Torsion of the foot in low cut basketball shoes in four cutting movements

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Preliminary results
The MVC results (Figure 1) illustrate the angle dependent torque development of pronators and supinators. The pronator and supinator curves reveal an ascending-descending and a descending characteristic, respectively. M. peroneus longus shows highest activity in IEMG during pronations, m. tibialis anterior is about 65–94% active with respect to m. peroneus longus. M. tibialis anterior (70%) and M. soleus (39%) are the primary muscles based on the surface EMG recordings that contribute to maximum voluntary supinations.

Discussion
On the basis of the MVC results a variable cam was constructed and implemented into the driven shaft to fulfil the demands of a functional resistance training machine which takes the angle-torque relationship of the pronators and supinators into account.

Functional strength training of the supinators at the ankle may contribute to decreased pronation in runners at the support phase. During the early part of the stance phase the m. tibialis anterior is eccentrically active, at midstance the deep plantarflexors act eccentrically and may help to limit pronation and pronation velocity (Reber et al. 1993). The results of study 2 will show the possible morphologic changes of supinators and pronators and their influence on joint stiffness. Considering the adaptive potential of the deep plantarflexors, a combination of lower leg strength training and appropriate footwear might be a new approach to the prevention and treatment of overuse injuries in running.

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References

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Introduction
The foot is a complex structure composed of 26 bones and many joints, four of which contribute substantially to the movements of the foot (Moore and Dalley 2006). The foot is often represented as a single rigid body rotating about the ankle joint complex (Davis et al. 1991). This simplification may be acceptable for walking or running where the primary movement occurs in a single plane. However, for more complex motions this simplification has many limitations.

Dividing the foot into two segments (forefoot and rearfoot) allows for the description of the movement of the forefoot independent of the movement of the rearfoot, which may have implications for footwear design and for clinical applications (Hunt et al. 2001). The assessment of the movement of the forefoot and the rearfoot has been used for the analysis of walking (Hunt et al. 2001, Leardini et al. 2007, Wolf et al. 2007), and running (Eslami et al. 2007). However, there is little information of two segment foot kinematics.
during more complex tasks. The purpose of this study was to determine the relative movement of the forefoot to the rearfoot during common basketball movements with different cutting angles.

Methods
The data used in this analysis was collected using two separate groups of adult male basketball athletes. Group one (mean ± SD; height 1.89 ± 0.03 m; weight 88.75 ± 11.35 kg) performed the 45° cut and the 180° cut during a shuffle movement. Group two (height 1.83 ± 0.05 m; weight 81.95 ± 6.97 kg) performed a 90° cut and a 180° cut during a forward running movement. All movements were performed at the subject’s maximum self selected controlled speed except for the 45° cut, which consisted of a forward run at a reduced speed (2/3 max) and an acceleration to maximum speed after the cut. All subjects wore the same low cut basketball shoe (adidas Superstar 2G Pro Low) during data collection. The rearfoot and forefoot were modeled as rigid segments. Three markers were used to define each segment. The ankle joint was identified using two markers, one on the medial and one on the lateral malleolus, which were removed after a standing calibration. The metatarsal-phalangeal joint was identified with two markers on the first and fifth distal metatarsal bones. These markers remained on the foot during the movements. Data was recorded using an eight camera motion capture system (EVaRT, Motion Analysis Corp, Santa Rosa, CA). Data were analyzed in Matlab (Matlab 7.4.0, The MathWorks Inc.). The metatarsal-phalangeal joint line was projected onto a plane in the rearfoot to calculate the motion between the forefoot and the rearfoot. Angular rotation was calculated during the transition stance phase of the cutting movement and referenced to the torsion angle calculated during the standing neutral position.

Results
Due to the use of separate subject groups, the analysis of the results is limited to a descriptive comparison

Comparison of the 45° and 90° cut (Figure 1): the torsion angle at touch down was similar for both movements which close to the neutral position of the foot (1.5 ± 0.4° and 1.1 ± 0.5°, respectively). The 90° cut resulted in a greater torsion angle for the first 50% of stance. Both cutting movements had similar maximum torsion angles, 16.2° at approximately 70% of stance and 16.5° at approximately 75% of stance for the 45° and 90° cut respectively.

Discussion
The torsion angles calculated for this study followed a similar protocol to previous research (Hunt et al. 2001); however, the motion of the forefoot in this study was simplified to a single rotation of the metatarsal line with respect to the rearfoot. The motion correlates the highest with the inversion-eversion angle of the forefoot. During running Hunt and coworkers reported inversion-eversion angles of the forefoot to be around 5°, whereas values calculated for cutting in this study...
were almost five-fold that of running. The overall torsion of the foot was quite similar for cutting at 45 and 90°. However, a 180° cut preceded by a forward run resulted in substantially higher torsion of the foot than for the same cut performed during a shuffle movement.

**Conclusion**

The results of this study provided information regarding the relative motion of the forefoot to the rearfoot during four common cutting movements in basketball. The information gained from this study may aid in the understanding of the loading characteristics of the shoe/athlete during these movements and may have implications in future footwear design.

**References**


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**Mechanism of pose regulation and distribution characteristics under feet in air-gun shooters**

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**Introduction**

Proprioreceptive feelings play a big role in shooting because they give information about the size and speed of movements. With the help of long-term intensive training they become more reliable and help the shooter to take the appropriate position easier. A shooter with good kinetic feeling decreases the expense of physical and nervous energy in the shooting position, so he moves the weapon less. With pistol shooters, there are two kinetic chains during the shooting. The first one consists of the pistol–arm system, while the second one consists of the torso and the lower limbs (legs). The indicators of the right position are: (a) activity of self-regulation of the pose-position; (b) efficiency of impact of one kinetic chain (torso–legs) to the other (arms with the pistol); (c) mutual act of the kinetic chains. The position of the shooter when he is discharging a pistol is asymmetrical, and is characterized by the fact that the torso is skewed to the opposite side of the shooting level (Nasonova 2005). The vertical line of the mass centre of the body passes through the back of the hip line and the front of the knee and wrist line. Thus the athlete’s side is positioned to the target, the legs are parted, to the width of shoulders or closer, almost parallel, naturally without straining, so that the shooting level goes through both feet, almost through the middle (Korh 1987, Nasonova 2005). The angle between feet varies from 0° to 40° (depends on the shooter). When this happens the knees are fixed and all the muscles that take part in the shooter–weapon system are strained (Korh 1987). In the projection position of the general mass centre in the centre of the surface, equal angles of stability are created. The body weight of an athlete with a weapon should be equally distributed on both legs, or at least a little more on the back leg and a little closer to the fingers, which makes for an equal feeling in each leg, especially the muscles on the front and back side of the shin, and also to the same energetic waste. During discharge the burden on both legs is almost equal (Nasonova 2005). The goal of our research project was to define the characteristics of the distribution of under-foot pressure within a population of air pistol shooters and ways to increase stability.

**Methods**

For the registration of the characteristic of distribution burden, the footscan podoplatform is used of the firm RSscan, which is 0.5 m long and 0.4 wide and working frequency of 300 Hz. World class air pistol shooters (Olympic, World and European champions), of both genders (n = 14), with a working period of 5 years took part in this experiment. The experiment took place in an indoor shooting-gallery, in standard competitive conditions. The characteristics of the distribution burden under the foot are supervised with tests, suggested (Vasiljev et al. 2007) for the grade of the stability of the body. The complicated test