BIOMECHANICAL ANALYSIS OF SPRINTING TO IMPROVE INDIVIDUAL TECHNIQUE

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INTRODUCTION: The aim of this study was to record dynamic and kinematic parameters during sprint start and sprinting with maximum velocity. The motion analysis aims for an improvement of individual technique.

METHODS: 21 male and 3 female runners took part in this study. Kinematic and dynamic parameters were recorded during start and fast running. In the sagittal plane the following parameters were analyzed: joint-angles, -velocities and -acceleration of hip, knee and foot. Centers of these joints were also analyzed. These parameters were recorded with two high-speed cameras (250 Hz) and a 3-dimensional force platform (measuring area 240x80 cm). The experimental set-up allowed the recording of two successive steps on the force platform while the dynamic- and kinematic -data were obtained synchronously. Additionally, the reaction time was measured. The reaction time is defined as the time from the start signal to the moment the rear leg leaves the block. The high-speed video data were analyzed with the software package winanalyze from Mikromak.

RESULTS: Very different rotary actions of the shoulders to balance the hip action were observed. The main differences between the athletes became evident in the angular velocities and the angular accelerations of the hip and the knee. Particularly, variable forces in the direction of movement (retarding stroke) became apparent among the different athletes.

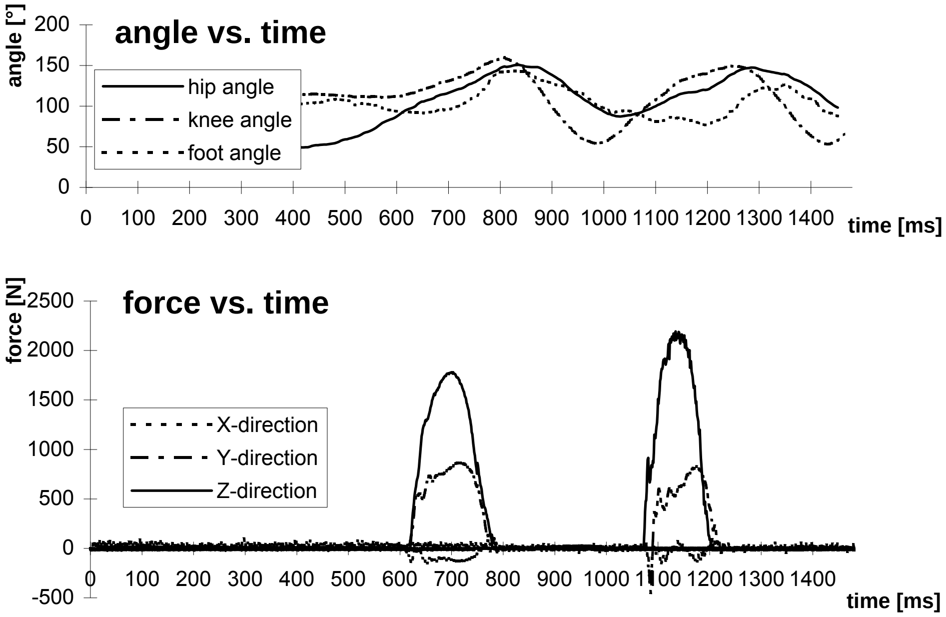
Exemplary, the start and the sprinting of two runners with a different standard of performance are investigated (Athlete A: male, body mass 83 kg, height 181 cm; Athlete B: male, body mass 75 kg, height 183 cm).

Athlete A has a lower hip angle during the start than athlete B. After the push-off from the starting-block the knee angle in the forward movement of the lower leg is 20° lower for athlete A than athlete B. That also applies to the forward movement of the lower leg during the run. Because of the lower knee angle the resulting moment of inertia of the whole leg is reduced. Therefore, the angular acceleration and the angular velocity are increased. The leg can be brought in front faster to take the next step. This becomes evident in the comparison of athlete A and athlete B.

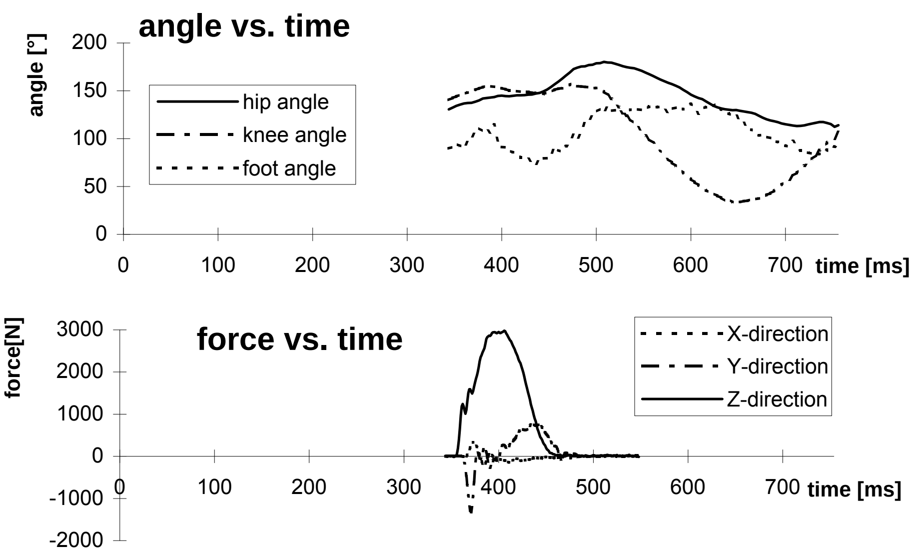
When the foot begins to touch the ground, the hip angle and the knee angle of both athletes hardly differ.

During the sprint the force in the vertical direction is 3.6 bw (2988 [N]) for athlete A and 3.3 bw (2500 [N]) for athlete B. In the direction of running the achieved forces are 1.11 bw (921 [N]) for athlete A and 0.6 bw (480 [N]) for athlete B. From this one can conclude that athlete A is accelerating more powerfully than athlete B.

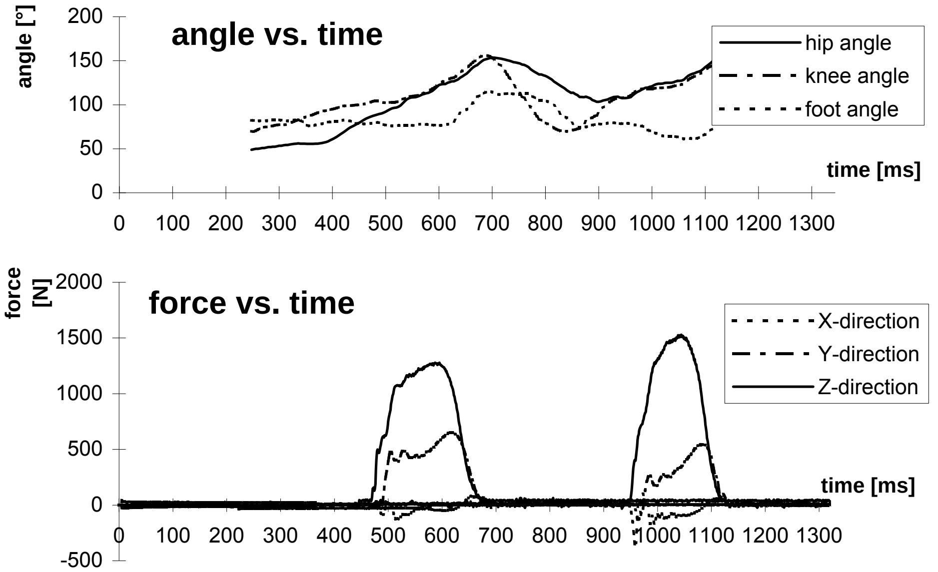
Athlete A: angle and force versus time during the start (left leg)



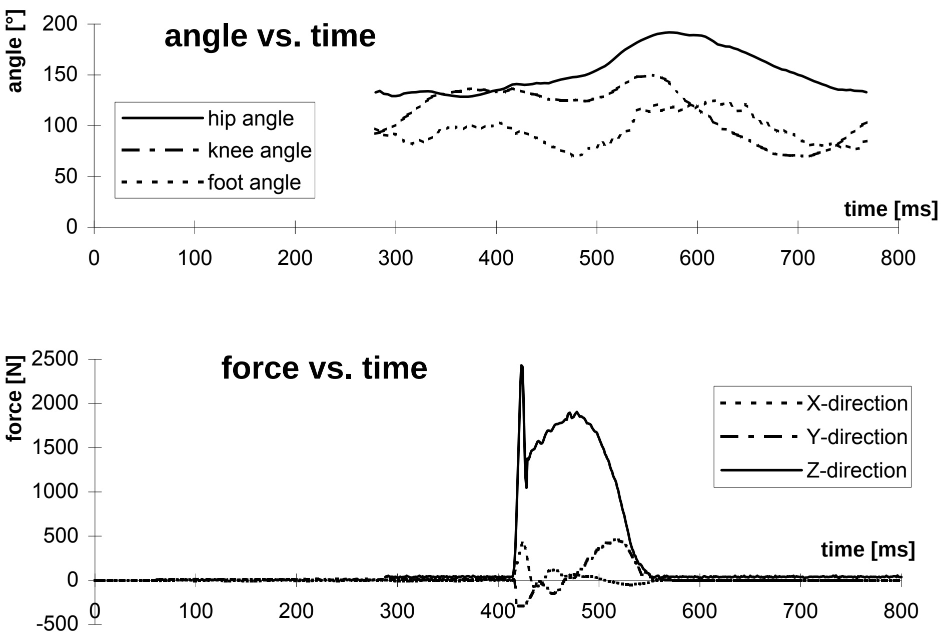
Athlete A: angle and force versus time during sprinting (left leg)



Athlete B: angle and force versus time during the start (left leg)



Athlete B: angle and force versus time during sprinting (left leg)



OUTLOOK: The observed tendencies will be verified in a following study. After the inquiry of the general fitness of the sprinters the development of a special training-program for each athlete is intended in the next step. It will be based on the Multi-Joint-Concept of R. P. Narcessian.