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Effects of Ankle-Foot Orthosis on Balance of Foot Drop Patients

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Abstract. Ankle-Foot Orthoses (AFOs) are common non-surgical treatments used to support foot and ankle joint when their normal functioning is compromised. AFOs have relevant impact on gait biomechanics, while scientific literature about effects on static balance is less strong and confusing. This study aims to assess the effectiveness of a plastic semi-rigid AFO in improving static balance on foot drop patients. Results underline that no significant effects on static balance is obtained on the study population when the AFO is used on the impaired foot.

Keywords. Foot Drop, Ankle-Foot Orthosis, AFO, Postural Balance

1. Introduction and Methods

Ankle-Foot Orthosis (AFO) is an external support for foot and ankle joint used when their normal functioning is compromised. Foot drop is one of the most common condition that usually requires the use of an AFO. Orthoses generally improves gait functions and general effects on balance were also registered. However evidence about significant effects of AFOs on balance is less strong, with inconsistent findings due to the different orthoses or tests used [1]. In this study the effects of a semi-rigid AFO on static balance is explored on a group of patients suffering foot drop deficit, whose effects on balance were not deeply explored in literature. The system used to assess balance can provide more specific analytical metrics with respect to previous studies.

The analysis involved twenty-four patients (15 males, age 57±14 yrs, BMI 23.4±4.4 kg/m2), with bilateral (3) or unilateral foot drop syndrome (12 right foot). Static balance assessment was performed using ProKin platform (v. 252 Tecnobody, Dalmine (BG) – Italy). The experimental trial consisted of a static acquisition, repeated with open and closed eyes, in which the subject maintains the standing position for 30s, looking straight forward to a reference point with the feet in extra-rotation. Two-way ANOVA was used to analyse two main effects (open or closed eyes and the influence of the orthosis) and the interaction factor. Statistical analyses were performed using R version 4.0.3.

2. Results, Discussion and Conclusions

Table 1 reports descriptive statistics of the datasets. The ANOVA tests produce the results in Table 2. The level of statistical significance is specified by a different number

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of asterisks (*). The use of a semi-rigid passive posterior leaf orthosis does not produce improvements in static balance of subjects suffering from foot drop syndrome. The marked differences found between the open- and closed-eyes conditions confirms that this experimental setting can detect changes in static balance functionalities.

Table 1. Postural Parameters for Eyes Open/Closed, in Two Gait Conditions, expressed as mean ±std.

	Without AFO		With AFO	
	Eyes Open	**Eyes Closed**	**Eyes Open**	**Eyes Closed**
Sway Area (cm^2)	4.13±3.58	15.3±21.2	4.69±5.31	17.4±23.8
Sway Path Length (cm)	58.5±29.8	140±114	61.6±34.7	134±96
Standard Deviation AP (mm)	5.97±2.97	10.0±5.7	5.66±2.37	11.0±6.5
Standard Deviation ML (mm)	3.84±2.23	6.28±4.91	4.02±3.03	6.79±5.74
COP Velocity AP (mm/s)	15.3±8.1	39.4±32.9	15.9±9.9	37.7±27.5
COP Velocity ML (mm/s)	8.67±4.79	17.5±14.8	9.25±5.68	16.2±13.4

Table 2. ANOVA Statistical Test Results.

	AFO Condition	**Eyes**	**AFO Condition*Eyes**
Sway Area	0.632	5.37e-5****	0.783
Sway Path Length	0.887	9.32e-10****	0.670
Standard Deviation AP	0.632	2.21e-9****	0.354
Standard Deviation ML	0.579	7.62e-5****	0.794
COP Velocity AP	0.859	2.37e-10****	0.714
COP Velocity ML	0.803	2.31e-6****	0.534

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$.

Several studies have reported enhanced balance confidence in daily activities when using a lower limb orthosis [2], and in quantitative assessment of dynamic balance [3]. However the absence of improvements in static balance is reported in several studies in different patients [4,5]. Probably, the most general conclusion is that AFO principally improves gait and dynamic balance rather than static functions, and that different designs of AFO have different impacts on postural responses, thus being more appropriate for a group of specific patients. Our study focused on a group of subjects suffering from foot drop, and reported no effects on static balance when a passive AFO is used. However, some limitations should be mentioned: the study population is limited and the aetiology of foot drop is varied. Moreover, patients used this orthosis for the first time in this trial and had just few minutes of walking to be confident with it. The structure and the working mechanism of the passive orthosis are very simple, reducing the training time needed to achieve an appropriate use. This study aims to explore the immediate effects on balance of using a passive AFO and prompts future works to investigate the impact of long-term use before progressing to general considerations about the effectiveness.

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