

ENERGY RETURN OF DIFFERENT DESIGNS OF TRACK SPIKES

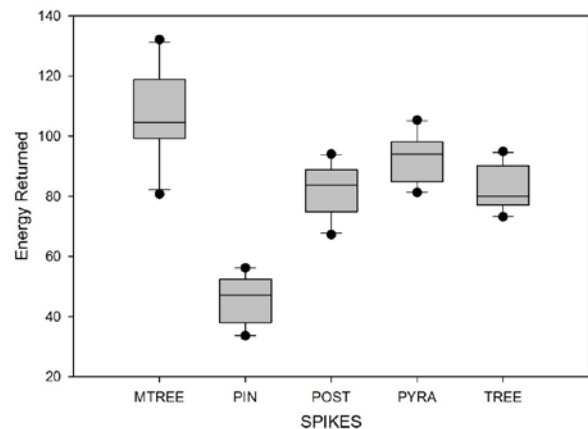
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INTRODUCTION: Advances in technology and design have generated changes to the traditional track spike. Today, there are a number of different spike shapes, the four most common being needle, pyramid, post, and Christmas tree and modified Christmas tree (the last two are also referred to as “compression tier”) (see Figure 1). Running magazines, product advertisements, coaches, and manufacturers make claims about the potential effects of each type of spike design and their use in different situations. To our knowledge, these types of claims and other information regarding spikes or track surfaces, have not been tested and reported in the peer-reviewed literature.



METHODS: The purpose of this preliminary study was to examine whether different shaped spikes elicit quantifiable differences in energy return on a [Mondo track surface](#), the most commonly used at track venues. Five different shaped spikes all 7mm in length were used in this study (see Figure #1). The spikes chosen are those commonly used by athletes on various indoor and outdoor track surfaces. The load-deformation between the spikes the track was measured using a Bose Electroforce 3200 (Eden Prairie, MN) testing device. OneWay ANOVAs using Sigma Plot 10.5 (Systat Inc., Richmond, CA) were performed to test for significant differences between spikes. Tukey post-hoc comparisons were performed at the $p=0.05$ level.

RESULTS: Figure 2 shows the ANOVA results [$F(4,49)=54.78, p<.001$] and Tukey post-hoc comparison for the energy returned. The MTREE spike generated the greatest amount of energy returned and was significantly different from the other spikes ($p<=0.05$). The PYRA spike generated second largest amount of energy returned and was significant different from the PIN and POST spikes. The PIN or needle spike, as expected, had the least amount of energy returned. All spikes penetrated the track surface.



DISCUSSION: The notion that compression spikes have less track penetration is unfounded. All the spikes tested penetrated the track under loads less than 105 N. Considering that vertical ground reaction force (GRF) increases linearly during walking and running from 1.2 BW to approximately 2.5 BW at 6.0 m s^{-1} and remains constant during forward lean sprinting at higher speeds, the likelihood of any of the tested spikes not penetrating the Mondo track surface seems improbable (Keller et al., 1996). For the Mondo track the spike with the largest energy return was the MTREE design. This MTREE provided the largest spike surface area, which helped it to compress the track. The common PIN design provided the least energy return but absorbed the least amount of energy. All the compression spikes seem to provide larger amounts of energy return when compared to the PIN. The measured energy returned by the various spikes is relatively small ($\text{N}\cdot\text{mm}$). However, for this study, the energy return was determined for only one spike while most sprint shoes have a sole plate with up to 10 mounted spikes. While it is difficult to assess how much of the energy returned in the spike-track surface interaction might actually aid the sprinter, these findings are nevertheless noteworthy. It is not uncommon for results in sprint races to be separated by only thousandths of a second, where even small levels of energy return could potentially make the difference between winning or losing a race.

CONCLUSION: This study shows that spike design affects the amount of energy returned and absorbed by a Mondo track surface. While all of the spikes tested penetrated the track surface, the modified Christmas tree design returned the most energy on the Mondo surface. Knowledge of which spike design offers the highest energy return on the various track surfaces that athletes compete on could be useful to coaches and athletes, as well as, spike and track manufacturers and thus is worthy of further investigation.

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