

PRESSURE MEASUREMENT BETWEEN A FUNCTIONAL KNEE BRACE AND THE LEG

Mario Lamontagne

School of Human Kinetics and Dept. of Mechanical Engineering, University of Ottawa,
Ottawa, Ontario, Canada

KEY WORDS: knee, brace, pressure measurements, jump

INTRODUCTION: When functional knee brace is applied on the leg, the kinematics and kinetics of the knee may be changed due to the relative motion of the brace to the leg and by external compression induced by the straps of the knee brace (DeVita, Lassiter, Hortobagyi, & Torry, 1998; Styf, Nakhostine, & Gershuni, 1992). If the brace moves during dynamic movement, the alignment of both centers of rotation of the knee and brace might induce more resistance to the motion. At the same time, the external compression by the strapping of the brace might cause high intramuscular pressure beneath the area of the brace straps. The intramuscular pressure under the strapping decrease local muscle blood flow and muscular oxygenation, and induce premature muscle fatigue. In this situation, functional knee braces do not improve performance and may even inhibit performance in asymptomatic athletes. The purpose of this on-going research was to measure the knee brace migration on the leg and pressure induced on the leg by the brace straps during dynamic motion. This work will only report the results on pressure and force measurements.

METHODS: Fifteen adult males with no previous knee injury agreed to participate in the study. All participants equipped with a functional knee brace (Legend; DonJoy, USA) were filmed with four high-speed video cameras (2 x JC Labs (200Hz) and 2 x JVC (120 Hz)) during five drop jumps (41 cm) before and after 30 min of Ergobike cycling. A set of three markers were fixed on the subject's lower limb and on the brace. Dynamics pressure pads (Pedar System; Novel GmbH, Germany) were inserted between the brace and the leg at the thigh and the shank. Maximum pressures and forces were recorded at 50 Hz during the jump preparation up to the touch-down on the ground. The brace was fixed at an initial pressure of 2N/cm^2 .

RESULTS AND DISCUSSION: Only five out of 15 subjects were used for the pressure and force measurements. Some problems were encountered during the data acquisition. The data analysis consisted of comparing the average maximum pressure and the maximum force at thigh and shank attachment before and after the exercise period. Before exercise, maximum forces at the shank and thigh (231.4N, 487.3N respectively) were significantly higher at thigh attachment ($p=0.0005$). The average peak pressures were at the shank and thigh (35.8 N/cm^2 , 40.1 N/cm^2) respectively). The average peak pressures were significantly higher at thigh attachment ($p=0.0003$). The same trend has been shown after exercise that the maximum forces or the average peak pressures were significantly higher at the thigh. However, the forces and pressures were significantly different before or after exercise. The findings show that average peak pressure and maximum forces are higher before than after exercise. The maximum external pressure applied to limb was 40.1 N/cm^2 (125 mmHg) which may reduce blood flow to the muscle, and consequently increase muscle fatigue and reduced athletic performance (Styf et al., 1992). Therefore, if we want to improve knee brace design, we must consider modifying the fixation of the brace on the limb.

REFERENCES:

- DeVita, P., Lassiter, T., Jr., Hortobagyi, T., & Torry, M. (1998). Functional knee brace effects during walking in patients with anterior cruciate ligament reconstruction. *Am J Sports Med*, **26**(6), 778-784.
- Styf, J. R., Nakhostine, M., & Gershuni, D. H. (1992). Functional knee braces increase intramuscular pressures in the anterior compartment of the leg. *Am J Sports Med*, **20**(1), 46-49.