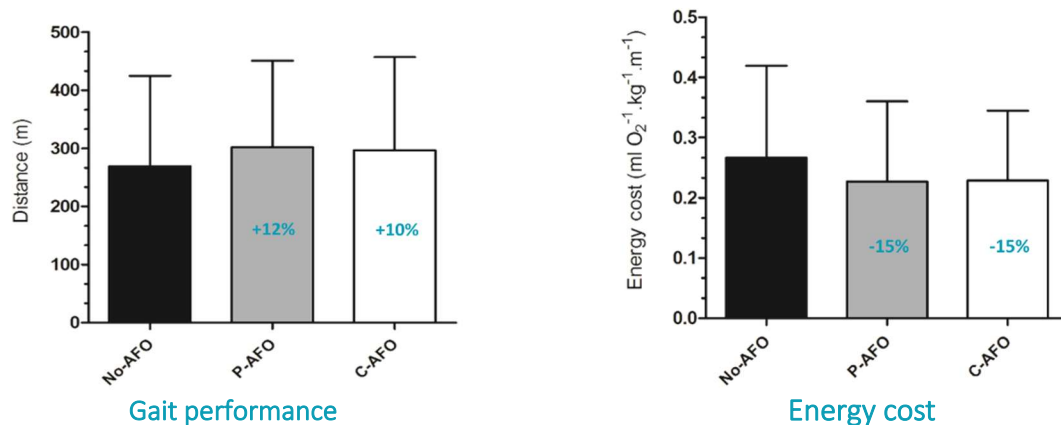
- This randomized controlled crossover study was conducted in France from September 2020 to September 2021.
- 15 patients with hemiplegia following stroke for more than 6 months and using a custom-made thermoplastic Ankle Foot Orthosis (AFO) for at least 3 months were recruited from the Physical Medicine and Rehabilitation Unit of the Saint-Etienne University Hospital.
- All patients tested 3 conditions in a randomized order every 15 days:
 - No AFO
 - Their own custom-made thermoplastic AFO (P-AFO)
 - An off the shelf composite Sprystep Original (C-AFO)
- Two weeks prior to the evaluation with Sprystep, the patient was asked to wear and walk with the Sprystep. The same applied to the thermoplastic evaluation. In the 2 weeks prior to the No-AFO evaluation, the patients were allowed to wear and walk with their preferred orthosis.
- The primary outcome was the distance covered in the 6 Minutes Walking Test (6MWT).
- Secondary outcomes were Energy cost of walking, gait analysis, kinetic and kinematic variables, satisfaction.



RESULTS

1

Similar increase in walking distance with Sprystep Original and custom-made plastic AFO



The **distance walked** during the 6MWT was **significantly longer with the P-AFO (+12%, $p = 0.013$) and the C-AFO (+10%, $p = 0.005$)** compared with walking without an AFO. Similarly, the average walking speed during the 6MWT (i.e., at maximal speed) was significantly faster with both AFOs (+12% with the P-AFO, $p = 0.013$; and +10% with the C-AFO, $p = 0.005$) than under the No-AFO control condition.

Energy cost was significantly 15% higher with No-AFO than with the P-AFO ($p = 0.024$) and the C-AFO ($p = 0.024$).

2

Spatio-temporal parameters similarly improved with Sprystep Original and custom-made plastic AFO

Gait velocity was significantly **greater with both AFO** than without AFO (+9% with P-AFO and +10% with C-AFO, $p=0.045$).

Stride length and stride width were significantly improved with both AFO, i.e +9% stride length with both AFO ($p<0.001$); and -9% stride width with P-AFO and -13% with C-AFO ($p<0.001$) compared without AFO.

The **step length** for both the paretic and non-paretic legs was significantly enhanced with both AFOs as opposed to the No-AFO condition (+8% for the paretic leg with both AFOs, $p = 0.005$).

3

Improved kinematic parameters with Sprystep Original and custom-made plastic AFO

The **ankle plantar flexion angle** of the paretic limb decreased significantly by 40.6% (-6.5°) with the P-AFO and by 43.1% (-6.9°) with the C-AFO ($p < 0.0001$) compared with that in the condition without orthoses.

In the non-paretic leg, there was a decrease in the maximal knee extension angle (**knee hyperextension**) measured during the stance phase with both AFOs, compared with the No-AFO condition ($p = 0.0247$).

Patients with knee hyperextension were significantly more common ($p = 0.003$) in the **responding group of C-AFO** (6 patients with symptomatic hyperextension) than in the non-responding group (no patients with symptomatic hyperextension).

4

A higher satisfaction with Sprystep Original

Satisfaction scores were **significantly higher with C-AFO** than with P-AFO for the items “I take bigger steps” ($p = 0.03$) and “I have less fatigue” ($p = 0.02$). Some 60% of patients reported that of the 2 AFOs, the C-AFO was the orthosis with which they felt most comfortable when walking, and 67% of patients wished to keep the C-AFO at the end of the study.

KEY MESSAGES

- The use of Sprystep Original in patients with chronic stroke may immediately increase walking speed, improve gait variables, and decrease the energy cost of walking as effectively as the patient’s usual plastic custom-made AFO.
- The functional adaptation of the patients to Sprystep original seems relatively fast and efficient since similar results were obtained with both AFO although the habituation period is totally different: only two weeks for the Sprystep versus a long time for most patients using custom-made plastic AFO.
- For patients with a genu recurvatum, a standard, less expensive, ready-to-wear and composite Sprystep AFO can be a good alternative to the plastic custom-made AFO.
- Taking into account the population of the study, and the individual analysis, a clinical and individual approach is always needed to prescribe the most effective and more appropriate AFO to the specific schema of walking with hemiplegia.