

# **GAIT RELATED RISK FACTORS FOR EXERCISE-RELATED LOWER LEG PAIN DURING SHOD RUNNING**

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## **INTRODUCTION**

Exercise-related lower leg pain (ERLLP) is a common and enigmatic overuse problem in athletes and military populations (Beck, 1998). Runners, track athletes and athletes participating in jumping sports are frequently diagnosed with ERLLP which is usually induced by repetitive tibial strain imposed by loading during intensive, weight bearing activities. Retrospective studies have noted excessive dynamic foot pronation in subjects with a history of exercise-related lower leg pain (Messier and Pittala, 1988; Viitasalo and Kvist, 1983). A recent prospective investigation showed that subjects susceptible for ERLLP showed an altered barefoot running pattern which included a central heel strike, a significantly increased pronation, accompanied with more pressure underneath the medial side of the foot and a significantly more lateral roll-off (Willems et al., 2004). However, most of athletes perform their sports in shod condition; therefore, the purpose of the current study was to prospectively determine gait related risk factors for ERLLP during shod running in order to increase knowledge of the aetiology.

## **METHODS**

Subjects were 400 healthy undergraduate physical education students. 3D-gait kinematics combined with plantar pressure profiles were collected during shod running at a speed of 3.33m/s with a standard neutral shoe with a flat outsole. The experimental set-up consisted of a 2m x 0.4m AMTI-force platform set into a 16.5m indoor running surface. Plantar pressure data were collected with a Footscan pressure plate (RsScan Int, 2m x 0.4m, 2 sensors/cm<sup>2</sup>, 480Hz, dynamic calibration with AMTI), mounted on top of the force platform. Kinematics were collected at 240Hz using 7 infrared cameras (Proreflex) and Qualisys software. Marker placement and modeling was based on that of McClay and Manal (1999). 3D modeling with Visual3D (C-motion) rendered tri-planar motions of the rearfoot, lower leg and thigh. The 3D motions of the knee and ankle were investigated through positioning the distal segment relative to the proximal segment.

After the evaluation, all sports injuries were registered by the same sports physician during a certain period.

## **RESULTS**

During the follow-up period, 46 of the subjects developed ERLLP, of whom 29 subjects had bilateral complaints. So 75 symptomatic lower legs, 35 left and 40 right were classified into the ERLLP group. As control group, bilateral feet of 167 subjects who had no injuries at the lower extremities were selected.

Results of the Cox regression analysis (Table 1) of the 3D kinematic data revealed that the shod gait pattern of subjects who will develop ERLLP has typical characteristics of a significantly increased tri-planar pronation excursion (eversion+abduction+dorsiflexion). Timing of maximal eversion is significantly delayed and re-inversion velocity is significantly increased in the injury group.

Results of the analysis of the plantar pressure data are soon expected and will be submitted for the Nike Award during May.

The results of this study affirm earlier findings of an association between an increased pronation during barefoot running and ERLLP (Willems et al., 2004). When the rearfoot pronates, the foot becomes a mobile adaptor that allows shock attenuation. Because the rearfoot and knee are mechanically linked by the tibia and because of the inclined axis of the subtalar joint in the sagittal plane, pronation in the foot normally leads to internal rotation at the knee (McClay and Manal, 1997; Hamill et al. 1992). However, as we see in our study that pronation at the rearfoot is increased in our injury group but the internal rotation at the knee is not increased, these motions could be absorbed by musculoskeletal structures in the lower leg itself. This could lead to excessive midtibial torsion stress during the stance phase. On the other hand, increased inversion moments may be associated with the excessive pronation as the invertor musculature attempts to control the motion. This may lead to excessive eccentric traction to the plantar flexor and invertor musculature which has their origin on the medial and posterior region of the tibia. However, these relationships were identified in a cohort population, and do not always exist on individual level. Not every identified risk factor was present in every subject who developed ERLLP.

The findings of this study during shod running show the same trends of increased pronation and accelerated resupination as during barefoot running (Willems et al., 2004).

**Table:** Mean and SD for significant contributors for ERLLP by univariate Cox regression analysis

	<b>Uninjured</b>	<b>Injured</b>	<b>P-value</b>
<b>Tri-planar pronation excursion</b>	50.3 ± 8.1	54.2 ± 10.1	.007
<b>Timing of maximal eversion (% of stance phase)</b>	47.2 ± 12.1	51.8 ± 10.0	.011
<b>Mean re-inversion velocity (°/s)</b>	81.6 ± 50.4	96.7 ± 136	.049

## CONCLUSION

This is the first prospective study that identified an increased and delayed maximal pronation and accelerated resupination during shod running as risk factors for ERLLP. To prevent these overuse injuries, athletes should be screened on identified risk factors and these parameters should be adapted.

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