

# Effects of EMS training

## Scientific literature collection

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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).

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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-Elektromyostimulation – „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, and Wolfgang Kemmler Institute of Medical Physics, University of Erlangen-Nürnberg, 91052 Erlangen, Germany *Journal of Osteoporosis* Volume 2015, Article ID 643520, 7 pages
3. Whole-body electromyostimulation as a means to impact muscle mass and abdominal body fat in lean sedentary, older female adults: subanalysis of the TEST-III trial *J. Clinical Interventions in Aging*, 10/2013 Wolfgang Kemmler, Simon von Stengel
4. Impact of whole-body electromyostimulation on body composition in elderly women at risk for sarcopenia: the Training and ElectroStimulation Trial (TEST-III) Wolfgang Kemmler, Michael Bebenek, Klaus Engelke, Simon von Stengel Received: 11 December 2012 / Accepted: 29 July 2013 AGE; American Aging Association 2013
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6. Ganzkörper-Elektromyostimulation zur Prävention der Sarkopenie bei einem älteren Risikokollektiv. Die TEST-III Studie Kemmler W, Engelke K, von Stengel S *Deutsche Zeitschrift für Sportmedizin* Jahrgang 63, Nr. 12 (2012)

## 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 Freund<sup>1</sup>, Sören Schenk<sup>1</sup>, Klaus-Peter Mellwig<sup>2</sup>, Heinz Kleinöder<sup>3</sup>, Jan Gummert<sup>1</sup>, Dieter Horstkotte<sup>2</sup> 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 Buuren<sup>1</sup>, Klaus Peter Mellwig<sup>1</sup>, Christian Prinz<sup>1</sup>, Tanja Kottmann<sup>1</sup>, Britta Körber<sup>1</sup>, Andreas Fründ<sup>1</sup>, Lothar Faber<sup>1</sup>, Nicola Bogunovic<sup>1</sup>, Johannes Dahm<sup>3</sup>, Dieter Horstkotte<sup>1</sup>, Dirk Fritzsche PERFUSION 2013; 26: 76–84
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**Content responsibility**

EMS GmbH

Windscheidstraße 21–23

D-04277 Leipzig

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