The Adjustable Dynamic Response AFO: Giving children another option?

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Aim:

Articulated ankle–foot orthoses (AAFO) are commonly prescribed for children with lower limb spasticity to improve ambulation primarily by restricting ankle plantarflexion through the gait cycle while allowing full dorsiflexion through stance phase. The Adjustable Dynamic Response (ADR) AFO is a new design that incorporates an ankle joint which can be tuned to control both plantarflexion and dorsiflexion to suit the child's available ankle range of motion.

The aim of this study was to quantify and compare the spatiotemporal characteristics, and lower limb kinematics and kinetics during gait of children with neurological and developmental conditions between two different orthoses; 1) their standard issue AAFO; and 2) an ADR AFO.

Method:

Fourteen children (8.2±2.5yrs, 130.5±15.3cm, 28.4±8.3kg) with a hemiplegia already using an AAFO daily participated in the study. Each participant was cast and fitted for their new ADR AFO by an orthotist at least three weeks prior to presenting for gait analysis testing. A minimum of 10 trials of 10m walks in each AFO were collected.

Three-dimensional lower limb kinematics and kinetics were captured with the following primary outcome measures: peak knee flexion and extension, sagittal plane knee and ankle range of motion (ROM), peak ankle dorsiflexion and plantarflexion, and ankle joint power of the AFO limb. Standard spatiotemporal outcome measures were output.

This study was a within-subjects repeated measures design using paired t-tests ($p<0.05$) to determine any differences in outcome measures between the two AFO types. Data from two participants were excluded due to equipment failure during testing. A total of 112 trials were included in the kinematic analysis and 56 trials in the kinetic analysis.

Results and Discussion:

The data analysis showed no significant spatial-temporal differences. Six kinematic variables were significant and are listed in Table 1. There were no differences in peak power generation, with a trend towards increased work done at the ankle joint through single support when wearing the ADR AFO.

Table 1: Significant sagittal plane kinematic findings

Mean kinematic angles (degrees)	ADR AFO	AAFO
Hip flexion at initial contact	40.2 ± 8.6	38.6 ± 6.9
Knee flexion/extension ROM	62.9 ± 12.2	64.2 ± 11.5
Ankle dorsi/plantarflexion ROM	20.1 ± 5.9	18.3 ± 4.0
Peak ankle dorsiflexion swing	2.9 ± 4.2	1.8 ± 4.3
Peak ankle plantarflexion stance	-6.4 ± 5.2	-3.9 ± 4.3
Peak ankle plantarflexion swing	-3.5 ± 4.9	-2.3 ± 4.2

The kinematic data supports the hypothesis that the ADR AFO increases ankle range of motion compared to an AAFO, particularly during late stance and swing phase with an increase in plantarflexion. However these differences were variable between participants. Increased ankle range of motion was associated with an increase in work done at the ankle during single support phase. Development of the positive ankle work phase earlier in the gait cycle may be due to the increased available range when wearing the ADR AFO. This necessitates further research with larger sample sizes. Of the 14 children assessed, 10 were recalled to optimize knee and ankle joint alignment in the ADR AFO and may account for the increased variation in the ADR AFO condition and have some impact on the findings of this study.

Conclusion: Clinicians should consider use of an ADR AFO as an option for management of gait dysfunction in children to optimise the available ankle range of motion during gait.