

EFFECT OF SHOE CONSTRUCTION ON THE DE-COUPLING OF LOWER LEG MUSCLES

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INTRODUCTION

In the early phase of the foot ground contact during heel toe running the ankle joint undergoes an initial plantarflexion of about 5 - 10° within the first 10% of the stance time (Reinschmidt et al., 1997). Therefore the length of the entire muscle tendon complex of the triceps surae muscle (TS) should shorten. It can be roughly estimated that the shortening velocity of the muscle tendon complex in that phase is about 50 cm/s. However the contractile components of the TS produce considerable forces only at clearly lower contraction velocities (Edgerton et al., 1986; Hof, 2003). That means that the shortening should occur in the Achilles tendon. According to that Komi (1990) reported a rapid drop in Achilles tendon force with footstrike in heel toe running. That means that the contractile component of the TS is de-coupled (slack) from the calcaneus during that phase of initial plantar flexion and cannot transmit force to the bone. To a certain extent that mechanism should also be functional at the other plantarflexors, in particular the Mm. tibialis posterior (TP), flexor hallucis (FH) and flexor digitorum (FD). If those muscles are de-coupled from their respective insertion, they should also lose their capacity for producing a plantar flexion moment.

It has been suggested, that the compliance of the running surface as well as the midsole construction might influence the touchdown angle of the foot (De Wit, 2000; Stacoff, 1995). The purpose of this study was to investigate the influence of midsole construction on the de-coupling mechanisms of the TS and eventually other plantar flexors.

METHODS

To investigate the effect of surface compliance subjects run barefoot on a hard surface (indoor tartan) and a soft surface (midsole material EVA). To investigate the effect of midsole height subjects run shod over a hard surface with two dif-

ferent shoe constructions with a difference in midsole height of 2 cm, while the stiffness characteristics of the midsole conditions stayed unchanged. For each of the four experimental conditions five runs (3.5 m/s) per subject have been carried out. The lower leg kinematics was recorded with a set of 12 high-speed cameras (Vicon, 250 Hz). Ground reaction forces were sampled with two force plates (Kistler, 1250 Hz).

RESULTS AND DISCUSSION

First data indicate that shoe design has an effect on the de-coupling mechanism in heel toe running. Apparently the midsole construction can modulate the initial passive plantar flexion in the early phase of foot contact. It seems that midsole height has a bigger influence on the de-coupling mechanisms than the stiffness of the running surface when running barefoot.

Based on the assumption that the de-coupling mechanism is also functional for the plantarflexors TP, FH and FD, it can be deduced, that those three muscles, which are also foot inversion muscles, should also lose their capacity to produce an inversion moment in the early stance in running.

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