Do Ankle Foot Orthoses Improve Gait for Individuals with Cerebral Palsy?

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Introduction: The prescription of ankle foot orthoses (AFOs) is a standard practice in the treatment of patients diagnosed with cerebral palsy (CP). AFOs are typically made of lightweight polypropylene or carbon fiber, and can be fabricated as a solid or posterior leaf spring orthosis (SAFO or PLS), or as two piece orthosis with a hinged ankle joint (HAFO). Selection of a specific type of AFO is not always straightforward due to the complex set of clinical factors impacting the prescription (e.g. spasticity, contractures, selective motor control, gait patterns). Different standardized prescription methods have been proposed\cite{footnote1}, but none have been shown to be optimal. The ability to gage the effectiveness of current prescription methodologies is a critical step in finding an optimal prescription algorithm.

Clinical Significance: The current prescription paradigm for AFOs is shown to produce only minimal improvements in gait. Factors contributing to improvements are identified.

Methods: A search of the clinical database at Gillette Children’s Specialty Healthcare Center for Gait and Motion Analysis was conducted. Inclusion criteria were a primary diagnosis of diplegic CP, and walking trials collected both barefoot (BF) and wearing orthoses (ORTH) during a single visit. Allowable AFO designs were SAFO, PLS, or HAFO. The gait data was analyzed for each trial, and the change in GDI from BF to ORTH was calculated for each limb; with a positive change indicating an improvement\cite{footnote2}. The GDI score is a single number that represents the overall gait pathology. A GDI>100 indicates normal gait kinematics; and each decrement of 10 points is one standard deviation from normal. An ANOVA was run to explore main effects of assistive device use (dependent or independent), AFO design (SAFO, PLS, or HAFO), and barefoot GDI level (continuous), as well as v.

Results: The database search returned 686 subjects (1372 limbs) meeting the criteria. The average GDI change was an improvement of +1.6 from BF to ORTH. Assistive device use, barefoot GDI, and the interaction between these two variables were significant predictors of the GDI change (p<.05). Subjects with poorer kinematics (lower GDI) derived greater benefit than those with milder gait deviations [Figure 1].

Figure 1. Barefoot GDI is a strong predictor of change in GDI with AFO use. There was a slightly smaller effect among subjects who use assistive devices compared to those who walk independently.
Compared with independent ambulators, subjects with assistive devices derived greater benefit from AFO use; even after adjusting for lower overall GDI [Figures 1 and 2]. The effect of barefoot GDI on change in GDI was slightly smaller among dependent ambulators compared to their independent counterparts (slope = -.13 vs. -.20 respectively) [Figure 2].

**Discussion:** A retrospective analysis of gait changes associated with AFO use among individuals with CP showed a small benefit among subjects who use assistive devices, but nearly negligible improvements for independent ambulators. Barefoot GDI was found to be a significant predictor of improvements, as was the use of an assistive device. The AFO design was not a statistically significant factor in predicting changes in GDI. The distribution of GDI changes suggests that while overall response to AFO wear is underwhelming, there are a significant number of good responders (*i.e.* GDI changes of >5). Future work should focus on identifying patient characteristics that lead to meaningful positive gait changes, as well as analyzing the existing prescription algorithm in an effort to improve AFO efficacy.

**References**


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