THE DYNAMIC SUPPORT STRUCTURE AND THE FOOT STABILITY RELATED TO RUNNING SPEED

ABSTRACT

Veloso A. and Abrantes J.,

Biomechanics Lab., Faculty of Human Motricity, Technical University of Lisbon, Portugal.

The alterations of the dynamic support structure in running, related to horizontal speed increase, has been studied by several authors; Cavanagh (1989) studied the displacement of the support center and the pressure distributors; Nigg et al. (1981) analysed the active and passive loads; Bates (1983) studied the critical variables defining the support dynamics. Simultaneously, the study of the rearfoot mobility around the horizontal axes of the subtalar joint during ground contact has been gaining in importance (Nigg et al., 1978). The above mentioned subjects are integrated in the present study for a more complete knowledge of the foot contact. Relations between the increase of running speed and, respectively, the variables defining the rearfoot mobility and the critical variables of the ground reaction forces are established.

Six sprinters of portuguese national level carried out each of them 6 performances, barefoot, at three different speeds (V_1=3.37 ms +/-0.56; V_2=4.37 ms+/-0.37 e V_3=5.44 msl +/-0.31). The kinetic data were obtained by a force platform (kistler 9281B, sampling frequency 1000 Hz) connected to the computer via A/D card (DT 2801A Data Translation). The runners speed was controlled by means of photoelectric sensors that synchronised the collection of the kinetic and video images. The kinematic data were processed according to the methodology proposed by Nigg et al. (1978).

The obtained kinetic results are similar to those contained in the corresponding bibliographic references, in form patterns as well as in quantitative results (Cavanagh 1989, Nigg et al. 1981, Bates et al. 1983). Regarding the rearfoot mobility the displacement / time curves are similar to the ones presented by Nigg et al. (1978) as far as barefoot runners are concerned. Significant statistical correlations (correlation coefficient, Bravais-Pearson) were ascertained showing that the running speed increase is related to : 1) decrease of ground contact time ($r = -0.96$, $P<0.01$), 2) increase of anterior-posterior speed variation (ΔV_y) ($r=0.77$, $P<0.01$), 3) decrease of the braking phase of the anterior-posterior speed variation ($\Delta V_y(-)$) ($r=-0.70$, $P<0.01$), 4) increase of the propulsion phase of the anterior-posterior speed variation ($\Delta V_y(+)$)($r=-0.24$, $P<0.02$). It was also ascertained that there is a significant correlation between the increase of the angular mobility between the calcaneus and the lower leg (Achilles tendon angle) ($r=-0.35$, $P<0.05$). Concerning the increase of the anterior-posterior component of the speed variation, significant correlations have been found between this increase %wd: 1) the decrease of Achilles tendon angle mobility ($r=-0.38$, $P<0.05$), 2) the decrease of angular mobility of the calcaneus in relation to horizontal ($r=-0.37$, $P<0.05$).

The developed methodology permitted to obtain kinetic results which are similar to those registered in the bibliographic references. It could be verified that, for the tested group (sprinters with significant volume of training-national level) the rear foot mobility around subtalar joint decreases with increase of running speed; this within the range of speeds performed by the sprinters, not in complete agreement with Stacoff's (1991) conclusions.