COMPARISON OF POSTUROGRAPHY ANALYSIS IN A FORMULA-3000 DRIVER AND IN SUBJECTS SUBMITTED TO LINEAR OSCILLATION

Guy Gosselin[1,2], Ivar Schenk[1], Jonathan Cook[1]
[1] AECC, Bournemouth, Dorset, UK
[2] University of Southampton, Southampton, Hampshire, UK

KEY WORDS: driving, balance, linear oscillation, fatigue.

INTRODUCTION: Driving a Formula car represents a highly demanding technical task during which the driver is submitted to large +/- G forces. Cervical muscular pain and discomfort are common complaints reported not only by rookies but also by more experienced drivers. We have previously observed that even limited track time produces significant changes in postural sway (Gosselin, 2000). Studies performed at racing tracks are not practical, are expensive and involve numerous variables that are difficult to control. The aim of this project was to compare the postural disturbances observed in a Formula-3000 driver after track time to the postural disturbances in subjects submitted to linear oscillation in our laboratory. Linear oscillation is used to stimulate the somatosensory and vestibular system and more specifically the otholith since they are the primary receptors involved in the detection of linear oscillation (Hlavacka, 1996).

METHOD: A 24-year Formula driver with one-year racing experience in the Italian Formula 3000 Championship performed three 20 minutes driving sessions around a three and one half kilometre track. Linear oscillation was performed on two college students. They were seated on a parallel swing (without head rest) and submitted to a 5 minute of anterior-posterior simple harmonic motion of a 1-m displacement at 0.89-g acceleration. Pre and post posturography was performed on an AMTI ORG-6 and data acquired with a Biosoft software. T-test were used to examine pre and post differences between the groups. Experimentation was done immediately before and after both track time and oscillation.

Table 1. Pre and post driving and linear oscillation sway in cm and cm^2, and cm/s.

	Formula-3000 Driving				Linear Oscillation			
Position	**Wide eyes open**		**Wide shut**		**Wide eyes open**		**Wide shut**	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Avg. Radial Displa.	0.26	0.25	0.32	0.37	0.28	0.31	0.39	0.46
95% Ellipse Area	0.29	0.61	0.69	1.07	0.32	0.71	0.81	1.89
Avg. Velocity	0.67	0.74	0.89	0.78	0.55	0.65	0.79	0.8
Position	**Narrow eyes open**		**Narrow shut**		**Narrow eyes open**		**Narrow shut**	
Avg. Radial Displa.	0.29	0.54	0.97	0.60	0.32	0.61	1.45	0.60
95% Ellipse Area	0.86	3.02	11.43	3.84	1.02	4.36	9.19	6.82
Avg. Velocity	1.28	0.70	0.89	0.76	1.44	0.62	0.68	1.44

RESULTS AND DISCUSSION: There was no significant difference ($p>.05$) in sway between the two groups pre and post differences in all situations except for the average velocity narrow stance eyes shut and wide stance eyes shut. Although, G-forces (2.6 lateral, 1.5 breaking and 1.0 accelerating) sustained during 20 minutes of high speed driving produced changes in the sway profile, it is interesting that in this case, 5 minutes of near continuous 0.89-g sustained were sufficient to reproduce similar postural disturbances. Linear oscillation may therefore be a useful tool to reproduce some of the effects of high performance driving in a controlled environment. By understanding the functional effects of race car driving on its driver, we may be able to develop strategies aimed at making this activity safer.

REFERENCES:

Gosselin, G., Blouin, J.S. (2000) Cervicoceplalic kinaesthesia and postural sway in a Formula-3000 racing car driver. *12th Conference of the European Society of Biomechanics.* Dublin. 353.

Hlavacka, F.(1996) Human self-motion perception during translatory vestibular and proprioceptive stimulation.*Neurosci Lett.* 1996 May 31, **210**(2), 83-6.