1306 Board #99 May 28, 9:00 AM - 10:30 AM

Proportionality of Resistance Band Tension and Corresponding Muscle Activity While Using a Resistance Band Exercise Device

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(No relationships reported)

Numerous exercise equipment companies have introduced products for training that incorporate resistance bands often with little known about the relationships among the bands and associated muscle activation (EMG) during exercise. One device using bands for resistance is a thigh trainer, intended to target hip abduction and adduction strength.
PURPOSE: The purpose of this study was to determine the relationship between changes in band tension and corresponding muscle activity when using a resistance band exercise device.
METHODS: The stress-strain characteristics of each of three sets of bands (low, moderate, high resistance) were first determined using an analog force dynamometer (Chatillon, AMTEK, Inc.) at four levels of strain (7, 14, 17, 21 cm). Ten healthy male subjects (81.3±13.2 kg; 1.73±0.07 m; 24.7±1.1 yrs) granted consent to participate and were instrumented with EMG electrodes on the adductor longus (AL) and gluteus medius (GM) following Noraxon electrode placement guidelines. After a brief practice with no resistance, participants used the thigh trainer for 30 s at each resistance (low, moderate, high) with movement rate controlled via a metronome (0.333 Hz). EMG data (1500 Hz) were filtered using a zero-lag fourth order recursive Butterworth filter. Average EMG for all subject-condition-muscles was identified across 30 s. Mean and standard deviation values were calculated among measured bands and muscle-band combinations.
RESULTS: Resistance bands showed 11% change between low ($\bar{x}$=33.81±10.4 N) and moderate ($\bar{x}$=37.5±13.4 N) and 5.4% change between moderate and high ($\bar{x}$=39.6±14.0 N) resistance, with strong correlations (r=0.996 or greater) at each level of stress-strain. GM EMG activity exhibited 3.7% change between low ($\bar{x}$=41.2±30.2 mV) and moderate ($\bar{x}$=42.79±32.1 mV) and 5.7% change between moderate and high ($\bar{x}$=45.25±33.5 mV) resistance. AL EMG activity showed a 13.1% change between low ($\bar{x}$=21.3±12.2 mV) and moderate ($\bar{x}$=24.1±15.5 mV) and 24.3% change between moderate and high ($\bar{x}$=29.3±22.2 mV) resistance.
CONCLUSIONS: These findings suggest that EMG activity, particularly AL activity, may exceed the proportionate increase in band tension. In addition, band tension and EMG activity appear to be muscle and/or movement specific.

1307 Board #100 May 28, 9:00 AM - 10:30 AM

The Relationship Between Hip Extensor Strength, Jump Height and External Hip Flexion Moments During Jumping

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(No relationships reported)

External hip flexion moments have been reported as the biomechanical variable most predictive of maximal jump height (MJH) during a drop vertical jump, however, this relationship has not yet been established during more basketball-specific tasks, such as a one-step countermovement jump (CMJ). Additionally, the extent to which the strength of the hip extensors influence external hip flexion moments and MJH during a one-step CMJ are unknown. Identifying the relationship between MJH, external hip flexion moments, and hip extensor strength during a one-step CMJ may be valuable to optimize MJH performance.
PURPOSE: To identify the relationship between MJH, external hip flexion moments, and hip extensor strength during a one-step CMJ.
METHODS: Twenty-three Division-1 collegiate basketball players (11M, 12F) participated in the study. Established 3D motion analysis techniques were utilized to collect three trials each of a one-step CMJ while leading with the preferred and non-preferred jumping leg. Hip extensor strength was measured as the average of the middle 3 of 5 isokinetic, concentric hip extensor strength trials performed at 60º/sec and normalized to body mass. Pearson product-moment correlations were performed to identify relationships between MJH, external hip flexion moment and hip extensor strength (p<0.05).
RESULTS: There was a significant positive correlation between MJH and external hip flexion moment of both legs measured during the one-step CMJ when leading with the preferred (Lead: r=0.90, p=<0.001; Trail: r=0.66, p=0.001) and non-preferred (Lead: r=0.85, p=<0.001; Trail: r=0.53, p=0.01) jumping leg. Concentric hip extensor strength was not significantly correlated to either MJH or external hip flexion moment.
CONCLUSIONS: External hip flexion moments explain up to 81% of the variance of MJH values during a one-step CMJ, yet concentric hip extensor strength measured at 60º/sec was not related to MJH or hip flexion moments. Further examination of hip extensor function (e.g. activation, strength at higher speeds) may warrant further investigation.

1308 Board #101 May 28, 9:00 AM - 10:30 AM

Joint-Specific Kinetic Adjustments Following Landing Height Manipulations

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Landing from a jump or elevated surface is a common mechanism of injury. Contrasting lower extremity adjustments in response to landing height alterations may highlight factors related to injury.
PURPOSE: The purpose of the study was to examine changes in lower extremity sagittal joint moment variability following landing height manipulations. Joint-specific adjustments were investigated via principal component analysis (PCA).
METHODS: Ten healthy volunteers (4M, 6F; 21.5±2.3y, 1.71±0.12m, 66.3±11.7kg) provided institutionally approved consent prior to participation. Subjects completed 5 landing trials from 3 heights, computed as percentages of maximum vertical jump height (60%, 100%, 140% MVJH). Data were acquired using dual force platform (Kistler 9281CA, 9281B; 2000Hz) and 12-camera motion capture systems (Vicon MX-T40S; 200Hz). Sagittal internal joint moments (hip, knee, ankle) were normalized to body mass (Nm/kg) and temporally normalized (101 data points) from ground contact to the point vertical center of mass velocity reached zero. Separate analyses were performed at the hip, knee, and ankle joints, extracting principal components (PCs) providing 95% cumulative explained variance. One-way ANOVAs and pairwise comparisons identified PCs demonstrating differences among landing condition PC scores (α=0.05; Bonferroni post-hoc adjustments). PC loading vectors were visually examined for sources of variation captured by each PC that showed differences among conditions.
RESULTS: The number of extracted PCs identified a proximal to distal decrease among joints (hip: 8 PCs, knee: 6 PCs, ankle: 4 PCs). Differences among landing height PC scores were detected in PC1 at the hip (140% > 60%) and PC2 at the knee and ankle joints (140% & 100% > 60%; p<.05). At the hip, PC1 loading vector identified a peak flexor moment from 0-10% of landing and peak extensor moment from 10-30% of landing. At the knee, PC2 loading vector identified bimodal extensor moments from 0-10% and 10-40% of landing, while PC2 loading vector at the ankle captured a peak plantarflexor moment from 0-30% of landing.
CONCLUSIONS: Joint-specific adjustments were observed across landing heights. The availability of contrasting motor solutions expressed via PCA may highlight important considerations for factors related to landing injuries.