**Introduction:**
In previous human in vivo measurement, middle third tibial diaphyseal strains even during vigorous activities have not been found to exceed 2500 microstrains in compression or tension \([1,2]\). These values are far below those found to be necessary in ex vivo studies to fatigue cortical bone, suggesting that a bone remodeling response may be associated with tibial stress fractures \([3,4]\). The observed clinical course of metatarsal stress fractures suggests that they may occur without an intermediate remodeling response. Often a frank metatarsal stress fracture is seen in a recruit at the end of a long march who was entirely asymptomatic at the beginning. The purpose of this study was to see if 2nd metatarsal compression and tension strains can reach levels high enough to theoretically fatigue fracture the bone secondary to the number of loading cycles which occur during a long march or prolonged exertional activity.

**Methods:**
Simultaneous in vivo tibial and 2nd metatarsal axial strains were measured in two male subjects and (age 40, 78 kilos with pes planus foot type and age 54, 82 kilos with pes cavus foot type). All procedures were approved by the Helsinki Committee. Strain gauged staples (3M 16x15 bone staples with two strain gauges EA-06-031DE-350 and EA-06-031EC-350 mounted perpendicular to each other on the undersurface of the staple bridge) were implanted in the mid diaphysis of the medial tibial cortex and in the dorsal surface of the 2nd metatarsus under local anesthesia (Fig. 1). Measurements were made during treadmill walking at 5 km/hr and treadmill jogging at 11 km/hr while barefoot and while wearing Nike Air running shoes. Measurements were made while performing a 50 cm broad jump and a 1 km/hr while barefoot and while wearing Nike Air running shoes. Shear strains were not measured in this experiment.

**Results:**
Metatarsal compression and tension strains and strain rates while wearing running shoes for both subjects were significantly higher than those of the tibia for all activities except for treadmill jogging in tension and tension strain rate. Metatarsal compression and tension strains and strain rates during treadmill walking and jogging barefoot were significantly higher than during treadmill walking and jogging wearing running shoes for the subject with pes planus. A peak axial compression strain of 5766 microstrains was reached for the pes planus subject during treadmill jogging barefoot.

**Fig. 1.**

**References:**

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