The short- and long-term effects of mechanical and electrical stimulation on current strength-diagnostic parameters

Speicher U., Kleinöder H., Ruppert T., Mester J.
Institute for Training Science and Sport Informatics, German Sport University Cologne, Germany

Introduction: In order to develop the individually best performance in strength related sports an effective training regulation is needed. This can generally be achieved by continuous performance diagnostics and the realisation of the results into training practice. In the focus, however, should be those strength parameters which directly influence performance in training and competition. Accordingly, the aim of this study was to find out the development of classic and modern strength parameters such as maximal force, power, rate of force (RFD) and power development (RPD) etc. dependant on mechanical (resistance training) and electrical stimuli. The relation between load and velocity and the resulting power output will be discussed in this context, too. Aim of the study is to find out classifications and relations between different training stimuli with different loading, different movement velocities and different power output. On this basis, practical training advice should lead to a professional strength training approach in elite sport.

Methods: 40 sport students with strength training experience were randomized in 4 training groups (n=10), i.e. 1) electromyostimulation (EMS), 2) mixed EMS/hypertrophy, 3) hypertrophy and 4) maximal strength group. After pilot training and pilot diagnostic a 4 week long training period took place for all training groups (2x/week). The traditional strength training was performed 2x/week on the Leg Curl and the Leg Extension Machine. The hypertrophy group trained with 3 sets, 10 RM, 1 min. rest between sets and a computer given speed (biofeedback) of 2 s con, 0.5 s (iso) and 4 s (ecc). The maximal strength group performed 3 RM, 3 sets with explosive strength development and 3 minutes pause between sets. Training parameters of the EMS group were: 3 sets with 10 contractions each, stimulation/pause ratio 6 s/ 4 s, individually 70% intensity, impulse frequency 85 Hz, impulse width 350 µs, impulse type rectangle. Squat and lunge were the exercises of the EMS group. Strength diagnostics took place before, after 2^{nd}, 4^{th} and 6^{th} training week at the leg extension and the leg curl machine (3 tests isometrically and 6 tests dynamically with 50 % und 75 % additional load). Reliability of test performance was investigated beforehand with a test-retest study.

Results: Maximal force, power as well as force development like isometric and dynamic RFD, RvD and RPD showed different adaptations dependant on the training method. The combined approach (EMS and hypertrophy), however, suggests to use a mixture of different training stimuli to improve a variety of strength related parameters. The new approach of isometric and dynamic testing delivered a better understanding of the effects of various strength training methods and their specific effects and allows a more precise strength training regulation.

Conclusion: Modern strength diagnostics elucidates differentiated adaptations of different mechanical and electrical stimuli on isometric and dynamic strength parameters. This allows an individually better training regulation and offers new concepts for the use of the individually best mixture of strength training methods.