Analysis of muscular activation during different leg press exercises with maximum and submaximum effort levels

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Introduction
Recently, a great number of studies have been analyzing muscular activity in different strength exercises. Often, the superficial electromyography (EMG) technique is used to identify muscle participation in these researchs. Leg press (LP) is one of the most common exercises performed in strength training programs. Escamilla et al. (2001) tried to identify muscle activity during high LP and low LP; however, only one submaximum effort level was used, and the activity of glutus maximus, one of the primary hip extensors, was not quantified. Thus, the specific aim of this study was to verify the activities of the knee and hip extensor muscles, and gastrocnemius muscle during different LP exercises at maximum and submaximum intensities of effort.

Methods
Fourteen long-term strength-trained women were selected for the study. First, the subjects performed a repetition maximum test (RM) in three LP exercises: 45° LP (45LP), high LP (HLP), and low LP (LLP). One week after the tests, the subjects returned to the laboratory for the data collection. They performed the LP exercises at different intensities (80, 60, 40, and 20% of RM). Root Mean Square (RMS) electromyographic (rmsEMG) values of the activity of the right rectus femoris (RF), vastus lateralis (VL), biceps femoris (BF) long head, lateral gastrocnemius (GAS) and glutus maximus (GM) were recorded, using surface electrodes, rectified and normalized by using muscle activity during the 45LP RM. Data interpretation was realized in accordance with the Pincivero et al. (2001) procedures. Nonparametric tests were used to detect statistical differences (p<0.05) in myoelectric activity among LP exercises at different intensities and in both concentric (CON) and eccentric (ECC) phases of exercise.

Results
The average of the rectified rmsEMG values in the RF, VL, GAS, and GM muscles was statistically (p<0.05) greater during the CON phase than during the ECC phase in the three exercises. The results for the BF muscle were similar; however, in HLP exercise, no statistically significant differences (p=0.83) were detected between these phases. Among the exercises, the RF activity was greater (p<0.05) during 45LP (20% = 0.29 ± 0.09 vs 0.13 ± 0.06; 40% = 0.47 ± 0.11 vs 0.27 ± 0.12; 60% = 0.64 ± 0.14 vs 0.47 ± 0.16) and 80% = 0.88 ± 0.13 vs 0.64 ± 0.20) compared to HLP (20% = 0.19 ± 0.09 vs 0.13 ± 0.06; 60% = 0.71 ± 0.20 vs 0.47 ± 0.16 and 80% = 0.98 ± 0.25 vs 0.64 ± 0.20) and HLP (20% = 0.18 ± 0.09 vs 0.13 ± 0.09) during HLP. Only one statistical difference was detected between the 45LP and LLP exercises. RF activity in 45LP was greater (p<0.05) than during LLP (0.29 ± 0.09 vs 0.19 ± 0.09) when the intensity of 20% was used. VL showed a greater activity (p<0.05) during LPL compared with HLP (0.38 ± 0.25 vs 0.64 ± 0.20) at the intensity of 20%. GAS presented a greater activity (p<0.05) during 45LP (20% = 0.22 ± 0.1 vs 0.13 ± 0.09; 40% = 0.38 ± 0.12 vs 0.25 ± 0.15; 60% = 0.65 ± 0.25 vs 0.29 ± 0.09) and 80% = 0.76 ± 0.22 vs 0.43 ± 0.28) and LPL (20% = 0.18 ± 0.11 vs 0.13 ± 0.09; 40% = 0.33 ± 0.18 vs 0.25 ± 0.15; 60% = 0.62 ± 0.27 vs 0.29 ± 0.09) and 80% = 0.78 ± 0.48 vs 0.43 ± 0.28) compared to HLP in all effort levels. When rmsEMG values of muscle activity were compared among muscles in each exercise, during 45LP, at the intensity of 20%, VL activity was greater (p<0.05) than that of GM. On the other hand, during LPL, no statistical differences were showed among muscle activities, whatever effort levels were required. The results showed during HLP are presented in Figure 1.

Discussion/Conclusion
The results showed that, during the HLP exercise, BF long head can work isometrically or near this position (1). The RF and GAS muscles are more required during the 45LP and LLP exercises than during HLP. It can be explained by the position of the RF, GAS and GM muscles in 45LP, LLP, and HLP. These different positions could induce modifications on tension-length curves in these muscles (3). At high intensities of effort, quadriceps appears to be more active in LLP than in HLP. However, HLP could be used to specify the GM work, probably because it is an important hip extensor.

References