

Does increased loading during running lead to tibial stress fractures? A prospective study

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Stress fractures are among the most serious injuries a runner can sustain. The majority of these fractures occur in the tibia, and females are twice as likely to sustain this injury compared to males. Stress fractures are thought to be related, in part, to abnormal loading during running. While retrospective studies are informative, prospective studies are essential to establish cause and effect.

PURPOSE: The purpose of this study was to examine, prospectively, the relationship between measures of increased loading and the incidence of tibial stress fractures (TSF) in competitive women runners. It was hypothesized that runners who sustained a TSF would have greater tibial shock, peak vertical forces, vertical loading rates and lower extremity stiffness than those who did not experience one. **METHODS:** Currently 5 runners have sustained a documented TSF or tibial stress reaction, the precursor to TSF. Five age and mileage matched runners served as controls. Tibial accelerometry and ground reaction forces were collected at 960 Hz as subjects traversed a force plate centered on a 25 m runway at 3.8 m/s. Five trials were averaged for the analysis. Peak positive acceleration (PPA), peak vertical ground reaction force (PVGRF), instantaneous load rate (ILR) and average load rate (ALR), as well as lower extremity stiffness (K) were all examined.

RESULTS:

	PPA(g)	PVGRF(bw)	ILR (bw/s)	ALR (bw/s)	K (kN/m)
TSF	9.06	2.55	112.88	88.20	9.21
Controls	4.73	2.63	81.03	62.91	9.63
P	0.06	0.15	0.04	0.06	0.30

While these data are preliminary, they appear to suggest that runners who sustain a tibial stress fracture exhibit evidence of increased lower extremity loading, including increased tibial shock, and instantaneous and average vertical loading rates, prior to injury. While stiffness has been shown to be related to load rate, increases in lower extremity stiffness were not found in these subjects.

CONCLUSIONS: Based upon the results of these preliminary data, it appears that tibial shock and vertical load rates are increased in female runners who develop TSF.

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