

THE INFLUENCE OF FUNCTIONAL KNEE BRACES ON MUSCLE FATIGUE

Mario Lamontagne¹ and Fatemeh Sabagh-Yazdi²

School of Human Kinetics¹ and Department of Cellular and Molecular Medicine², University of Ottawa, Ottawa, Ontario, Canada

INTRODUCTION

In this study we investigated the possible influence of wearing functional knee braces on various factors of muscle fatigue. We measured isometric, isokinetic, and muscle fatigue parameters such as; MVC, Peak Velocity (PK), power and number of repetition to muscle fatigue during isokinetic exercise, and also muscle fatigue during 50s isometric contraction. For the 50s isometric exercise at 80% MVC, the muscle fatigue was measured from the decrease of Median Frequency (MF) of EMG signals.

METHODS

Two groups of healthy and ACL-deficient knee joint subjects with an average age of 28.8 years and 26.6 years respectively volunteered to this study. Each group was composed of six males and two females. Two separate sessions were necessary to measure isometric, isokinetic, and muscle fatigue parameters for the braced and unbraced conditions. For the brace condition, the subjects were wearing a functional Donjoy (Legend) knee brace. All tests were performed on an isokinetic device (Kin-Com 500H) while the EMG signal was collected at 1000 Hz for six muscles; rectus femoris (RF), vastus lateralis (VL), vastus medialis (VM), gastrocnemus (G), Medial Hamstring (MH) and Lateral Hamstring (LH).

RESULTS AND DISCUSSION

Analysis of EMG data revealed that no significant differences were obtained for the EMG amplitude or the integral of the linear envelope EMG between the groups and conditions. During the 50s isometric exercise at 80% MVC, the fatigue state is represented by decline of MF value of EMG signal greater than 10 Hz. Muscle fatigue state was obtained in all muscles except for VL in healthy group and VM in ACL group during unbraced condition, and G in healthy and ACL groups during the braced condition. Percentage of decline of median frequency in the gastrocnemius was significantly different between the groups ($p>0.05$). Percentage of decline of median frequency in VL of healthy group was found to be not quite significant ($p>0.05$) between the condition.

In the fatigue recovery, there were no significant differences between groups or conditions. In subjective assessment of muscle fatigue using the Borge scale at 10 s interval during the 50s isometric exercise at 80% MVC, the outcomes showed a high correlation between the subjective perception of fatigue and percentage of decline of the MF ($r >0.64$) for VL and RF muscles during the brace condition. All other muscles showed very low correlation.

Table 1. Average percentage of decline of the median frequency

Muscles	ACL						Healthy					
	VL	RF	VM	G	MH	LH	VL	RF	VM	G	MH	LM
Braced	9.1	27.6	14.8	1.8	35.0	27.3	18.4	24.9	12.3	1.7	39.3	34.5
Unbraced	12.0	22.4	9.0	10.6	43.4	24	8.9	21.2	16.4	9.5	48.0	28.5

In conclusion, wearing functional knee brace did not seem to affect the muscle fatigue performance as assessed by the EMG fatigue parameters. This may indicate that the external pressure created by the brace straps is not high enough to reduce the blood flow of the knee muscles that may cause accumulation of metabolic substrates such as lactate acid in muscles.

ACKNOWLEDGEMENTS

This research was supported in part by the Natural Sciences and Engineering Research Council.