GENDER AND AGE RELATED RUNNING BIOMECHANICS

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In running and other sport activities related injuries differ between genders in frequency and localisation. For example in cutting manoeuvres ACL injuries occur more often in females than in males. In addition females suffer generally more often from osteoarthritis in the knee. In the scientific literature it is discussed that the higher incidence of certain knee problems in women could be related to differences is running mechanics (McLean et al., 2004, Ferber et al. 2003, Heiderscheidt et al., 1999). During the stance phase in running higher hip adduction and internal rotation angles as well as higher knee abduction angles are reported (Ferber et al., 2003). Other authors (Malinzak et al., 2001) found higher knee valgus angles in females compared to their male counterparts. They also relate the higher ACL injury risk of females to higher knee flexion angles in different tasks as well as to higher quadriceps and lower hamstring activity. Calculations with forward dynamic models contradict those latter conclusions (McLean et al., 2004). Other neuromuscular control related studies reported higher activity of the medial hamstrings (DeMont and Lephart, 2004) and lower muscular joint stability in female athletes (Wojtys et al., 2003) and related that to possible altered mechanics and therefore potential causes for injuries. Anthropometrical characteristics of women (relation between femoral length and hip width) in relation to men are assumed to cause different running and movement mechanics due to different static alignments. The different muscular capacities as well as the different activation patterns are also stated to be the reason of gender specific knee and hip joint loading.

To study experimentally both the muscle activity and running mechanics at the knee joint, 20 male and 20 female subjects performed five valid running trials (v=3,75m/s) under the three different surface conditions: grass barefoot (GB), tartan barefoot (TB), tartan shod (TB). Bipolar surface EMG of selected thigh and shank muscles were recorded (Noraxon®, 3000Hz) and analysed using wavelet software (von Tscharner). Under GB and TB 3D kinematic and kinetic analysis was performed (Vicon®).
Obvious differences in activation pattern of different leg muscles between men and women were found and could be associated to the determined kinetic and kinematic gender differences. Especially the differences in the activation pattern of the Mm. tibialis anterior, peroneus longus and tensor fasciae latae can contribute to the explanation of the results.
When trying to better understand gender specific running mechanics and injury mechanisms the specifity in activation patterns of certain muscles and their role in joint loading and/or joint stabilizing has to be investigated more detailed. To design gender specific footwear pure static or geometrical differences, the different muscular capacities and different activation patterns of men and women have to be identified, understood and considered. That preponderates for different age groups. Since in relation to young people the number of older runners in both genders increases, the effect of aging on running mechanics could be important for running shoe design.
The effect of aging on running mechanics is studied in extensive experiments on male subjects (Kramanidis and Arampatzis, 2005). It could be shown that older adults react to their age-related reduced muscular capacities of the triceps surae and quadriceps muscles by increasing their running safety (higher duty factor, lower flight time). They benefit from a mechanical advantage of the triceps surae (lower gear ratio at the ankle joint).

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