THE INFLUENCE OF ELECTRICAL STIMULATION TRAINING ON SWIMMING PERFORMANCE

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INTRODUCTION

The purpose of this study is to examine the influence of a three week cycle of 
electrostimulation of latissimus dorsi on strength development and swimming performance.

METHODS

Subjects

A group of fourteen swimmers training in a club agreed to take part in the experiment. Subjects were divided into two groups: the first one (23,1±1,9 years; 179,8±4,8 cm; 72,8±6 kg) was composed of seven swimmers who underwent three electrostimulation sessions a week during three weeks in addition to swimming training. The second one (23,1±1,9 years; 178,1±4,8 cm; 75,1±6 kg) was the control group composed of seven swimmers training only in the pool. They trained between five and ten hours a week. It was a group of regional and national standard sprint swimmers whose speciality was 50 and 100 meters. Therefore swimmers with dominant speed who must work their maximal strength in order to improve their performance.

Electrostimulation sessions

Sessions are carried out using a portable stimulator (stipro) with two independant way outputting a symmetric orthogonal pulse train lasting 0,3 ms at 80 Hz. So the two latissimus dorsi could work together. The sessions lasted 12 minutes, the contraction time was five seconds and the rest one was 15 seconds. There were three sessions a week for three weeks.

Peak torque

A biodec type (Biodec Corporation, Shirley, NY, USA) isokinetic ergometer was used to measure the maximum torque values developed over the arm flexion-extension movement at different velocities (-120, -60, 0, 60, 120, 240, 300, 360°/s). After one or two testings at selected speed, a rest of twenty seconds was observed between two repetitions. For the whole test tests, the effort must be maximal. For each speed, tests were doubled. Only the best performance was taken into account. Between each test four minutes rest permitted the subject to retrieve in order to make another test in the best conditions. Before each test, an overheating with and without biodec was carried out.
Swimming tests

Each swimmer did three tests: hvo on 25 meters (the first one with a pull-buoy between thighs and belt fasten to feet, in order to avoid the leg participation, and the second one was carried out in full movement, that is to say without contrain). The 50 meters crawl was realized in full movement. Each test started in water. A fifteen free overheating was made before the beginning of the tests. A rest of ten minutes was respected between two tests in order to permit swimmers to retrieve enough and can make a maximal effort.

Analysis statistic

Pre and post-training mean values were compared within each group using the Wilcoxon non-parametric statistical test. For each test any difference is significant if the probability threshold is at least equal to p<0,05 (noted: *).

RESULTS

Biodex tests

At the end of training, the results for electrostimulated swimmers show an improvement (+43%) in peak torque eccentrically at velocity of 120°/s (p<0,05), isometrically (+15% and p<0,05) concentrically at fast velocities of 180 (+10%), 300 (+12%), 500 (+14%) with p<0,05 (fig. 1). While the control group shows no significant difference.

Swimming tests

A gain in swimming time for study subject is recorded for the 25 meters arms only (19 hundredth of a second with p<0,05), and for 50 meters full movement (38 hundredths with p<0,05) (fig. 2). There, the control group shows no significant difference.

DISCUSSION

The improvements recorded in eccentric for electrostimulated swimmers could be explained by preferential recruitment of fast fibres (Nardone, 1989). So an electrical stimulation cycle would entail a preferential recruitment of fast fibres.

CONCLUSION

To sum up the experiment point to the explosive strength.
The strength improvement depends on the contraction regimen used for training and testing 
with a pull-buoy between swimmers who crawl was realized using the Wilcoxon non-
pulse threshold test. The recorded results on Biowin at fast velocities could be explained by Thorstensson (1977) who suggests that from 180°/s velocity, fibres composition of the muscles can be forecast. Moreover, the percentage of fast fibres in a muscle seems to be determinant for strength producing during fast concentric actions (Thorstensson et al., 1976; Froese and Houston, 1985). Electrostimulated swimmers who show higher improvements in peak torques, would profit by a bigger solicitation of type II fibres.

The adaptation shown in this part could be the consequence of a better activation of motor units (Thorp-Mathieu, 1984) and/or preferential solicitation of muscular type II fibres (Enoka, 1988). This approach is supported by Cabric and al (1988) whose origins are favorable to reverse recruitment order of motor units. More recently, Duchateau and al (1990) checked the this hypothesis by using a method which allows to record the mechanical answer of an isolated motor unit. The result shows a higher strength improvement for the largest, the fastest and at a higher level motor units compared to smaller and slower ones. Several factors could be responsible for that:

- The first one is the diameter of motor axons. As a matter of fact, the excitation level of an axon is inverse ratio to its diameter (Solomonov, 1984). So large motoneuron have a lower excitability level. Also the large diameter axons are faster than small diameter ones on the contrary of voluntary contraction.
- The second one is the distance separating the electrostimulation electrode from axon. As a matter of fact, motor unit with a large diameter are the most often superficially located in the muscle and so near the electrode (Lexel and al., 1983).
- The last one is the setting of cutaneous receivers that by the reflex way inhibit motorneurons of small motor units and excite big ones. Also they favours the recruitment of the biggest motorunits to the detriment of the smallest one (Garnet and Stephens, 1981; Burke and al, 1970).

The setting of these three factors clearly shows that the contraction under electrostimulation, of which the trend is the preferential recruitment of large motor units, would be liable to produce a reverse activation ordered compared to voluntary contraction one.

The important improvements recorded in swimming tests show that force gains measured by isokinetic ergometer are transferred to swimming gestural.

CONCLUSION

To sum up the essence of this work, it can be claimed that the significant results of the experiment point to the use of electrical stimulation for sports training if it is decided to increase explosive strength.
BIBLIOGRAPHY


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INTRODUCTION

The relationship between muscle strength development in training and the relationship between training and isometric conditions (60°)

**Force development (RFD), quotients between EMG (RFD50),quotient between EMG (RFD50) and AEEMG, force developed (CMRR=70 db).** EMG signals were digitized on-line and were integrals (CMRR=70 db) of IEMG, integration of the IEMG signals was carried out 3 to 100 ms and to 500 ms frequency MF) was carried out.

Two groups (n=8) of subjects were tested for.

Basical statistical differences were tested for.

RESULTS

The results of a number of subjects are...