

Electrostimulation for Sport Training
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The effects of electromyostimulation training and basketball practice on muscle strength and jumping ability;

Maffiuletti NA, Cometti G, Amiridis IG, Martin A, Pousson M, Chatard JC
Int J Sports Med. 2000 Aug;21(6):437-43

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The aim of this study was to investigate the influence of a 4-week electromyostimulation training program on the strength of the knee extensors and the vertical jump performance of 10 basketball players. Electromyostimulation sessions were carried out 3 times weekly; each session consisted of 48 contractions. Testing was carried out before and after the electromyostimulation training program (week 4) and once more after 4 weeks of normal basketball training (week 8). At week 4, isokinetic strength increased significantly ($p < 0.05$) at eccentric and high concentric velocities (between 180 and 360 $\times s(-1)$); this was not the case for low concentric velocities (60 and 120 degrees $\times s(-1)$). Electromyostimulation training increased also isometric strength at the two angles adjacent to the training angle ($p < 0.01$). Squat jump increased significantly by 14% at week 4 ($p < 0.01$), whereas counter movement-jump showed no change. At week 8, gains in isokinetic, isometric strength and squat-jump performance were maintained and the counter movement jump performance increased significantly by 17% ($p < 0.01$). Electromyostimulation as part of a short strength-training program enhanced knee extensor strength and squat jump performance of basketball players.

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Electrostimulation training effects on the physical performance of ice hockey players

Brocherie F, Babault N, Cometti G, Maffiuletti N, Chatard JC;
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PURPOSE: The aim of this study was to examine the influence of a short-term electromyostimulation (EMS) training program on the strength of knee extensors,

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skating, and vertical jump performance of a group of ice hockey players. **METHODS:** Seventeen ice hockey players participated in this study, with nine in the electrostimulated group (ES) and the remaining height as controls (C). EMS sessions consisted of 30 contractions (4-s duration, 85 Hz) and were carried out 3x wk for 3 wk. Isokinetic strength of the knee extensor muscles was determined with a Biodex dynamometer at different eccentric and concentric angular velocities (angular velocities ranging from -120 to 300 degrees .s). Jumping ability was evaluated during squat jump (SJ), countermovement jump (CMJ), drop jump (DJ), and 15 consecutive CMJ (15J). Sprint times for 10- and 30-m skates in specific conditions were measured using an infrared photoelectric system. **RESULTS:** After 3 wk of EMS training, isokinetic torque increased significantly ($P<0.05$) for ES group in eccentric (-120 and -60 degrees .s) and concentric conditions (60 and 300 degrees .s), whereas vertical jump height decreased significantly ($P<0.05$) for SJ (-2.9 \pm 2.4 cm), CMJ (-2.1 \pm 2.0 cm), and DJ (-1.3 \pm 1.1 cm). The 10-m skating performance was significantly improved (from 2.18 \pm 0.20 to 2.07 \pm 0.09 s, before and after the 3-wk EMS period, respectively; $P<0.05$). **CONCLUSION:** It was demonstrated that an EMS program of the knee extensors significantly enhanced isokinetic strength (eccentric and for two concentric velocities) and short skating performance of a group of ice hockey players.

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Effects of electromyostimulation training and volleyball practice on jumping ability

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J Strength Cond Res. 2003 Aug;17(3):573-9

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The aim of this study was to investigate the influence of a 4-week electromyostimulation (EMS) training program on the vertical jump performance of 12 volleyball players. EMS sessions were incorporated into volleyball sessions 3 times weekly. EMS consisted of 20-22 concomitant stimulations of the knee extensor and plantar flexor muscles and lasted approximately 12 minutes. No significant changes were observed after EMS training for squat jump (SJ) and counter movement jump (CMJ) performance, while the mean height and the mean power maintained during 15 seconds of consecutive CMJs significantly increased by approximately 4% ($p < 0.05$). Ten days after the end of EMS training, the jumping height significantly ($p < 0.05$) increased compared with baseline also for single jumps (SJ +6.5%, CMJ +5.4%). When the aim of EMS resistance training is to enhance vertical jump ability, sport-specific workouts following EMS would enable the central nervous system to optimize the control to neuromuscular properties.

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Effects of neuromuscular electrical stimulation on static and dynamic abdominal strength and endurance in healthy males

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Neuromuscular electrical stimulation (NMES) has reportedly increased quadriceps femoris isometric strength by 20-25% over a 28-35 day period (Currier and Mann, 1983; Balogun et al., 1993). Lower abdominal strength is important for stability of the lumbar spine and pelvis during exercise, and it is postulated that limb musculature efficiency is increased when the lumbar spine and pelvis are stable. Weak lower abdominal muscle may lead to compensatory action by other muscle groups, which may become prone to injury as a result. The aims of this study were to investigate the effects of a NMES program on static and dynamic abdominal strength and endurance. Subjects were 16 male volunteers, 10 were randomised to the stimulation group and 6 served as control. All subjects underwent medical examination pre-randomisation to out-rule abdominal musculature insufficiency. Static isometric strength (MVC in N) and endurance (time to exhaustion at 66% MVC in s) at hip angles of 0 and 10° were assessed using a calibrated 500 kg load cell and strain gauge amplifier and interfaced to a MacLab data recording system on a purpose built test-bed. Dynamic endurance was assessed using the incremental abdominal curl conditioning test, data (in s) were recorded as time to volitional exhaustion. Abdominal skinfold thickness (sum of 4 transverse abdominal sites in mm) were recorded using a Harpenden skinfold callipers, lower abdominal girth (cm) was recorded using a tape measure. Data were collected pre-randomisation (day 0) and at 14, 28 and 42 days postrandomisation. The stimulation group underwent 30 min daily muscle stimulation (intermittent stimulation 15s on-15s off) pulse width 250 (s, frequency 50Hz for 42 days, the control group undertook no specific abdominal training). All post-randomisation static endurance tests at hip angles 0 and 10° were at a force equivalent to 66% of the individual MVC recorded on day 0. Results across time were analysed using ANOVA for repeated measures. Values of $P < 0.05$ were considered statistically significant. Post-hoc analysis of significant differences were investigated using the Student-Newman-Keuls multiple comparison test. Day 0 data across groups were compared using the Welch test. No significant between group differences were observed pre-randomisation. Results across time showed that the stimulation group increased significantly ($P < 0.01-0.001$) in terms of both static (0 and 10°) and dynamic endurance, and static isometric strength (0 and 10°) following 28 days NMES. At day 28, mean \pm SEM increase in static strength were (131 ± 30 and 107 ± 29 N, in static endurance were 47 ± 15 and 45 ± 14 s at 0 and 10° respectively, increase in dynamic endurance was 42 ± 9 s. For static strength and endurance, no significant increases across time were observed for the control group, except for endurance at 10° ($P < 0.01$) at day 28

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and 42 compared with pre-randomisation, mean increase were 52 ± 14 and 62 ± 15 s, dynamic endurance showed no significant increase across time. No significant changes were recorded across time for either group for abdominal girth or skinfold thickness. For the muscle stimulation group at day 28, mean increases in isometric strength were equivalent to 28 and 17%, in isometric endurance to 154 and 114% at 0 and 10° respectively, mean increase in dynamic endurance was equivalent to 33%. The significant increases recorded in the muscle stimulation group support the hypothesis that NMES can cause an increase in the strength and endurance of the abdominal musculature. The percentage increases recorded were of a similar order of magnitude to that reported by Balogun et al. (1993) for the quadriceps femoris. From a longitudinal viewpoint our data suggests that the increases tend to plateau after 28 days.

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