FOOT FUNCTION IN SPRINTING: BAREFOOT AND SPRINT SPIKE CONDITIONS

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INTRODUCTION: The mechanical energy contribution of the metatarsophalangeal joint (MPJ) during sprinting has implications for improving performance. Mechanical properties of sprint spikes have been demonstrated to influence sprinting performance (Stefanyshyn and Fusco, 2004) but little work has examined foot function in relation to normal barefoot behaviour. This study investigated the effect of footwear on MPJ kinematics, kinetics and forefoot pressure distribution, comparing sprint spike conditions to barefoot sprinting.

METHOD: Trained sprinters performed maximal sprints on a 55 m indoor runway, contacting a force platform in the middle (Kistler, Switzerland, sampling at 1000 Hz). Kinematic data was also captured at 1000 Hz using 6 opto-electronic cameras (Qualisys Inc, Sweden). Plantar pressure distribution was also collected using an RSScan pressure mat. Four initial subjects ran barefoot and wearing their own sprint spikes. Kinematic and kinetic data was smoothed using a digital filter with a 100 Hz cut off frequency. The MPJ was modelled as having a single, oblique axis defined by markers on the 1st and 5th metatarsal heads.

PRELIMINARY RESULTS: Sprint spikes reduced the range of motion and energy lost at the MPJ (Table 1). Although energy was predominantly absorbed for both conditions, spikes tended to increase energy generation at takeoff but overall they reduced energy production during stance. Barefoot pressure results demonstrated that although lateral loading was evident at touchdown, overall loading was confined to the medial side of the foot during stance and progressed medially and distally for takeoff. In spikes, the loading transition was similar but loading was further concentrated on metatarsals 1, 2 and the hallux.

Table 1 Comparison of MPJ kinematics and kinetics in barefoot and sprint spikes (n=4)

	Sprint Spikes	Barefoot
Angular range of motion (º)	35.6 (± 3.8)	50.0 (± 4.6)
Energy absorbed during MPJ flexion (J)	-29.7 (± 5.7)	-38.6 (± 13.5)
Energy generated at touchdown (J)	5.1 (± 2.4)	9.4 (± 3.6)
Energy generated at takeoff (J)	0.6 (±0.5)	0.1 (±0.1)

DISCUSSION: Regardless of footwear, energy was mostly absorbed at the MPJ, agreeing with Stefanyshyn and Nigg (1997); however this energy loss appears to be reduced wearing sprint spikes. Loading occurred medially, concurrent with the notion that the MPJ axis is centred on metatarsals 1-3 in sprinting. The application of appropriate bending stiffness in relation to the MPJ axis, along with medio-lateral differences, dictated by pressure findings, could affect MPJ energetics and sprinting performance and warrants future investigation.

CONCLUSION: Preliminary findings suggest substantial changes in foot function and performance related parameters between barefoot and shod sprinting.

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