

TRANSCUTANEOUS STIMULATION FOR THE DEVELOPMENT OF STRENGTH, POWER, AND TIME TO PEAK POWER

349 M.P. Venable*, H.S. O'Bryant*, M.A. Collins, M.J. Sedivec*, and C.R. Denegar. Biomechanics/Kinesiology Lab., Appalachian State University, Boone, NC 28608

The purpose of this study was to determine if short-term weight training (WT) supplemented with electrical muscle stimulation (EMS) increases strength and power more than WT alone. Thirty-three subjects (aged 18 - 30) were divided into three groups: EMS and WT (ES) $n = 13$, WT only (WO) $n = 12$, and control (C) $n = 8$. The WT consisted of lifting free weights 3 days per week for 5 weeks. The ES group was also supplemented with EMS of the quadriceps three times per week. Muscular strength (MS) was assessed using a one-repetition maximum squat. To assess ballistic power (BP) vertical jump scores were converted to power using the Lewis formula and also a modified Wingate test was used to determine peak power (PP) and time to peak power (TPP). The ES (20.6%) and WO (20.7%) groups increased significantly ($p < .05$) in MS, but not the C group. Both the ES (3.1%) and WO (5.2%) groups increased significantly ($p < .05$) in BP, but not the C group. However, the WO group had a larger gain ($p < .05$) in BP than the ES group. There were no significant changes ($p > .05$) in PP or TPP for the ES, WO, or C groups. In conclusion short-term WT supplemented with EMS does not appear to enhance strength and/or power gains over WT alone.

TORQUE ACCELERATION ENERGY AS AN ALTERNATIVE PREDICTOR OF ANAEROBIC POWER

350 S.M. Lephart, D.H. Perrin, J.M. Manning, J.H. Gieck, F.C. McCue III, E.N. Saliba. Sports Medicine Research Lab., University of Virginia, Charlottesville, VA 22903

The relationship between anaerobic power and its role in athletic performance is well documented. Further, various measures of anaerobic power have been found to be interchangeable. The relationship between torque acceleration energy (TAE) (work performed in the initial 1/8 second of contraction) and traditional measures of power has not been examined. The present study examined the relationship between TAE, average power (AP), the Margaria-Kalamen stair climbing test (M-K), and vertical jump (VJ) in 25 intercollegiate lacrosse players (\bar{x} age-20.3 yrs., \bar{x} ht.-181.95 cm, \bar{x} wt.-83.55 kg). TAE (Nm) and AP (watts) measures were obtained for the knee extensor muscle group at 270°/s with the Cybex II isokinetic dynamometer. M-K and VJ data were converted to Kg-M/s. Regression analysis indicated that TAE correlated significantly ($p < .01$) with M-K, AP and VJ. Highest correlations were found for TAE and M-K ($r = .73$, SEE = 12.89), followed by TAE and AP ($r = .54$, SEE = 33.48), and TAE and VJ ($r = .53$, SEE = 15.39). It was concluded that TAE may be used as a determinant of anaerobic power and may be a preferable index of anaerobic power in some athletic populations.

RELATIONSHIP BETWEEN MAXIMAL ISOKINETIC AND ISOMETRIC TORQUES

351 S.G. Aitkens, M.A. McCrozy*, and E.M. Bernauer, FACSM. Dept. of Physical Medicine and Rehabilitation, University of California, Davis, CA 95616

Nineteen subjects (5 males, 14 females) were tested for both isokinetic and isometric knee extensor strength to investigate the relationship between the two methods of strength assessment. Subjects were tested isokinetically on a LIDO Digital Isokinetic System by performing six maximal knee extension/flexion repetitions at a speed of 60 deg/sec. The highest peak torque and corresponding joint angle for knee extension were identified. Following a two minute rest, subjects performed three maximal isometric trials using a force transducer with the joint position fixed at the joint angle at which peak isokinetic torque was produced. Mean isokinetic peak torque values for the right and left legs were 115.4±31.7 ft lbs and 112.0±30.3 ft lbs. Corresponding mean isometric peak torque values were 136.0±37.5 ft lbs and 132.6±40.4 ft lbs respectively. A Pearson product-moment correlation revealed the two strength measures to be highly related for both the right ($R = .75$) and left ($R = .79$) legs. These data support the conclusion there is a positive relationship between isokinetic strength as measured by the LIDO system and isometric strength as measured by force transducer.

Supported by NIMR Grant # G0008300078.

ISOKINETIC WORK COMPARED TO PEAK TORQUE AS A MEASURE OF FATIGUE

352 M.A. D'Arche*, E.A. Reynolds*, J.E. Zachazewski, G.A. Wolfe, and S.J. Stuckey*. School of Physical Therapy, Children's Hospital of Los Angeles/Chapman College, Orange, CA 90027

The purpose of this study was to compare the decrease in peak torque (PKTQ) to the decrease in work output (WO) of the quadriceps muscles during isokinetic exercise as measures of muscular fatigue. Sixteen male and 16 female volunteers were tested on a Cybex II® isokinetic dynamometer at 180° s⁻¹ for 55 repetitions. Results obtained following statistical analysis of the data indicated the following: 1) PKTQ declined signif. ($p < .05$) in the first rep. following the initial contraction (defined as the contraction with the highest PKTQ reading within the first five reps.); 2) WO declined signif. between reps. 2-9 following the initial contraction; 3) PKTQ and WO fatigue curves were related to initial strength and exhibited linear and quadratic components; 4) changes in PKTQ accurately reflected changes in WO as the quadriceps muscles fatigued. Based on these results PKTQ and WO can be used interchangeably as measures of muscular fatigue in normal individuals.

Supported by Grant 86-7 from the California Physical Therapy Fund, Inc., California Chapter, APTA.

MUSCLE ACTIVATION DURING PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF) STRETCHING TECHNIQUES

353 L. Ostermig, R. Robertson, R. Troxel, and P. Hansen. Biomechanics/Sports Med. Lab., Univ. of Oregon, Eugene, OR 97403

Proprioceptive neuromuscular facilitation (PNF) techniques are often used to induce muscle relaxation and increase joint range of motion (ROM). However, the relationship between muscle activation and ROM with PNF is not well understood. The purpose of this study was to investigate the effect of three common PNF stretching techniques on hamstring muscle activation and knee extension. Three PNF techniques: stretch-relax (SR), contract-relax (CR) and agonist contract-relax (ACR) were applied to ten male and female subjects aged 23-36 yr who were stabilized to isolate knee extension measurements. Knee joint position and EMG activity from quadriceps and hamstring muscles were computer processed throughout technique application. The results revealed mean hamstring EMG activity increased 8-43% within a given trial of CR and ACR respectively, and did not diminish across trials. SR produced a 11% decrease in mean hamstring EMG activity. ACR produced 3-6% greater knee extension values than CR and SR respectively, in spite of 71-155% greater hamstring EMG activity during ACR. The data suggest that CR and ACR do not evoke sufficient relaxation in muscles opposing knee extension to overcome tension facilitation generated by stretch. Thus, increases in ROM are achieved while the hamstrings are under considerable tension. Such tension increases muscle vulnerability to soreness and strain if stretching continues. The degree of knee extension produced via SR, although 4-6% less than CR and ACR, was achieved during simultaneous reduction in hamstring activity and may be the safer stretching technique.

COMPARISON OF THREE METHODS OF ASSESSING STRENGTH IMBALANCES AT THE KNEE.

354 Karen D. Nunn, J. L. Mayhew, Human Performance Laboratory, Northeast Missouri State University, Kirksville, MO 63501.

Three strength measurement methods for determining muscle imbalances at the knee were compared in 24 male athletes. Peak quadriceps (Q) extensions and hamstring (H) flexions were measured isotonically (IT), isometrically (IM), and isokinetically (IK). IK measurement was performed on a Cybex II at 60, 180, and 300 deg/sec. IM extension and flexion were also performed on a Cybex II at 69 and 18 deg, respectively. IT measurements were done on Nautilus apparatus. Test, leg, and movement order were randomized to avoid a treatment order effect. Repeated measures ANOVA revealed no significant difference ($F = 1.54$) among the 3 methods for bilateral imbalance ratio measurement. However, H/Q ratios were significantly ($F = 32.03$) greater when measured IK than when measured by the other methods. H/Q ratios recorded at 300 deg/sec were significantly greater than those recorded at 60 and 180 deg/sec. Individual determinations of excess bilateral imbalances (>10%) were not consistent across methods. Strength measurement methods are not interchangeable when determining imbalance ratios at the knee. Problems may arise when identifying safety limits from muscle testing using different methods.