A PROSPECTIVE STUDY OF LOADING VARIABLES IN FEMALE RUNNERS WHO DEVELOP PLANTAR FASCIITIS

Bradley Bowser¹, Joseph Hamill² and Irene Davis¹,³

¹University of Delaware, Newark, DE, USA
²University of Massachusetts, Amherst, MA, USA
³Drayer Physical Therapy Institute, Hummelstown, PA, USA
email: bbowser@udel.edu

INTRODUCTION

Plantar fasciitis is reported to be one of the top 3 overuse injuries and one of the top 5 of all injuries sustained by runners [1, 2]. The primary cause of this injury is often attributed to a repetitive stress or overloading of the plantar fascia. Excessive pronation, a flat or cavus foot, and limited dorsiflexion have frequently been cited as predisposers to plantar fasciitis. However, few studies have examined the potential role that loading variables may play in this injury.

The plantar fascia plays an integral role in maintaining the integrity of the longitudinal arch of the foot. Integrity of the arch is maintained by the plantar fascia creating tension between the calcaneous and metatarsal heads. As the foot is loaded in running, this tension increases to maintain stability of the arch. However, runners who have higher than normal external forces, thereby loading the foot more quickly, may be placing greater rates of tension on the plantar fascia. These conditions may place runners at an increased risk for developing plantar fasciitis.

One retrospective analysis has indicated that runners with a history of plantar fasciitis had significantly higher vertical load rates than healthy controls [3]. However, with retrospective analyses, it is difficult to ascertain whether differences between an injured and a control group were a result of the injury or some other unknown factor. It is therefore imperative to look at the prospective nature of this injury.

The purpose of this study was to compare vertical loading rates, vertical impact peak, and peak positive acceleration between female runners who go on to develop plantar fasciitis (PF) and runners who have never reported any running injury (CON). We hypothesized that the PF group would display higher vertical loading rates, vertical impact peaks, and peak positive accelerations of the tibia compared to the CON group.

METHODS

These data are part of a larger study examining prospective running injuries. Female runners between the ages of 18 and 45 years who run a minimum of 20 miles/week were recruited to participate. Participants were required to be injury free for the previous two months before beginning the study. Upon entering the study, ground reaction force and tibial accelerometer data (960 Hz) were collected while participants ran over-ground at 3.7 m·s⁻¹ (± 5%). Five acceptable trials were captured.

Each runner’s mileage and injuries were then tracked monthly for a 2 year period. During the 2 year follow-up period, 10 participants (age = 28 ± 8 yrs) running 23 ± 8 miles per week, were diagnosed by a clinician with plantar fasciitis. The PF group was compared to a CON group of 10 runners (age 24 ± 8 yrs), running 23 ± 9 miles per week. The CON group was also followed for 2 years and never reported a running injury.

Vertical loading rates (instantaneous (VILR) and average (VALR)), impact peaks (VIP), and peak positive accelerations (PPA) of the tibia were compared across groups. Descriptive statistics including percent difference and effect size (ES) were used to quantify any group differences. ES was calculated as the difference between the two group means divided by the pooled standard deviation. ES was defined as small (d = 0.2), medium (d = 0.4), and large (d = 0.8).
RESULTS AND DISCUSSION

Differences between the PF and CON groups are displayed in Figures 1 and 2. ES was considered large for all variables (VILR, $d = 1.20$; VALR, $d = 1.29$; VIP, $d = 0.89$; PPA, $d = 0.98$)

The rates at which external forces are applied to the foot and leg during running occur more rapidly in runners who go on to develop plantar fasciitis. This is evidenced by the VILR and VALR being 40% higher in the PF group when compared to the CON group. Additionally, the external load itself is also higher in the control group with VIP and PPA being 15% and 76% higher, respectively, for the PF group.

The increases in external loads and loading rates to the foot while running may be increasing the load and strain rates on the plantar fascia. These mechanical changes to the plantar fascia during running may be associated with the development of plantar fasciitis for those in the PF group.

The results of this study coincide with those found in a retrospective study comparing similar groups. Although the percent differences were not as large as those found in this present study, Pohl et al. reported that runners with a history of plantar fasciitis display higher external loading (8% higher) and loading rates (21% faster) to the foot while running than an uninjured group of runners [3].

High loading rates, impact peaks and PPA of the tibia have all been linked to other running injuries such as stress fractures and patellofemoral pain syndrome [4, 5]. Interventions, such as gait retraining, have been shown to reduce impact loading by teaching runners to land softer [6]. It is possible that decreasing these loading variables may decrease the risk for not only plantar fasciitis, but also other common running injuries.

CONCLUSIONS

The results of this prospective data suggest that runners who have high vertical loading rates, impact peaks, and PPA of the tibia while running may be predisposed to developing plantar fasciitis. Understanding these mechanical differences will aid clinicians in developing optimal treatment plans to help prevent plantar fasciitis. Future studies may include regression models, which include multiple factors, to more accurately predict those who may be at risk for developing plantar fasciitis.

REFERENCES


ACKNOWLEDGEMENTS

Supported by Department of Defense grant DAMD17-00-1-5