BIOMECHANICAL EFFECTS OF ELASTIC BANDS, CHAINS AND FREE-WEIGHT RESISTANCE ON SUBMAXIMAL BACK SQUAT EXERCISE

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Introduction: Imposing variable resistance using elastic bands (EB) or chains (Ch) in addition to the free-weight resistance (FWR; i.e. the bar and weights) alters the loading characteristics of a squat lift. This can increase the range of motion through which substantial loading is applied, while maintaining the average load, thus reducing loading at the movement's 'sticking point'. The manipulation of the loading characteristics can enable the athlete to operate at near maximal levels for a greater proportion of the exercise, providing a greater training stimulus and thus may be a more effective training tool. The aim of the present study was to examine the biomechanical differences between EB, Ch and FWR during the submaximal squat exercise. **Methods:** Fifteen strength-trained active men (age = 26.9 ± 7.9 yr, height = 172.3 ± 18.8 m, mass = 80.6 ± 12.2 kg) experienced in squatting (>3yr) volunteered for the study after giving written informed consent; ethical approval was granted from the University of Northampton. On three separate occasions the subjects performed FWR (control), EB or Ch (variable resistance) squat lifts for two sets of three repetitions at 85% 1-RM (35% of the load was generated from variable resistance). 3D motion analysis was used to record knee joint kinematics, and vastus medialis (VM), vastus lateralis (VL), rectus femoris (RF) and semitendinosus (ST) electromyograms (EMG) were recorded simultaneously. To reduce EMG variability (increasing the ability to detect significant differences), VL, VM, RF EMG data were averaged to represent quadriceps femoris (QF) EMG activity. Repeated measures MANOVA's were used to examine EMG and kinematic differences between conditions; significance was accepted at $p < 0.05$. **Results:** No significant differences ($p > 0.05$) in peak (1.8-2.8%) or mean eccentric (2.4-6.6%) and peak (3.5-4.0%) or mean concentric (5.0-6.0%) QF EMG activity were found between conditions. Similarly, no differences ($p > 0.05$) in peak (5.8-14.3%) or mean (9.2-15.8%) eccentric and peak (8.9-9.6%) or mean concentric (1.2-1.7%) knee angular velocities, or peak knee flexion angle (1-1.5%) were observed. **Discussion:** Performing the back squat exercise with the use of elastic bands or chains to provide 35% of the resistance compared to FWR alone at 85% of 1-RM did not alter knee extensor EMG amplitude or knee kinematics during the squat lift in either eccentric or concentric phases, and did not affect squat depth. Both significant and non-significant changes in kinematics, ground reaction forces and muscle activity have been previously reported in the literature; substantial differences in methodology likely explain these equivocal findings.