ASSOCIATION BETWEEN ILIOTIBIAL BAND SYNDROME STATUS AND RUNNING BIOMECHANICS IN WOMEN

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INTRODUCTION

Iliotibial band syndrome (ITBS) is a common overuse running injury. Atypical secondary plane lower-extremity and trunk biomechanics during running are likely to play a role in the etiology of ITBS [1, 2]. Proximal factors such as a large hip adduction angle may increase the tensile strain in the iliotibial band during the stance phase of running [1]. A lack of ability to limit hip adduction may be due to hip abductor muscle weakness [1]. Furthermore, it has been postulated that runners with ITBS exhibit contralateral pelvic drop coupled with trunk lateral flexion away from the stance limb [2]. In this scenario, the whole body center of mass moves away from the stance limb. This would increase the moment arm between the knee joint and resultant ground reaction force. Consequently, a greater external knee adduction moment is produced potentially resulting in greater tensile strain in the iliotibial band [2]. In the transverse plane, the iliotibial band functions to limit knee internal rotation [3]. Excessive knee internal rotation may also increase the strain experienced by the iliotibial band [1]. The aforementioned joint and segment variables provide indirect information about the status of the iliotibial band during running. Musculoskeletal modeling and simulation can complement biomechanical analyses of lower-extremity joint motion to investigate how running pattern affects iliotibial band strain. Therefore, the purpose of this cross-sectional study was to determine if biomechanics during the stance phase of overground running, as well as isometric hip abduction strength differ among female runners with current ITBS, previous ITBS, and controls. It was hypothesized that biomechanics during running would differ among groups in peak: trunk contralateral flexion, contralateral pelvic drop, hip adduction, knee internal rotation, iliotibial band strain, and external knee adduction moment. Second, we hypothesized that hip abduction strength would be less in runners with current ITBS and previous ITBS compared to controls.

METHODS

As part of an ongoing investigation examining biomechanical factors associated with ITBS, 21 female runners between the ages of 18 and 45 were recruited. All procedures were approved by the Institutional Review Board prior to the commencement of the study. All women provided written informed consent prior to participating. Participants comprised three groups: current ITBS (n = 7 ; age: 25.9 ± 8.6 years; height: 1.63 ± 0.04 m; mass: 52.1 ± 3.3 kg; weekly mileage: 22.1 ± 16.9 mi·wk^{-1}), previous ITBS (n = 7 ; age: 25.0 ± 4.7 years; height: 1.67 ± 0.04 m; mass: 63.7 ± 10.4 kg; weekly mileage: 24.4 ± 12.8 mi·wk^{-1}), and controls (n = 7; age: 26.3 ± 7.5 years; height: 1.70 ± 0.04 m; mass: 58.6 ± 6.0 kg; weekly mileage: 28.1 ± 14.6 mi·wk^{-1}). Overground running data were collected using standard three-dimensional motion capture techniques. Passive reflective markers were placed bilaterally on the lower-extremity and trunk. Standard laboratory footwear was worn by participants. Marker trajectories were collected using a 9 camera motion capture system sampling at 120 Hz. Participants ran at a velocity of 3.5 m·s^{-1} ± 0.18 m·s^{-1} over a 17 m runway for 5 acceptable trials. A force plate sampling at 1200 Hz was used to determine the stance phase of the limb of interest. After completing the running trials, isometric hip abduction strength was measured using a hand-held dynamometer [4]. Right hip abductor strength was measured in the controls and previously or currently injured side measured in the ITBS groups. Hip abduction strength was normalized by participant body weight and height [3]. Kinematic data were processed using a joint coordinate systems method. Peak values of the joint and segment variables from five running trials were extracted from the first 60% of stance: trunk lateral flexion, contralateral pelvic drop, hip adduction, knee internal rotation, and external knee adduction moment. Musculoskeletal modeling of the iliotibial band and dynamic simulation of the running trials were performed in OpenSim [5] using a model developed previously [6]. Dependent variables from the running trials were averaged for each participant and group. Data were analyzed using descriptive statistics and one-way analysis of variance. *Post hoc* Fisher's least significant difference test was used to determine where any significant differences existed among dependent variables. Given the preliminary status of the study an alpha level of 0.10 was set for all statistical tests.

RESULTS AND DISCUSSION

Peak hip adduction during running was different among groups (Table 1; $P = 0.044$). Runners with previous ITBS exhibited deceased hip adduction compared to controls during overground running. Additionally, isometric hip abduction strength ($P = 0.095$) was different among groups. Hip abduction strength was less in runners with previous ITBS compared to controls. All other dependent variables were similar among groups.

No previous study has compared biomechanics during running and hip abduction strength among female runners with current ITBS, previous ITBS, and controls. Therefore, the purpose of this investigation was to determine if differences exist in secondary plane joint and segment biomechanics, iliotibial band strain, and hip abduction strength among the three groups. However, these preliminary findings do not support our hypotheses. Interestingly, runners with previous ITBS exhibited less hip abduction strength than controls. Hip abductor weakness has been suggested to be associated with increased hip adduction exhibited by runners with ITBS [1, 3]. However, our results indicate the opposite. Peak hip adduction angle was less in runners with previous ITBS compared to controls. Thus, hip abduction strength may not influence hip position during running.

CONCLUSIONS

Our preliminary data indicate that female runners with previous ITBS exhibit decreased peak hip adduction angle and hip abduction strength compared to controls. This suggests that large peak hip adduction angle may not be an etiological factor associated with ITBS.

REFERENCES

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Table 1: Peak biomechanical variables of interest during overground running, and hip strength among runners with current iliotibial band syndrome (ITBS), previous ITBS, and control groups (mean ± standard deviation)

	Current ITBS	Previous ITBS	Controls	*P*-value
Iliotibial Band Strain (%)	1.9 ± 1.2	2.2 ± 0.9	2.3 ± 0.9	0.719
Trunk Ipsilateral Flexion (º)	5.1 ± 1.6	3.8 ± 1.5	3.5 ± 1.8	0.160
Contralateral Pelvic Drop (º)	-6.6 ± 3.2	-3.9 ± 1.7	-5.8 ± 1.7	0.111
Hip Adduction Angle (º)	16.7 ± 2.9	13.8 ± 1.7	17.2 ± 2.8	0.021*
Knee Internal Rotation (º)	4.1 ± 6.5	4.2 ± 7.9	2.4 ± 3.7	0.832
Knee Adduction Moment ($Nm{\cdot}kg^{-1}$)	0.9 ± 0.2	1.0 ± 4.2	1.2 ± 0.7	0.588
Hip Abduction Strength (% BW*h)	19.7 ± 2.4	14.1 ± 5.6	22.7 ± 0.9	0.036*

* Indicates a significant difference between runners with previous iliotibial band syndrome and controls