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

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Introduction: Rocker-soled shoes have mechanical advantages by redistributing load to the forefoot and reducing local overload, and are widely used for foot and ankle pathologies and in sports models. By creating a plantar volume proximal to the metatarsal heads, the rocker establishes a fulcrum during support and can modify biomechanics. Compared with conventional shoes, the rocker shifts the point of rotation, redistributes pressure, and can alter the kinematic demands on the hip, knee, and ankle. Although some studies show changes in gait parameters with rocker shoes, the findings are heterogeneous, and there remains a lack of evidence from standardized three-dimensional (3D) analysis protocols in healthy individuals. The objective of this study was to compare 3D kinematic gait parameters in healthy individuals walking in conventional versus rocker shoes, with the hypothesis that rocker shoes would reduce peak knee flexion and ankle eversion/inversion amplitudes.

Methods: Cross-sectional study with 20 healthy volunteers (12 men), with clinical alignment of the hindfoot between 0° and 10°. Patients with rigid deformities, prior foot surgery/fractures, rheumatic diseases, and other secondary causes of metatarsalgia were excluded. The following were compared: conventional shoes (flat, flexible sole; 13 mm; 6 mm drop; Ever Way® Marvin) and rocker shoes (rigid sole; 30 mm; apex at 60% of the length; radius 15.5 cm; Hoka® Gaviota 5). The 3D kinematics were collected by a Vicon system with eight cameras. The walk was performed on a treadmill for three minutes at 5.5 km/h.

Results: Age 27.9 ± 4.8 years. Conventional shoes showed higher peak knee flexion during support, higher peak and longer ankle eversion times, and lower peak ankle inversion ($p < 0.05$).

Conclusion: The rocker sole modifies gait kinematics in healthy individuals, reducing peak knee flexion and peak ankle eversion time, and increasing peak inversion time, compared to conventional shoes.

Keywords: Footwear; Kinematics; Biomechanical phenomena.

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