

# Does Increasing the Toe Box of Shoes Improve Athletic Performance?

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## Summary

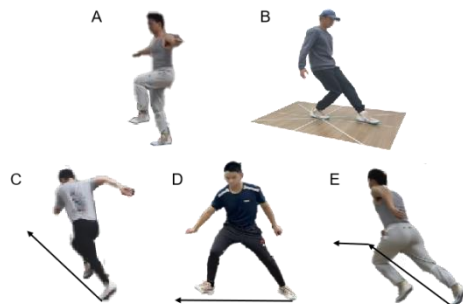
The research sought to determine whether a larger toe box, designed to provide a greater range of motion for the metatarsophalangeal joint, could enhance athletic abilities such as static and dynamic stability, longitudinal propulsion, and the efficiency of direction changes. Forty-five participants were recruited for the experiment, and they wore shoes with toe boxes enlarged to varying degrees during the sports tests. The results indicated that an enlarged toe box could improve the athletic performance of basketball players, which has significant implications for shoe design.

## Introduction

A narrow toe box may lead to toe deformities, hallux valgus, poor foot blood circulation, and an increase in peak plantar pressure [1][2]. Enlarging the toe box is of great benefit to foot health, but whether it is beneficial to athletic performance remains to be verified. Therefore, in this study, parametric design was carried out on basketball shoes, and experiments were conducted to explore the impact of increasing the toe box size of shoes on athletic performance, so as to provide a reference for basketball shoe design.

## Methods

Thirty college students and fifteen adolescent basketball enthusiasts were recruited for the experiment. The biomechanical parameters of the subjects during common basketball movements while wearing different experimental shoes were captured. Before the experiment, the research team gave a comprehensive explanation and training on the movements to ensure the standardization of the subjects' actions. The subjects signed informed consent forms.



**Figure 1:** Sports test movements: A. Static stability tests, B. Dynamic stability tests, C. Forward movement tests, D. and E. Lateral movement tests.

The experiment was divided into static stability tests, dynamic stability tests, forward movement tests, and lateral movement tests (Figure 1) to analyze the impact of parametric design on shoe performance from different perspectives [3]. After the tests, a Likert scale was used to collect the evaluations of the subjects.

## Results and Discussion

Widening the toe box can extend the single-leg standing time, improve the eight-point star excursion balance score, shorten the sprint, lateral sliding, and sidestep cutting times. Therefore, widening the toe box has a significant impact on both static and dynamic stability, as well as forward and lateral athletic performance. Moreover, widening the toe box by 3mm leads to a greater improvement in athletic performance compared to widening it by 1.5mm. Compared with college students, adolescents have better static stability, but their dynamic stability and forward and lateral athletic performance are relatively poor.

## Conclusions

Basketball shoes with an enlarged toe box can enable athletes to perform better on the basketball court, which is of great significance for the production and selection of basketball shoes.

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