523 EFFECTS OF FREE WEIGHT AND HYDRAULIC RESISTANCE TRAINING EVALUATED BY FREE WEIGHTS AND HYDRAULIC AND ISOKINETIC TESTS.

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Three testing modes were used pre, twice during, and post training to compare the effects of training with free weights (N=16) and hydraulic resistance exercise (N=12). Training included 4 to 6 sets of 3 to 6 reps of supine bench press (BP) and upright squat (SQ) $3 \cdot wk^{-1} \cdot 13$ wks. A control group did not train (N=10). Testing included 1-rep maximum without a prestretch using free weights for BP and SQ, peak force and rep power for BP assessed on an Omnitron dynamometer (Hydra-Fitness, Belton, TX), and isokinetic peak force and peak power for BP and SQ at $5° \cdot s^{-1}$ (Ariel 2000, Trabuco Canyon, CA). Repeated measures ANOVA showed increases in all variables and no between group differences ($p>.05$). Significant interactions were found for testing modes, free weight BP and SQ, and isokinetic/hydraulic force and power ($p<.05$). No changes occurred for the control group ($p>.05$). Pre to post test % changes were:

	FREE WEIGHT TEST		ISOKINETIC TEST				HYDRAULIC TEST	
Groups	SQ(N)	BP(N)	SQ(V)	SQ(V)	BP(N)	BP(V)	BP(N)	BP(V)
Free Weight	36%	17%	9%	24%	9%	23%	7%	13%
Hydraulic	38%	10%	12%	28%	6%	12%	9%	13%

The results demonstrate that 13 weeks of free weight and hydraulic resistance training does not produce similar changes in maximum force and peak power, and that improvements occur independent of training mode.

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524 COMBINED STRENGTH AND ENDURANCE TRAINING EFFECTS ON MUSCLE ENZYMATIC AND HISTOCHEMICAL CHARACTERISTICS.

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Previous studies suggested that combined strength and endurance training (ComTr) impairs the rate of performance adaptations, compared with the adaptation rate to a single training method. This study evaluated ComTr effects on muscle enzyme activities, fiber areas and capillarization. Subjects were divided into 2 groups of 8: S-Comb strength-trained one leg and did ComTr with the other leg; E-Comb endurance-trained one leg and did ComTr with the other leg. Strength training was unilateral leg presses, 6 sets, 15 RM/set. Endurance training was five 3-min bouts of unilateral cycle exercise at 90-100% $\dot{V}O_2$max. The vastus lateralis of each leg was biopsied before and after training three times weekly for 20 weeks. CS, PFK, and/or LDH activities increased by up to 50% ($p<0.01$). Mean fiber area increased by 17% in both legs of S-Comb, but no change was observed in either leg of E-Comb. Inter-leg comparisons of enzymatic, fiber area and capillary density changes did not support the hypothesis that ComTr impairs cellular adaptations normally associated with engaging in a single type of training.

525 INVESTIGATION OF EXERCISE EFFECT OVERFLOW FROM SPEED-SPECIFIC ISOKINETIC ACTIVITY

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The concept of physiologic overflow during speed-specific isokinetic exercise was tested on 30 volunteers, 14 female, 16 male; mean age 24.5 yrs; age range 17-29 yrs, who were subjected to a repeated measures experimental design. Testing involved 5 repetitions of knee extension/flexion at the velocity spectrum speeds of 60, 120, 180, 240 and 300 deg/sec preceded by a warm-up of 3 gradient submaximal repetitions and 1 maximal effort at each speed. The experimental treatment consisted of isokinetic exercise of the knee musculature to the level of 50% quadriceps fatigue at the speed of 180 deg/sec in a format of 3 sessions per week over a period of 8 weeks. ANOVA testing ($p=.01$) with repeated measures revealed statistically significant differences in quadriceps and hamstrings function for peak torque, torque acceleration energy, and watts average power at all velocity spectrum speeds over the period of experimentation. It was concluded that a ±120 deg/sec physiologic overflow of exercise effects to both slower and faster speeds existed during the program of isokinetic activity. This information would be important for the clinical design of rehabilitation programs.

526 SPECIFICITY OF ISOKINETIC TRAINING ON QUADRICEP AND HAMSTRING PEAK TORQUE, TORQUE ACCELERATION ENERGY, POWER, AND WORK IN INTERCOLLEGIATE LACROSSE PLAYERS

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The effect of high speed isokinetic training on peak torque (PT) has been documented. Lesser attention has been given to changes in torque acceleration energy (TAE), average power (AP), and total work (TW) with high speed isokinetic training. The present study examined the effect of high speed isokinetic training on knee extension (KE) and knee flexion (KF) PT, TAE, AP, and TW in intercollegiate lacrosse players (8 experimental (E), 9 control (C), randomly assigned; $\bar{X}$ age-19.1 yrs., $\bar{X}$ ht.-182.2 cm., $\bar{X}$ wt.-84.4 kg.). Training of right and left KE and KF consisted of 3 sets of 25 repetitions at 270 °/s, 3 days per week for 7 weeks on an orthotron isokinetic dynamometer. Subjects were pre- and post-tested for right and left KE and KF PT at 60, 180, and 270 °/s, and TAE, AP and TW at 270 °/s with a Cybex isokinetic dynamometer. Analysis of variance revealed a significant training effect for KE PT ($p<.05$) (ΔE vs ΔC $\bar{X}$ diff.-18.93 Nm), TAE ($p<.05$) (ΔE vs ΔC $\bar{X}$ diff.-7.10 Nm), AP ($p<.01$) (ΔE vs ΔC $\bar{X}$ diff.-64.24 watts), and KF TAE ($p<.05$) (ΔE vs ΔC $\bar{X}$ diff.-7.03 Nm) at 270 °/s. No significant differences were observed for KE or KF PT at 60 or 180 °/s. It was concluded that increases in PT resulting from high speed isokinetic training were associated with increases in TAE and AP. It was further concluded that increases in PT were specific to training velocity.

527 EQUIVALENT CHANGES IN $\dot{V}O_2$ MAX AND PERCENT BODY FAT SUBSEQUENT TO CONTINUOUS AND INTERVAL TRAINING

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Forty male subjects, ranked in order of their relative $\dot{V}O_2$ max values, were assigned to one of the following four groups by the technique of stratified randomization so as to equalize their initial fitness level: (1) control group, CG (2) continuous training group one, CTG1 (3) continuous training group two, CTG2 and (4) interval training group, ITG. The training intensities were regulated as follows: CTG1 - 10% above the first ventilatory threshold (power output at which $\dot{V}_E/\dot{V}O_2$ reaches a minimum); CTG2 - between the first ventilatory threshold and $\dot{V}O_2$ max; ITG - 100% $\dot{V}O_2$ max with work: rest intervals of one minute each. Training power output was equated for the three training groups during the eight week program. After 24 training sessions, all three training groups showed similar increases in $\dot{V}O_2$ max ($p<.01$) and similar decreases in percent body fat ($p<.05$). The CG did not show any changes during this period. The hypothesis that the different intensities and methods of training will induce equivalent changes in $\dot{V}O_2$ max but differential changes in percent body fat provided the total amount of work accomplished was equated was not substantiated. It appears that short term interval training is just as effective as continuous training in eliciting changes not only in $\dot{V}O_2$ max, but also in percent body fat.

528 DIFFERENTIAL CHANGES IN LEG FUNCTION CONSEQUENT TO LOW, MODERATE, AND HIGH REPETITION WEIGHT TRAINING.

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The functional effects of three weight training programs were compared in 38 untrained men. Dependent variables were isotonic squat strength, isokinetic knee extension and flexion peak torque at both 60°/sec and 300°/sec, and vertical jump. After pretesting, subjects were randomly assigned to one of three exercise groups or to a sedentary control group. For 7 weeks, 3 days per week, each exercise group completed one of the following training routines: Group I, 4 x 3 - 5 repetitions maximum (RM); Group II, 4 x 13 - 15RM; Group III, 23 - 25RM. Group IV remained inactive. Squat strength increased significantly ($p<.001$) in Groups I and II as compared to the control, while Group I also increased significantly more ($p<.05$) in the squat than Group III. Knee extension peak torque at 60°/sec increased significantly ($p<.01$) in all three exercise groups when compared to the control. No significant differences ($p>.05$) were found between the groups for changes in any of the other dependent variables. These results indicate that short-term squat weight training programs do little to enhance functional abilities of the legs as measured in this study except for squat strength and slow-speed isokinetic peak force.