The Effects of Forefoot and Rearfoot Loading on Knee Pain in Female Recreational Runners

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Introduction

Recreational runners typically present with a rearfoot or forefoot strike pattern and often report knee pain. Injuries occur in about 19%-79% of runners. The majority are overuse injuries where a structure is repeatedly exposed to loading forces. The predominant site of LE injury is the knee, ranging from 7.2%-50% incidence in runners. Forefoot striking has been found to transform ground reaction forces into kinetic energy[1] which can be better for the knee joint and those that have knee joint problems[2] such as pain or an unstable ACL. This can be due to the fact that forefoot running has lower anterior-posterior and loading reaction forces at the knee joint. In return, this pattern can result in higher stress at the ankle joint and a shorter stride length[1]. Rearfoot running, in contrast, has been shown to be better for those with a history of ankle injuries as it produces a low shearing force at the joint[2]. It produces high vertical loading rates and a "high-magnitude abrupt force" that is transmitted through the lower extremity with little dissipation during initial contact[1]. The purpose of this study is to determine how strike pattern effects forces at the knee joint during recreational running in relation to potential pathologies. We hypothesize that rear foot loading (RFL) will increase ground reaction forces at the knee joint in comparison to forefoot loading (FFL).

Methodology:

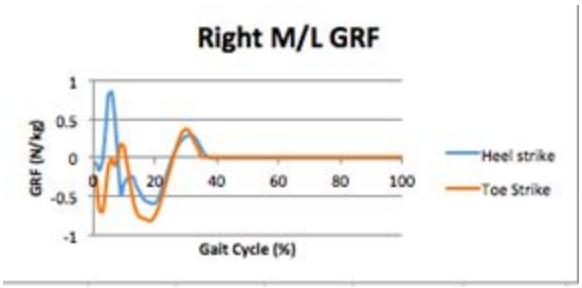
Two college aged female recreational runners, naturally rearfoot runners, were selected for our study. Kinetic and kinematic 3D data was collected for three trials for both rearfoot and forefoot running using 8 cameras at 120 Hz with the plug in gait Vicon system positioned around the force plate. Data was collected for anterior posterior, medial lateral, and vertical impact peak max and min of trials of each pattern per participant.

Results

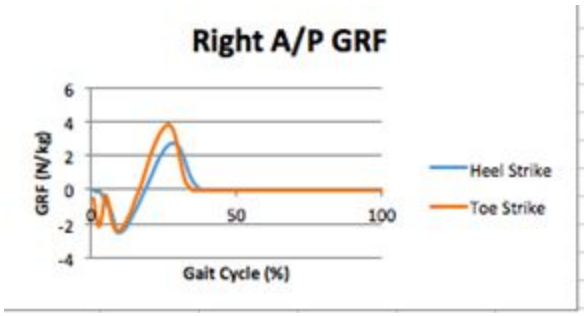
When looking at the vertical ground reaction forces between the two running forms, the largest difference is that rearfoot strike patterns present with an impact peak. An impact peak is the initial force applied to the ground by the foot and lower leg at initial heel contact. After this impact peak however, the active peaks are equal when comparing the forefoot and rearfoot strike patterns. The active peak represents the force applied by the foot and supported body weight during roughly mid-stance.

Impact Peaks:

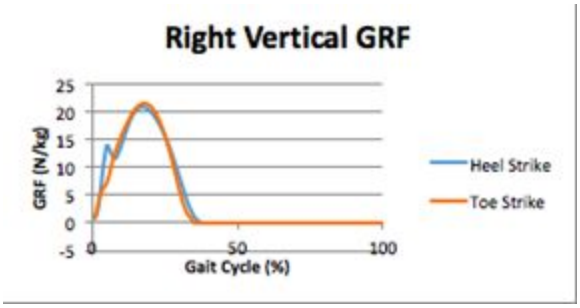
Graph 1:



Graph 2:



Graph 3:



Discussions

Forefoot strike pattern was found to have a greater anterior ground reaction force compared to a rearfoot strike. Whereas, peak medial/lateral ground reaction forces were found to be larger in those that heel strike. These differences in peak forces may result in overuse injuries at the joints more susceptible to these forces. Both conditions had the same impulses when disregarding the impact peak force produced with rearfoot strike running. The active peak vertical and posterior ground reaction forces showed to be similar in both conditions. It is also noted that these results that are discussed are collected from asymptomatic runners.

Conclusions

Our hypothesis that increased ground reaction forces (GRF) would be seen with rearfoot running was shown to have no significant differences between the forces created with forefoot running. When there is no pathology present, GRF will be similar in forefoot versus rearfoot running. One style of running is shown to not be superior over another in regards to injury, especially when you have used one pattern for a long time and intend to switch. There are extraneous factors to consider when considering changing running patterns such as past injury history.

Clinical Implications

Clinically we can use this study to allow patients to self-select their running style to conserve energy and decrease risk of injury. In the presence of a pathology, additional data gathered from the Vicon system could assist in making biomechanical changes to address impairments.

References:

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4.Van Der Worp MP, Ten Haaf DSM, Van Cingel R, et al. Collection review injuries in runners; a systematic review on risk factors and sex differences. *PLos one.* 2015.