

## Three-dimensional kinematic analysis of running in rocker-soled shoes

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**Introduction:** Rocker-soled shoes (rocker-bottom/profile) are widely used to redistribute forefoot loads and reduce local overload in conditions such as diabetic foot, rigid hallux, and metatarsalgia. By creating a fulcrum proximal to the metatarsal heads, the rocker shifts the shoe's rotation point and can alter lower-limb kinematics; however, evidence from running in healthy individuals remains limited and controversial. The objective is to compare three-dimensional (3D) kinematic parameters during a race between a conventional shoe and a rocker-soled shoe, testing the hypothesis that the rocker reduces ankle eversion and knee flexion peaks.

**Methods:** Cross-sectional study approved by the Ethics Committee, with 20 healthy volunteers (12 men; 18–35 years), without previous lesions and with alignment of the hindfoot between 0° and 10°. The following were compared: (1) conventional shoes (flat and flexible sole; 13 mm; drop 6 mm; Ever Way® Marvin) and (2) rocker shoes (rigid sole; 30 mm; apex at 60% of the length; radius 15.5 cm; Hoka® Gaviota 5). 3D kinematics were collected using a Vicon system with 8 cameras (250 Hz during running), Butterworth filtering, angular calculation using Grood and Suntay, anatomical calibration (CAST), and phase identification using the Foot Velocity Algorithm. The run was performed on a treadmill, at the participant's preferred speed, after warm-up and adaptation. Statistics: paired t-test or Wilcoxon test ( $p < 0.05$ ), with a priori sample calculation ( $n = 20$ ).

**Results:** Age  $27.9 \pm 4.8$  years; BMI  $23.7 \pm 2.1$  kg/m<sup>2</sup>. Conventional shoes showed a higher peak and a longer ankle eversion time during support, along with a lower eversion speed; there was no difference in cadence or angular parameters of the knee and hip.

**Conclusion:** The rocker sole modifies the kinematics of running and reduces ankle eversion during support, without changing the cadence or kinematics of the knee and hip.

**Keywords:** Footwear; Kinematics; Biomechanical Phenomena.

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