Effects of EMS training

Scientific literature collection

EN

Literature collection selected and summarised by Prof. Dr. Dirk Fritzsche

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Maximum strength and muscle hypertrophy

- Trained athletes from various disciplines experienced increases in maximum isometric strength of between 15% and 40%, with an average of 32.6% (5, 6, 7, 9, 22, 24, 27).
- The average improvement in maximum isometric strength following EMS training with untrained subjects was 23.5% (1, 2, 3, 4, 8, 10, 11, 14, 15, 16, 18, 19, 20, 21, 25, 28).
- Athletes can achieve 30 - 40% improvements in maximum strength after only 5 weeks using EMS (12).
- Using MVC, competitive swimmers achieved improvements in the eccentric and concentric contractions of their latissimus dorsi and quadriceps femoris muscles and better freestyle swimming times (23).
- Case study of a high-performance weightlifter: 4 months of EMS training: 1 RM (repetition maximum) increased during squats by around 20kg, further improvements to 'snatch' and 'clean and jerk'.
- EMS can also be provided to untrained people and those looking to get fit: muscle size increased by around 10% after 8 weeks using isokinetic training (eccentric and concentric) combined with EMS (26, 29).
- Mixed training (hypertrophy using machines) combined with EMS was shown to have the greatest effects on maximum strength (13).

Selected literature:

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Elasticity and performance

- Various authors have confirmed a positive effect on contraction speed (1, 3, 5).
- The EMS training group saw the greatest gain in movement speed (approx. 30% improvement in muscles involved in bending bones), thus significantly increasing performance (4, 6).
- A combination of classic strength training (hypertrophy) and EMS training increases both performance elements (movement speed and power), (4,6).

Selected literature:

1. Andersen, L.L., & Aagaard, P. (2006). Influence of maximal muscle strength and intrinsic muscle contractile properties on contractile rate of force development. Eur J Appl Physiol, 96, 46-52.
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Sprinting and jumping

- The sprint studies showed improvements in competitive athletes of 3.1±1.7% over a 3-week period.
- Brocherie et al. (2) improvement of 4.8% in the sprint time of ice hockey players over 10m.
- Pichon et al. (9) improvement of 1.3% to cover 25m (sport type: swimming) and 1.45% for the 50m freestyle time.
- With combined strength training (plyometrics/EMS), Herrero et al. recorded (3) a 2.3% reduction in time needed to sprint 20m among untrained individuals.
- After EMS training, jumping abilities improved by between 2.3% and 19.2%; after isometric EMS training (an average of +10±6.5%); and 6.7% to 21.4% after dynamic EMS training (1, 4, 5, 7, 8, 13).
- After combined EMS training, the literature states that there was an average increase in jumping ability of 11.2±5.5% (3, 6, 11).

Selected literature:

1. Babault, N., Cometti, G., Bernardin, M., Pousson, M. &Chatard, J.-C. (2007). Effects of Electromyostimulation Training on Muscle Strength and Power of Elite Rugby Players. Journal of Strength and Conditioning Research, 21(2), 431-437.
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Endurance

- Static endurance: the average increase is 30.3% at an average stimulation frequency of 75 +/- 44 Hz. (1, 2, 3)
- Dynamic endurance: the average increase is 41% at an average stimulation frequency of 76 Hz +/- 10 Hz (2, 4, 5, 7).
- Long-term stimulation with low frequency stimulation of skeletal muscle in experiments on animals (rabbits) resulted in the development of mainly slow twitch muscle fibres with a high proportion of mitochondria (6).

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Prevention of sarcopenia and demineralisation of bones

- Increasing bone density
- Prevention of age-related fractures, particularly vertebrogenic compression fractures
- Alleviation of osteoporosis
- Optimisation of fat distribution and body fat/muscle ratio

Selected literature:

1. Effekt von Ganzkörper-Elektromyo -stimulation – „A series of studies“ Eine alternative Trainingstechnologie zur muskuloskelettalen Prävention bei älteren Menschen Osteologie 1/2015, S. 3-17 W. Kemmler; M. Teschler; S. von Stengel Institut für Medizinische Physik, Friedrich-Alexander Universität Erlangen-Nürnberg
2. Whole-Body Electromyostimulation to Fight Osteopenia in Elderly Females: The Randomized Controlled Training and Electrostimulation Trial (TEST-III) Simon von Stengel, Michael Bebenek, Klaus Engelke, andWolfgang Kemmler Institute of Medical Physics, University of Erlangen-N¨urnberg, 91052 Erlangen, Germany Journal of Osteoporosis Volume 2015, Article ID 643520, 7 pages
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Performance, stamina; oxygen consumption at the anaerobic threshold; maximal oxygen uptake

- EMS training leads to an increase in maximal oxygen consumption or oxygen uptake at the anaerobic threshold (at) of 22-37%.
- Vo2max; VO2 at 22-37%
- EMS training leads to an increase in maximum strength and/or performance at the anaerobic threshold (at) by up to 32%.
- Watt max; Watt at 32%
- EMS leads to an increase in the cardiac ejection fraction (EF) of 8%

Selected literature:

1. Elektromyostimulation (EMS) bei kardiologischen Patienten. Wird das EMS-Training bedeutsam für die Sekundärprävention? Dirk Fritzsche, Andreas Fruend1, Sören Schenk1, Klaus-Peter Mellwig2, Heinz Kleinöder3, Jan Gummert1, Dieter Horstkotte2 Herz 35 · 2010 · Nr. 1 © Urban & Vogel
2. Electrical myostimulation improves left ventricular function and peak oxygen consumption in patients with chronic heart failure: results from the exEMS study comparing different stimulation strategies Frank van Buuren • Klaus Peter Mellwig • Christian Prinz • Britta Korber • Andreas Frund • Dirk Fritzsche • Lothar Faber • Tanja Kottmann •Nicola Bogunovic • Johannes Dahm • Dieter Horstkotte Received: 17 November 2012 / Accepted: 3 April 2013 Clin Res Cardiol DOI 10.1007/s00392-013-0562-5
3. Elektromyostimulation (EMS) verbessert die Leistungsfähigkeit und die linksventrikuläre Funktion bei Patienten mit chronischer Herzinsuffizienz Frank van Buuren1, Klaus Peter Mellwig1, Christian Prinz1, Tanja Kottmann1, Britta Körber1, Andreas Fründ1, Lothar Faber1, Nicola Bogunovic1, Johannes Dahm3, Dieter Horstkotte1, Dirk Fritzsche PERFUSION 2013; 26: 76–84
4. Elektromyostimulation: Verbesserung von Lebensqualität, Sauerstoffaufnahme und linksventrikulärer Funktion bei chronischer Herzinsuffizienz. F. van Buuren, D. Horstkotte, Dirk Fritzsche Rehabilitation 2014; 53: 321-326

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