

## **Barefoot Versus Orthoses: Is There an Order Effect on Gait Analysis?**

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### **Introduction**

Most reports<sup>1,2,3</sup> suggest that clinically prescribed orthoses result in changes in velocity, cadence and step lengths in children with cerebral palsy. However, it is not reported in any of the studies whether an order effect has been ruled out. The order of the data collection could play a significant role in the temporal spatial changes seen in children with and without orthoses. Most gait labs collect barefoot motion data followed by the orthoses trials. To date no studies have investigated whether or not this protocol introduces a bias in the data as the child becomes "comfortable" in the motion lab.

### **Statement of Clinical Significance**

The aim of the study was to determine whether there is any order effect in gait analysis between walking with orthoses, such as an AFO, and barefoot walking.

### **Methods**

This is a prospective study involving patients attending gait analysis. One group of patients had gait analysis with orthoses (OT) first followed by barefoot (BF) and the other group had barefoot trials followed by orthoses trials. Kinematic data were collected using a 6 camera Motion Analysis Corporation (Santa Rosa, CA) system using Eva 6.0.2 software. The step length, velocity and cadence were calculated using OrthoTrak 5.0.2 (MAC) software. The data analysis was done using a repeated measures ANOVA .

### **Results**

The data show that there was no order effect between the walking with orthoses first or with barefoot first for velocity (Table 1) and stride length (Table 2). There was, however an order effect seen in the cadence (Table 3) with the cadence being significantly decreased with the orthoses on when the orthoses was tested after barefoot than when orthoses was tested before barefoot. Irrespective of order walking with orthoses improved step length ( $p<.001$ ), decreased cadence ( $p<.001$ ) but did not alter velocity ( $p>0.05$ ).

**Table 1.** Velocity with barefoot (BF) and orthoses (OT) comparing barefoot vs orthoses first.

	<b>Order</b>	
<b>Condition</b>	<b>BF 1<sup>st</sup> (cm/s)</b>	<b>OT 1<sup>st</sup> (cm/s)</b>
<b>OT</b>	108 ( <u>±</u> 16.4)	102 ( <u>±</u> 23.9)
<b>BF</b>	102 ( <u>±</u> 26.6)	110 ( <u>±</u> 17.1)

**Table 2.** Step Length with barefoot and brace comparing barefoot vs orthoses first.

<b>Order</b>		
Condition	<b>BF 1<sup>st</sup> (cm)</b>	<b>OT 1<sup>st</sup> (cm)</b>
<b>OT</b>	51.5 ( $\pm$ 7.4)	48.5 ( $\pm$ 10.7)
<b>BF</b>	47.3 ( $\pm$ 4.8)	45.9 ( $\pm$ 11.1)

**Table 3.** Cadence with barefoot (BF) and brace comparing barefoot vs orthoses first.

<b>Order</b>		
Condition	<b>BF 1<sup>st</sup> (steps/min)</b>	<b>OT 1<sup>st</sup> (steps/min)</b>
<b>OT</b>	126.8 ( $\pm$ 17.8)	127.6 ( $\pm$ 15.9)
<b>BF</b>	141.9 ( $\pm$ 19.5)	135.9 ( $\pm$ 19.7)

**Table 4.** Temporal measures between orthoses and barefoot during walking.

	<b>Barefoot</b>	<b>OT</b>
<b>Steps (cm)</b>	46.0	50.0
<b>Velocity (cm/s)</b>	106.0	105.6
<b>Cadence (steps/min)</b>	138.4	127.2

### **Discussion**

The impetus for this study was drawn from clinical questions regarding the effect of patient comfort in the gait lab setting. The present comparisons between braced and barefoot gait analyses both support<sup>1,2</sup> and refute<sup>1</sup> previously published data. This study indicates that step length increases, cadence decreases and velocity remains unchanged when an orthoses is used regardless of trial order. Interestingly when order is considered there is greater decrease in cadence with an orthoses when the orthoses is tested after barefoot giving the effects of the orthoses a biased improvement in cadence. Because there are no significant changes in the other variables considered (step length and velocity) it would seem that different strategies may be utilized by the patient to either maintain stride length or maintain velocity.

The results of the present investigation are significant for two reasons. First, research that indicates there is a difference between two groups, ie. orthoses vs. barefeet, may have introduced an order bias depending on protocol, barefoot first followed by orthoses or random assignment of brace first/barefoot first. Second, in a clinical setting decisions on effectiveness of bracing may be a result of order bias and not necessarily a result of the addition of an AFO. Therefore, both the clinician and the researcher must be aware that order biases are possible and that appropriate measures to reduce this bias must be made in the gait analysis laboratory.

### **References**

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