DYNAMIC SYMMETRY IN FEMALE RUNNERS WITH A HISTORY OF TIBIAL STRESS FRACTURES

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INTRODUCTION

Change in gait symmetry, assessed using a variety of kinetic or kinematic measures, is observed across many pathologies affecting gait [1]. The observed asymmetries are typically viewed clinically as a pathological by-product of the affliction and efforts are expended to correct the asymmetry [2]. Newer research has however suggested that some degree of asymmetry is present in healthy non-afflicted individuals and may actually be functional [1]. Further, spatio-temporal symmetry measures derived from dynamical systems techniques, such as continuous relative phase (CRP), have been shown to change in locomotion based on the constraints of the task [3]. This past research suggests that changes in limb symmetry may not be a symptom of pathology, but rather a functional mechanism utilized by the body to cope with altered mechanical constraints caused by injury.

The purpose of this study was to examine changes in spatio-temporal gait symmetry in asymptomatic female runners who had previously experienced a unilateral tibial stress fracture (TSF) compared to a control group (CTRL) of mileage matched female runners. It was hypothesized that the TSF group would show increases in limb asymmetry compared to the CTRL group.

METHODS

Fifteen female runners with a unilateral retrospective tibial stress fracture (TSF) and 15 mileage matched control (CTRL) subjects were recruited for this study. All volunteers were female, rearfoot strikers who ran at least 20 miles per week and were free of any lower extremity injuries at the time of data collection.

Subjects ran along a 25 m runway at a speed of 3.65 m/s (± 5%). Three-dimensional kinematic data (120 Hz) were collected using a six-camera high-speed motion capture system. Five trials were collected for both the left and right limbs. For each subject, the profiles of the ankle, knee and hip sagittal view angles were interpolated to 100% of stance.

CRP was calculated bilaterally in the hip-knee and knee-ankle coupling of both groups. Spatio-temporal asymmetry was calculated as the difference in CRP patterns between involved and contralateral limb of the TSF subjects and the right and left limbs of the CRTL subjects in the hip-knee and knee-ankle couplings. Through these calculations, a time series about 0^{o} indicates perfect spatio-temporal symmetry across the stance phase whereas deviations from zero represent a magnitude of asymmetry.

Effect size (ES) was calculated to express differences between groups relative to the pooled standard deviation. Cohen (1988) proposed that ES values of 0.2 represented small differences; 0.5, moderate differences; and 0.8+, large differences [4]. Effect sizes greater that 0.5 were considered clinically important.

RESULTS AND DISCUSSION

In both hip-knee (ES=0.52) and knee-ankle (ES=0.5) couplings moderate effects were seen between the TSF and CTRL group, where increases in asymmetry were seen in the TSF group (Figure 1).

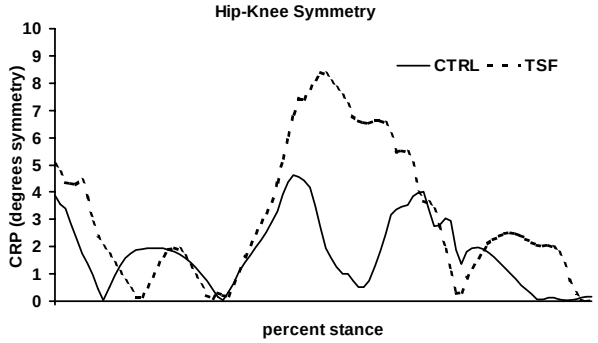

Figure 1: Between subject average of hip-knee CRP symmetry in both the stress fractured and control group.

Although effect sizes between groups were only moderate, it is interesting to note that all subjects were asymptomatic at the time of collection, showing that spatio-temporal asymmetry is present in female runners with a history of tibial stress fractures.

CONCLUSIONS

Female runners with a history of stress fractures show differences in spatio-temporal gait asymmetry compared to a healthy group. Although prospective studies are needed to determine whether this asymmetry is a cause or a result of the injury, this study adds to a growing body of literature that suggests gait asymmetry may be a functional adaptation utilized to cope with the injury.

REFERENCES

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