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SELECTED STUDIES OF WHOLE-BODYELECTROSTIMULATION

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3

Whole-body-electrostimulation (EMS-Training) to relieve back pain

(BOECKH-BEHRENS, W.-U. / GRÜTZMACHER, N. / SEBELEFSKY, J., unpublished diploma thesis, University of Bayreuth, 2002).

Objective

The aim of this study was to indentify the effects of a complex EMS-Training on back pain.

Methods

49 staff members (31 women, 18 men, average age 47 years) of the University of Bayreuth suffering from back pain voluntarily took part in this study. With the help of pre- and post questionnaires the frequency and intensity of back pain and also the general extent of discomfort, mood, vitality, body stability and body shape were determined.

The subjects performed two EMS-training sessions per week with a duration of 45 minutes (a total of 10 sessions) with following training parameters: Impulse duration 4 s, impulse interval 2 s, frequency 80 Hz, rise time 0 s, impulse amplitude 350 µs. Every training session started with a warm up period of 10-15 minutes in order to adapt to electrical stimuli and to set the individual impulse intensity for training. Within the following training program (about 25 minutes) the subjects performed different static exercise positions. To cool down the subjects performed a 5 minute relaxation program with following parameters: Impulse duration 1 s, impulse interval 1 s, frequency 100 Hz, rise time 0 s, impulse amplitude 150 µs.

Results

A decrease in back pain was observed in 88.7 % of the subjects. 38.8 % of these subjects reported a strong decrease in back pain and 41.9 % experienced a light improvement of the extent of discomfort. Also, the frequency and the intensity of back pain significantly decreased within the training period.
Furthermore, the EMS-Training showed following effects: 61.4 % of the subjects reported an improve of their general extent of discomfort, 75.5 % showed improvements in mood, 69.4 % noticed an increased vitality, 57.1 % of the men and 85.7 % of the women reported an increased body stability, 50 % of the subjects noticed positive body shaping effects and 75.5 % felt more relaxed after training.

Conclusion

The whole-body EMS-training counters back pain in a very effective way. The electrical stimulus obviously also activates the deeper muscle groups which are difficult to activate through conventional treatment methods.
EMS-training achieves therapeutic as well as preventive goals. Thus, the specific whole-body EMS-training offers a very effective and time-saving all-round-training to improve health.

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4

Whole-body electrostimulation (EMS) - an innovative method for the alleviation of urinary incontinence

(BOECKH-BEHRENS W.-U./SCHÄFFER, G., unpublished diploma thesis, University of Bayreuth, 2002).

Objective
The aim of this study was to indentify the effects of EMS-training on urinary incontinence.

Methods
49 subjects who suffered from back pain were examined in this study. With the help of pre and post questionnaires (GAUDENZ 1979) the existence, the type and the intensity of incontinence disorders was identified. 17 subjects (15 women, 2 men) with an average age of 47 years had a mostly light to medium type of urinary incontinence.
The subjects performed two EMS-training sessions per week with a duration of 45 minutes (a total of 10 sessions) with following training parameters: Impulse duration 4 s, impulse interval 2 s, frequency 80 Hz, rise time 0 s, impulse amplitude 350 µs. Every training session started with a warm-up period of 10-15 minutes in order to adapt to electrical stimulus and set the individual impulse intensity for training. Within the following guided training program (about 25 minutes) the subjects performed different static exercise positions. To cool down the subjects performed a 5 minute relaxation program with following parameters: Impulse duration 1 s, impulse interval 1 s, frequency 100 Hz, rise time 0 s, impulse amplitude 150 µs.

Results
64.7 % of the subjects showed an alleviation of urinary incontinence. 23.5 % were free of urinary incontinence afterwards, 24.4 % reported a reduction and 35.9 % showed no changes. These results are equal to the improvements reported after treatments of incontinence with specific local electrostimulation-therapies. (vgl. Eriksen 1987, Sebastio 2000, Salinas Casado 1990, Meyer, 2001).

Conclusion
The whole-body EMS-training offers an effective training method. EMS-training achieves therapeutic goals like the alleviation of incontinence and back pain disorders as well as preventive goals such as muscle gain, body shaping, improvements in mood, vitality, body stability and increase of the general performance.

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5

A comparison of the effects of three different strength training methods on maximal strength, strength endurance, body shaping, body perception and mood: Conventional strength training, maxxF and electrostimulation training

(BOECKH-BEHRENS, W.-U. / TREU, S., unpublished diploma thesis, University of Bayreuth, 2002).

Objective

The aim of this study was to indentify the effects of three different methods of strength training on maximal strength, strength endurance, body shaping, body perception and mood. Furthermore, an innovative method of electrostimulation-training was compared with a conventional strength training with machines and a strength training without machines (maxxF).

Methods

100 male students of sport science participated in this investigation. All subjects completed identical pre- and posttests where body circumferences, maximal strength and strength endurance were measured. With the help of questionnaires the mood and body perception were determined. According to the results of the pretests the subjects were randomized into 4 groups (n=25 subjects): EMS-training-group, conventional strength training-group, maxxF-training-group, control-group. The training groups trained twice a week over 6 weeks. The EMS-training was performed as group training (4 subjects) with following parameters: Training duration 25 minutes, including a 5 minute warm up and acclimatization and 20 minutes training program with high impulse intensity individual regulated according to the subjective perceived rate of exertion; impulse duration 8s (on-time), impulse interval 4s (off-time), frequency 80 Hz, rise time 0,3s, impulse amplitude 350µs.

The conventional training group performed a 3 set training for chest, leg extension and back muscles (m. latissimus dorsi) with maximal intensity (8-12 repetitions). The maxxF group performed exercises under bodyweight (lat-press when lying on the back, squats with on leg and push-ups) with 3 sets with a duration of 45s each.

Results

In Comparison the conventional strength training and the maxxF-training showed higher increases compared to the EMS-training (9-10% vs. 3% maximal strength; strength endurance 65-82% vs. 25%). The data of the tests showed that the body fat was very low (about 13 %) in the beginning and showed only little changes within the training period. Accordingly, the changes in body circumferences can be related to a gain of muscle mass. All training groups showed increases in circumferences: maxxF +3,13cm, conventional strength training +2,83cm, EMS-training +3,49cm. The highest increases were documented in gluts and leg muscles after EMS-training. The EMS-training group showed higher positive changes in body perception compared to the other groups.

Conclusion

Electrostimulation-training very intensively activates the majority of the muscles. Consequently, EMStraining can positively shape the body (gaining muscle mass and thus increasing the basal metabolic rate) within a short period of about 30 minutes duration per training session. An additional conventional strength training parallel to the EMS-training may compensate the lower increase in maximal strength.

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6

Effects of electrostimulation-training in combination with conventional strength training with machines

(BOECKH-BEHRENS, W.-U. / BENNER, D. / STÖTZEL, C., unpublished diploma thesis, University of Bayreuth 2003).

Objective

This investigation deals with the following question: Does a combination of EMS-training and conventional strength training with dumbbells or machines show higher increases in selected strength parameters than EMStraining alone?

Methods

74 students (27 female, 47 male, average age 21.7 years) were randomized into three training groups (group 1: n=26 (combined training, male), groups 2: n=27 (combined training, female), group 3: n=21 (conventional strength training)).Training period: 6 weeks, a total of 12 training sessions (45 min/session), training frequency twice a week. Group 1 and 2 performed one EMS-training session (impulse duration 8s, Impulse interval 4s, frequency 80 Hz, rise time 0,3s, impulse amplitude 350 µs, training duration 25 minutes) and one conventional hypertrophy-training session per week. Group 3 performed a conventional strength training twice a week.

Changes in strength (maximal strength and strength endurance), body weight, body fat, circumferences and mood factors were documented before and after the training period.

Results

The maximal strength increased 6-10%. Subjects showed increases in strength endurance of up to 117%. The results show that conventional strength training alone compared to combined training is slightly less effective.

Overall, the female subjects achieved higher strength gains compared to the male subjects (+13.2 % diff.). The subjects only showed slight changes in weight, body fat and circumference. 64 % of the men and 44 % of the women documented positive changes in muscle gain and body shape. 70 % of the men and 63 % of the women showed subjective improvements in performance.

Conclusion

The attempt to combine an EMS-training with a conventional strength training in order to connect the benefits of both methods shows positive effects and thus offers a successful method for enhancing strength. According to this the combined training achieved increases almost as high as reported with conventional strength training with exercise equipment and machines only. Besides this the subjects benefited of the positive effects of EMStraining such as an increased body stability and subjective improvements in body shape and performance. The results show that the female subjects achieved higher strength gains compared to the male ones in general.

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7

The training effects of a combined training, conventional strength training and electrostimulation-training

(BOECKH-BEHRENS, W.-U. / NIEWÖHNER, F./ WALZ, T., unpublished diploma thesis, University of Bayreuth 2003).

Objective

The aim of this study was to identify the sex-related training effects of a 6 week EMS-training combined with a fitness orientated strength training program with weight machines. The results of this study were compared to results of previous comparable investigations that exclusively performed EMS-training or conventional strength training.

Methods

28 women and 28 men with an average age of 46.2 years voluntarily participated in this experiment. The 56 untrained subjects performed one EMS-training session and one fitness orientated strength training session per week over 6 weeks. The data out of a parallel study investigating the effects of different strength training methods in strength trained subjects were taken for comparison. The EMS-training used the following parameters: Impulse duration 8s, impulse interval 4 s, frequency 80Hz, rise time 0.3s, impulse amplitude 350µs, training duration 25 minutes. As a control procedure maximal strength and strength endurance measurements were used and the body weight, body fat and body circumferences were measured. Furthermore, the subjective perceived health factors, performance, body perception and mood were documented with the help of questionnaires.

Results

The subjects showed increases in strength endurance of 41-51% in leg-press and 25-38% in lat-pull. In contrary, only a light increase was shown in maximal strength. The changes in body weight and body fat were significant.

The body circumferences significantly decreased in waist, hip and thigh. 86% of the men and 70% of the women reported an improved performance through training. 61% felt more flexible and 79% of the subjects reported an increased vitality. Over half of the subjects reported that they were in a better mood and more active after training. 90% of the men and 70% of the women reported that they felt tighter, stronger and more protected. 64% of the subjects noticed positive body shaping effects such as muscle gain and a tighter tissue.

In the beginning of this study half of the subjects suffered from back pain. 75% of them felt a reduction of back pain or were pain free after training.

Conclusion

The results show that a combined training (1x whole-body EMS-training session and 1x conventional strength training session with barbells or weight machines per week) is as effective as conventional strength training twice a week.

As shown in previous EMS-investigations, the positive effects of EMS such as the reduction of back pain and the strong sensed improvement in body stability were also documented in a similar way after a combined training.

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8

Electrical muscle stimulation as whole-body training – A multicenter study for the capability of whole-body training in the gym

(VATTER, J., University of Bayreuth, 2003; Publication AVM-Verlag Munich 2010, in print).

Objective

The aim of this work was to indentify in a field test if a whole-body training with electrical stimulation shows positive changes in strength, anthropometry, body perception, mood, general factors of health, back pain and incontinence.

Methods

134 subjects (102 women and 32 men, average age 42.5 years) voluntarily participated in this study. 6 weeks before and after training the subjects were interviewed, tested in 4 different gyms and were compared with a control group (n=10), age and gender. The tests determined the maximal strength, strength endurance, body weight, body fat and body circumferences, frequency and intensity of back pain and incontinence disorders as well as the general extent of disorder, mood, vitality, body stability and body shape.

A total of 12 training sessions (2 times per week) were performed with following training parameters: Impulse duration/impulse interval 4s/4s, 85 Hz, rectangular impulse, impulse amplitude 350 µs. After a 10-15 minute warm up for acclimatization the subjects performed a 25 minute training program with static exercise positions. The training ended with a 5 minute relaxation program (impulse duration 1s, impulse interval 1s, 100 Hz, rectangular impulse, impulse amplitude 150 µs).

Results

82.3 % of the subjects had less back pain after the study and 29.9 % were free of pain. The percentage of subjects with chronic pain reduced from 40.3 % before training to 9.3 % afterwards. 75.8 % reported an improvement in incontinence and 33.3 % were free of incontinence afterwards. The number of disorder cases significantly declined (about 50%). The maximal strength increased by 12.2 % and the strength endurance increased by 69.3 %. Women benefited more than men (13.6 % vs. 7.3 %). 18 subjects did not complete the training. The control group showed no changes.

The subjects showed only light changes in body weight and BMI. The body fat decreased by 1.4 % in the training group and increased about 6.7 % in the control group. Younger subjects lost more weight than older; there were no gender- or weight-related changes. The body circumferences of female subjects significantly decreased in chest (-0.7 cm), thigh (-0.4 cm), waist (-1.4 cm) and hip (-1.1 cm). Male subjects showed significant reductions in waist (-1.1 cm) with a gain in upper arms (1.5 cm), chest (1.2 cm) and thigh (0.3 cm) in the same time. The control group showed no reductions and gained in waist and hip.

The body perception in general improved. 83.0 % reported less hardening, 89.1 % noticed a higher stability and 83.8 % increased their performance. 86.8 % noticed positive body shaping effects. 90.0 % of the participants enjoyed the training. Training with higher intensities showed stronger improvements especially in patients with disorders but also increased muscle soreness.

Conclusion

Whole-body EMS-training offers a convincing training method for the reduction of back pain and incontinence.

The achieved strength gains are similar to those achieved with conventional strength training and in some cases they are even above. Body shaping and mood aspects are very attractive for women and men of all age groups. Consequently, whole-body EMS-training is an effective type of training that appeals to a wide spectrum of age groups.

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9

Optimizing strength training with electrostimulation – Analysis of selected physiological parameters

(Boeckh-Behrens, W.-U. / Erd, J., unpublished diploma thesis, University of Bayreuth 2005)

Objective

The main focus of this study was to determine the intensity of EMS-training compared to conventional strength training. Therefore, adequate methods for measuring muscle tension were tested. In addition, for the first time the physiological parameters lactate and heart rate were documented in connection with whole-body EMS and were compared to those of conventional training.

Methods

In two trials, a group of 4 male students (average age 24.3 years) and a group of 12 male students of sport science (average age 23.7 years) performed a 10 minute whole-body EMS program (impulse duration 4s, impulse interval 4s, frequency 80 Hz, rise time 0s, impulse amplitude 350µs) and a conventional strength training. To find an adequate method for measurement following methods were tested: Electromyography measurements, tension measurements with an oscilloscope, the determination of the subjective perception of contraction. Furthermore the lactate and heart rate were measured before training, after 5 and 10 minutes and 3 minutes after training.

Results

The electromyography and the oscilloscope are inadequate tools for measuring the muscle tension during EMStraining.

Interference effects of the current caused by EMS falsify the data for the measured muscle tension.

During an intensive 10-minute training it was determined that the EMS training device worked at a current of about 30 V and an impulse intensity of about 40 mA.

The subjectively perceived rate of contraction is an adequate method for rating the training intensity.

The current also dissipates into the surrounding area and does not only flow between two pairs of EMSelectrodes.

The use of two electrode pairs compared to only one pair results in a subjectively perceived intensification of the muscle contraction. A parallel increase of EMG-activity was not observed.

During and after the training period the lactate production in conventional strength training was significantly ($p < 0.01$) higher than measured during and after EMS-training. The highest lactate rate of an average of 13.31 mmol/l was documented immediately after conventional strength training. Also, EMS-training showed the highest lactate rate of about 5.78 mmol/l in average at the same time. The analysis showed that there is a significant relation ($p < 0.05$) between the level of controller and the lactate values.

The heart rate showed similar reactions: During training period the heart rate during conventional training with machines (142 bpm average) was higher than during EMS-training. After 10 minutes of EMS-training the subjects reached only 108 bpm in average. There was no relation between level of the controller and the lactate value.

Conclusion

The subjective perceived rate of contraction is an effective method for measuring the contraction intensity of different muscles. This research area holds potential for further investigations. The low cardiac and lactate activity in EMS-training might help to open up new application areas for EMS-training, e.g. a systematic use in health sports or training with elderly persons.

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10

Strength training with electromystimulation— An empiric investigation of the strength effects of electrostimulation-training with variation in stimulation ratio

(BOECKH-BEHRENS, W.-U. / BENGEL, M., unpublished diploma thesis, University of Bayreuth 2005).
Objective The aim of this study was to determine the influence of different interval durations in EMS-training on the strength effects and to determine the effects of EMS-training on the enzyme creatinkinase.

Methods
52 male students of sport science (average age 22.3 years) were randomized into two training groups (n=21/n=20) and a control group (n=11). The subjects performed two training session per week (impulse duration 4s, impulse interval group 1: 4s/ group 2: 10s, frequency 80 Hz, rise time 0s, impulse amplitude 350 µs, training duration 15 minutes) over a training period of 6 weeks. For control purposes the dynamic and static maximal strength and strength endurance of the m. latissimus dorsi and m. triceps brachii plus the subjects´ body weight, body fat were measured and the CK-values were determined 24 hours after training. In addition the body perception and mood were documented with the help of questionnaires.

Results
During training with an impulse duration of 4s no significant difference was seen between an impulse interval of 4s and 10s. The highest strength effects were reported for the dynamic strength endurance of the m. triceps brachii (81.9% (group 1) and 73.7% (group 2)). The dynamic maximal strength in both groups increased up to 14.7%. On the contrary only light increases were seen in static maximal strength (up to 5%). Increases in static strength endurance varied between 33.9% and 19.4%. Regarding body weight and body fat no significant changes were seen in the training groups or in the control group.
The results of the creatinkinase measurements reveal that the stress on the muscle tissue is about 40% higher during an intensive whole-body EMS-training than with intensive strength training with exercise equipment or machines. Consequently, the regeneration time between the training sessions with whole-body EMS might have to be longer or the intensity of the electrostimulation has to be lower in order not to overstress the muscular system.

Conclusion
Compared to the most studies that trained with higher training durations the shorter training duration of 15 minutes resulted in significant increases of strength parameters. These increases are about equal to the increases achieved with conventional strength training with machines. The use of different interval durations (4s and 10 s) doesn’t show significant differences in strength gain. The high increase of creatinkinase (CK) after EMS-training reveals that the subjects trained with very high intensity. This high intensity EMS-training showed about 40% higher stress on the muscle tissue compared to an intensive conventional strength training with machines.

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11

Strength training with electrostimulation – An empiric investigation of strength effects in electrostimulation-training with variation in training duration

(Boeckh-Behrens, W.-U./Mainka, D., unpublished diploma thesis, University of Bayreuth 2006).

Objective

The previous investigations of whole-body EMS-training by the University of Bayreuth revealed that EMStraining is an effective rehabilitation method (back pain and incontinence) and a preventive type of strength training. Positive effects in strength gain were particularly achieved with a treatment duration shortened to 15 minutes. The following study investigated in which way an even shorter training duration shows positive effects on enhancing muscle strength and further parameters. Further objectives are to determine the level of stress on muscle tissue through training in order to make conclusions about training intensity and indirectly on training effectiveness.

Method

55 male students of sport science (average age 22.9 years) were randomized into two (2x n=22 subjects) EMStraining groups (5 min and 10 min) and a control group (n =11).The training groups trained two times per week over a training period of 6 weeks with following parameters: Impulse duration 4s, impulse interval 4s, frequency 80Hz, Impulse amplitude 350 µs, biphasic rectangular impulse. The tests determined the dynamic maximal strength and strength endurance, body weight and body fat plus the CK-values (creatinkinase) 24 hours after training. Furthermore the body perception and mood were documented with the help of questionnaires.

Results

Both training groups achieved strongly significant ($p \leq 0.001$) increases in dynamic strength endurance (group 1: up to 41%, group 2: up to 34%). The maximal strength increased in both groups (group 1: up to 10%, group 2: up to 8%). The comparison of the achieved strength gains revealed no significant difference ($p > 0.05$) between a training duration of 5 and 10 minutes. Both training groups significantly gained in body weight ((group 1: 0.83%, group 2: 0.90%), but no improvements were achieved in body fat. The second training- group (10 min) showed slightly higher CK-values (761 U/l) than the first group (5 min) (595 U/l). The analysis showed that the creatinkinase-activity was mainly influenced by the training intensity.

Conclusion

Compared to previous investigations the shorter training duration of 5 and 10 minutes did not show higher strength gains. In contrast the results were clearly below the increases that were achieved with 15 minutes training duration. According to the present results it can be assumed that a training duration of about 15 minutes could be optimal for enhancing strength. The high increase of CK-values after EMS-training also reveals that in this study the subjects trained with a very high intensity. A decrease in the training duration does not significantly influence the CK-activity. In fact, it seems that the current intensity in particular plays an important role in increasing the creatinkinase-values.

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12

Effects of whole body electrostimulation training and traditional strength training on various strength and blood parameter in juvenile elite water polo players

(Kreuzer, S., unpublished diploma thesis, German Sport University Cologne, 2006).

Objective

The study was aimed at the following questions: Does a whole-body EMS-training (GK-EMS) increase selected strength parameters (isometric maximal strength and dynamic power) in juvenile elite water polo players? Is there a difference between whole-body EMS, traditional strength training or mixed training regarding selected strength and blood parameters? Are there any changes in strength parameters after training?

Methods

27 elite water polo players (age 16 years) were randomized into 3 groups (EMS-training (n=9), strength training (n=9), combination strength/EMS-training (n=9)). CK-values were measured during and after training (45 minutes and 24 hours) in selected subjects.

Furthermore, isometric strength and dynamic power were determined in all subjects plus blood count, fat and ECG was documented. The subjects performed 2 training sessions per week over 4 weeks. The EMS-training used the following parameters: impulse duration 4s, impulse interval 4s, stimulation frequency 85 Hz, impulse amplitude 350 µs, biphasic rectangular impulses. The EMS-training group performed dynamic sport specific exercise movements. The subjects performed 3 sets of 12 repetitions. In addition to pre- and posttest a retest was performed 14 days after training period.

Results

The isometric maximal strength between pre- and posttest decreased up to 8.3 % (except trunk flexion which increased by 6.7%) and increased again in retest after 14 days regeneration time. Depending on the test movement the maximal strength increased by 4.7- 12.7 % and in one case even over 30 %. In group comparison the analysis showed that the mixed training (+14.4%) was more effective than EMS or strength training alone (+12.2%). The high training intensity in EMS-training might have overstressed the muscular system and thus lowered the training effect. It can be assumed that whole-body EMS-training requires a significantly higher regeneration time between sessions. Supposedly, the subjects should show higher increases in strength endurance than with the training duration at hand. Furthermore, the strength was only measured in one jointangle position. Higher increases in power could be possible in different angle positions. Some subjects reported an increase in arm girth. However, morphological effects were not tested.

The EMS-group achieved the highest increase in dynamic power (strength x velocity) by 67.0% in trunk flexion (combined training +45.8%, strength training +24.4%). The high variances at the chosen intensity and results of the other tests reveal a high interindividual difference, in some cases up to 90%.

In the third training session significant summation of up to 1639% were documented for EMS-group. The peak values varied between 560 and 7671 U/l. These increased CK-values went in hand with muscle soreness during the first two weeks (primarily in buttocks and triceps). The CK-values of the EMS-group were about 82-90% higher than in mixed training or strength training alone. Obviously the regeneration time between the sessions have to be longer or the training intensity of the EMS has to be reduced in order not to overstress the muscular system.

Conclusion

The results of this investigation reveal that a sub-maximal whole-body EMS-training provides a sufficient stimulus for developing diverse strength (primarily trunk strength) and subjective parameters (body stability). The combination of EMS-training with traditional strength training seems to be a promising method for the enhancing of training quality.

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13

Short- and long term training effects of mechanical and electrical stimulation on strength diagnostic parameters

(Speicher, U. / Nowak, S. / Schmithüsen J. / Kleinöder, H. / Mester, J., German Sport University Cologne Köln 2008; published in medical sports network 04/2007)

Objective

The aim of the present study was to compare traditional strength training methods with dynamic whole-body EMS in regard to their effects on strength and speed.

Methods

80 students of sport science were randomized (n=10 each) into eight different training groups (hypertrophy, maximal strength, speed strength and strength endurance, whole-body EMS, vibration, mixed group wholebody EMS/hypertrophy and mixed group vibration/ hypertrophy). The traditional training groups trained the muscle groups for leg curl and leg extension with machines (gym80). Depending on the different training group the subjects performed 3 series with various additional loads (30-90%, 3-15 repetitions). The EMS-group performed lunges and squats without additional load (impulse duration/ impulse interval 6s/4s, impulse frequency 85 Hz, impulse amplitude 350 µs, biphasic rectangular impulses, 60% intensity). The movements were standardized via visual biofeedback. The subjects performed 2 training sessions per week over 4 weeks.

Pre- and posttests were conducted before and after training period with strength diagnostic machines. An additional retest was conducted after a two week regeneration period. The dynamics were determined in terms of power measurements (strength x velocity) with additional load (40% and 60%) in various angles.

Results

All training methods significantly increased the maximal power. The highest increase in maximal strength was achieved by the hypertrophy-group (+16%) followed by the EMS-group (+9-10%). Only the EMS-groups showed significant results in enhancing the velocity. Accordingly, the measured increase in power can be related to an increase in velocity (about 30%) - significantly higher than achieved with traditional methods (16-18%). Apparently, the direct activation of the fast twitch muscle fibres shows positive effects for enhancing velocity.

The mixed training designs such as EMS and traditional hypertrophy training show typical adaptations to both training stimuli (7% increase in maximal strength and 12% increase in power). Accordingly, combinations of traditional and modern training methods could offer new and promising stimuli constellations. Especially the long term effects of whole-body EMS are very interesting. The highest increases in power were measured after a two week regeneration period.

Conclusion

The present study revealed that dynamic whole-body EMS-training with miha bodytec, compared to various training methods, offers a highly effective training method for enhancing strength and velocity. Only EMStraining increased the sport relevant maximal power due to an increase of movement velocity. Furthermore, the great long term effects of EMS-training offer new possibilities in training periodization. A well calculated application of whole-body EMS in combination with dynamic exercise movements offers a promising combination for strength- and speed training.

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14

Effects of whole-body electrostimulation on resting metabolic rate, anthropometric and muscular parameters in the elderly. The training and electrostimulation trial (test)

(KEMMLER, W. / BIRLAUF, A. / VON STENGEL, S., University of Erlangen-Nuremberg 2009).

Objective
Especially women after menopause show serious changes of body composition with increasing abdominal body fat and a corresponding reduction of muscle mass. To counteract this development the whole-body electrostimulation-training (EMS) currently offers an alternative to conventional muscle training with a lower orthopedic and cardiac load and a comparing lower training volume. The aim of this pilot study was to identify the application and practicability of an EMS-training in the elderly plus to determine the effectivity of this training method on anthropometric, physical and muscular values.

Methods
30 postmenopausal women with long time training experience were randomized into a control-group (CG: n=15) and an EMS-group (n=15). While the control-group continued with their usual training the EMS-group performed a 20 minute whole-body EMS-training every 4th day in addition to two strength and endurance training sessions per week. Alongside with the resting metabolic rate and VO2 the most important anthropometric data (body weight, body length, body fat, waist girth etc.) were determined.

Results
The resting metabolic rate showed significant reductions in the control-group (-5.3%, p=0.038) and no changes in the EMS-group (-0.2%, p=0.991). Despite medium effect size (ES: 0.62) these parameters showed slight differences only between EMS-group and control-group (p=0.065). The sum of skin fold thickness significantly decreased (p=0.001) by 8.6% in EMS-group compared to a light and insignificant increase in control-group (1.4%). These differences were statistically significant (p=.001, ES: 1.37). The waist girth as a criterion for abdominal adiposity significantly decreased (p>0.001) by -2.3% in the EMS-group (vs. CG: +1.0%, p=0.106). The corresponding difference between the groups was significant (p=0.001, ES: 1.64).

Conclusion
In summary, besides health relevant effects on body composition the present study also revealed enhancements of functional parameters such as maximal strength and speed strength. Furthermore, the analysis identified a high acceptance of EMS-training in the well trained postmenopausal women. Accordingly, this training form, besides effectivity, seems to also ensure practicability.

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15

The influence of an adjuvant EMS-training on body composition and cardiac risk factors in elderly men with metabolic syndrome

(KEMMLER, W. / BIRLAUF, A. / VON STENGEL, S., University of Erlangen-Nuremberg 2009).

Objective
Sarcompenia and (abdominal) adiposity in the elderly are in close relation to mortality, mulitmorbidity and frailty. The aim of this investigation was to determine how far whole-body electrostimulation-(WB-EMS)- training influences the body composition and cardiac risk factors in the elderly with metabolic syndrome.

Methods
Overall 28 men with metabolic syndrome according to IDF (69.4±2.8 years) around the area of Erlangen were either randomized into a control-group (CG: n=14) or WB-EMS-group (n=14). The subjects of the WB-EMSgroup performed a 30 minute endurance- and strength training program with EMS every 5th day over 14 weeks.
In parallel the control group performed a whole-body vibration-training concentrating on the enhancement of flexibility and wellbeing. As primary focus parameters the abdominal and overall body fat plus the appendicular skeletal muscle mass (ASMM) were chosen. The parameters identifying metabolic syndrome according to IDF (waist girth, glucose, triglyceride, HDL-cholesterol, systolic and diastolic blood pressure) were chosen as secondary focus parameters.

Conclusion
The changes in abdominal fat mass with a high effect size (ES: d`=1.33) showed significant differences (p=0.004) between the WB-EMS-group and the control-group (-252±196 g, p=.001 vs. -34±103 g, p=.330). In parallel to this the overall body fat decreased by -1350±876 g (p=.001) in the WB-EMS-group and by -291±850 g (p=.307) in the control-group (difference: p=.008, ES: d`=1.23). The ASMM also showed significant differences (p=.024, ES: d`=.97) between the EMS- and vibration-control-group (249±444 g, p=.066 vs. -298±638 g, p=.173). Except for significant differences of the waist girth (EMS: -5.2±1.8, p=.000 vs. CG: -3.3±2.9 cm, p=.006) in group comparison (p=.023, ES: d`=1.10) no further effects on the parameters of metabolic syndrome (see above) could be identified.

Conclusion
A whole-body EMS-training with a lower training volume (about 24 minutes/week) and a short training period (14 weeks) shows significant effects on the body composition of elderly persons. Accordingly, WB-EMS might be able to offer a promising alternative to conventional training programs for training persons with lower cardiac and orthopedic capacity.

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16

Elektromyostimulation (EMS) with cardiologic patients. Does EMS-training become important for secondary prevention?

(Fritzsche, D. / Fruend, A. / Schenk, S. / Mellwig, K.-P. / Kleinöder, H. / Gummert, J. / Horstkotte, D., cardiology clinic Bad Oeynhausen, Herz 2010; 35 (1): 34–40)

Objective
By now, it is sufficiently validated that moderate endurance training in terms of secondary prevention improves the prognosis of chronic cardiac insufficiency (CHI). Experience in clinical routine shows that only few, expertly guided, highly motivated and predominantly younger patients are willing to undergo a permanent sport support-therapy. Own experience with whole-body electrostimulation (EMS) with patients suffering of cardiac insufficiency reveals the still unknown potential of EMS in regeneration of neuro humoral, inflammatory and skeletal muscular symptoms of diseases in general. On this basis the impact and acceptance of whole-body EMS on patients with cardiac insufficiency was investigated in a prospective pilot study.

Methods
15 patients diagnosed with chronic cardiac insufficiency performed a 6 month training program (whole-body EMS) with a miha bodytec training device. The following stimulation parameters were defined for the EMS training program: 80 Hz and 300 µs with 4 s impulse duration and 4 s impulse interval for a 20 min training duration. A cool-down program in the 100-Hz-range succeeded the training program. The patients themselves were responsible for regulating the stimulation intensity (mA) so that the subjective perception of “muscle contraction/current perception” reached level 8 according to a 10 level scale. Within the main training program the target was to perform 40-70 repetitions of exercises in isometric holding positions and dynamic movements.

The cardiac performance was measured in pretest and after 3 and 6 months of training applying spiroergometry, electrocardiography (ECG) and echo. Furthermore, the tests determined the metabolic status including creatinkinase (CK) and lactate dehydrogenase (LDH) plus body weight and distribution of body fat (impedance scale).

Results
The analysis showed an increase of up to 96% in oxygen uptake at the anaerobic threshold (VO2at 19.39 [± 5.3] ml/kg body weight [KG] before training; VO2at 24.25 [±6.34] ml/kg KG after the training period; $p < 0.05$). The diastolic blood pressure significantly decreased ($psyst < 0.05$; $pdiast < 0.001$) and the muscle mass increased up to 14% with no changes in body weight. The training method was accepted by 100% (no drop-outs) and the patients reported a clearly enhanced subjective performance.

Conclusion
The present investigation shows the effects of EMS-training in patients with cardiac insufficiency for the first time. The improvements, such as an increased objective performance and optimized muscle-physiological and metabolic parameters, by far exceed the results of conventional aerobe training forms in terms of primary and secondary cardiologic rehabilitation in patients with cardiac insufficiency. The training form at hand offers high potential in therapy of patients with cardiac insufficiency.