NEUROMECHANICS OF SPRINT SPECIFIC TRAINING SKILLS

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INTRODUCTION

Surface EMG applications in Sports are comparably seldom found. Hopes for a direct and simple correspondence to strength parameters could not be satisfied sufficiently for various reasons. (Zatsiorski, 1995; Epstein, Herzog, 1998). Besides scientific reserves it was certainly the uncomfortable use of EMG equipment during free exercises that prevented a more extensive application for a long time. Now that portable data loggers became widley available the interest of sport sciences in EMG is again increasing.

OBJECTIVES OF EMG STUDIES IN SPORTS SCIENCES

Four main areas of interest exist in sport biomechanics which are assumed to be clarified with the help of EMG.

- intermuscular coordination during the realization of specific sport movements
- the relation between muscle activation and strength
- fatigue effects during sport locomotion
- identification of load on the locomotor system during particular exercises

CORRESPONDENCE OF SPRINT SPECIFIC EXERCISES TO FREE SPRINTING

In elite sprinters' training routines sprints against resistance are rather common. The question arose among coaches and performance diagnostics personnel whether these tow sprints were as specific as they were assumed to be and whether there was an individual threshhold to be identified for the specificity of the skills. Kinematic analyses revealed considerable pertubations of running style already through small additional loads. However it could not be decided which effects the skills had on the underlying muscular work.

METHODS

A study was conducted with ten male sprinters who ran while pulling additional loads of 5, 10 and 30kg on a slay behind them. EMG signals were recorded on a "BIOVISION" data logger with a sampling frequency of 1000Hz from representing the main muscles

m. vastus medialis

m. tibialis anterior

m. gastrocnemius medialis

m. gluteus maximus

m. rectus femoris

m. biceps femoris

responsible for accelerating of the body in running direction. Two 120Hz "Peak Performance" video cameras covered the startphase and the phase of maximum runnning velocity respectively providing the data base for a 2-D video analysis.

RESULTS

From the innervation patterns it can be seen that extensor and flexor activities are clearly seperated from each other with only small areas of cocontractions in unloaded running (See Figure 1). Intermuscular timing patterns changed depending on the load added to the slay. Especially the knee extensors / flexors adjusted their innervation patterns according to the altered kinematics. As range of motion in the knee joint decreased with additional load

Start phase 1

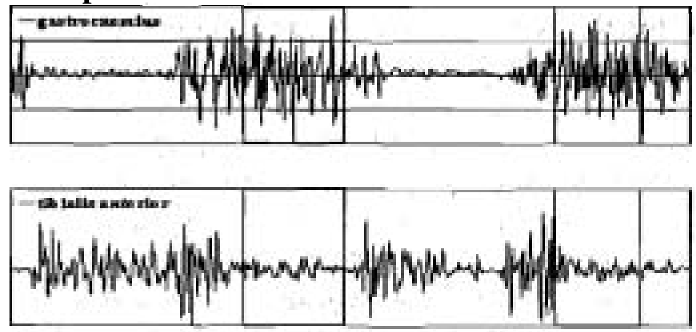

Figure 1. Raw EMG-signals from m.gastrocnemius and m. tibialis anterior during the first 2 seconds of the startphase of free sprinting. Shaded areas indicate foot-ground contact. (EMG amplitude in arbitrary units).

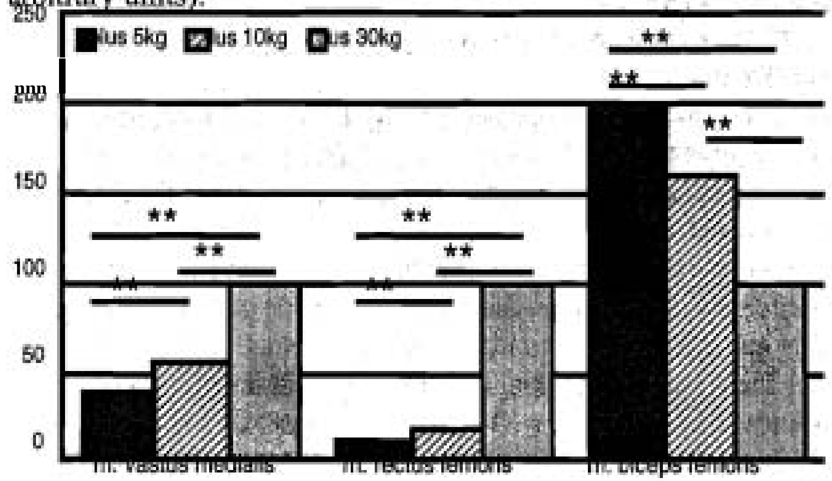

Figure 2. Mean relative IEMG amplitude during phase of maximum speed. 30kg load condition is set to 100%. (p=0.001)

the extensors became more and more involved into the acceleration of the body. With 30kg added the athletes did only show an extension in the kneejoint without preliminary flexion as usually performed in free sprinting. Time of activation during a complete stride changed significantly for the m.rectus femoris and m.biceps femoris corresponding to longer stride durations with increasing loads. As the extensor muscles had to work against higher loads the amplitudes of the EMG signals increased accordingly. This came true for the ground contact during startphase and particularly for the phase of maximum speed. The m.biceps femoris showed an opposite trend of decreasing EMG amplitudes as the load increased.

During swing phase the m.rectus femoris was the only muscle for which significant differences in EMG amplitude could be identified. With higher resistances the swing phase becomes shorter in time which might account for the decrease of the amplitude of the m.rectus femoris which acts as a hip flexor during swing.

CONCLUSIONS

Relating these results to free sprint kinematics we can summarize that

- the coordination of muscular activity is altered by external loads running against the resistance of a loaded sled increases the muscular activity of especially the knee extensor muscles. An EMG to load relation is evident.
- the coordination patterns of sprints with a loaded sled are similar but not identical to those in the early start phase of free sprinting.

The conclusions that can be drawn are valuable to coaches and athletes for the planning of training routines. Still the discussion about specificity of training skills will continue. A continuation of ressearch should focus on more longitudinal studies about the effects of specific skills.

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