A PROPOSED METHODOLOGY TO INVESTIGATE THE BIOMECHANICAL VARIABLES IN DISTANCE RUNNERS

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INTRODUCTION

Iliotibial Band Syndrome (ITBS) is a common injury among female runners and other athletes that perform repetitive flexion and extension of the knee. 22% of all lower extremity injuries comprise of ITBS [1], being characterized by pain in either the lateral knee or the hip while exercising. Even when the pain may contribute to changes in running performance and technique, runners continue to run their normal schedules, potentially altering running characteristics and worsening the injury.

Previous studies have investigated some kinematic and spatiotemporal parameters related to ITBS; however, no studies have performed a comprehensive overview of all these characteristics to describe the mechanism of adaptation acquired by these athletes. Most of these studies are limited due to the difficulty of capturing the motion, as well as sweat and the impact force of running causing the markers to fall off the body. For this, most studies have focused on a controlled set of variables. The purpose of this pilot study is to create an appropriate methodology to obtain a logical protocol to measure spatiotemporal and kinematic parameters, level of exertion, and pain during a run to determine the effects of ITBS on running mechanics.

METHODS

A female participant (age=21 years, mass=37 kg, height=143 cm, distance running experience=7 years) was recruited to test the proposed methodology. After consent was obtained, the participant was instructed to avoid exercise 48 hours prior to data collection, to prepare day-of as if running a race, and to wear spandex attire/normal running shoes. Upon arriving to the lab, a stretching warm-up time was given, then an investigator applied 31 reflective body markers on the lower body of the participant, securing them with kinesio tape to avoid markers falling off during the run. The participant was then directed to the treadmill. Once on the treadmill, the participant began a 5-minute self-selected slow velocity warm-up, followed by a 5-minute adjustment time to alter the running pace to a self-selected sub-max intensity (80% of calculated age-related max heart rate) velocity that could be maintained for at least 45 minutes. Once the running velocity was selected, the participant ran for 30 minutes, followed by a 5-minute cooldown, for a total of 45-minutes of running. This protocol was selected as it is similar to a study that investigated the effects of patellofemoral pain syndrome on running mechanics [2].

During the 30-minute run, exertion scale (Borg exertion scale), pain scale (Graphic rating scale), and heart rate (Polar heart monitor) were recorded every 5 minutes. Motion capture (Qualisys 3D motion system) was collected for 30-seconds at the 14:30- and 39:30-minute trial marks and processed with Kwon 3D 5.1 motion analysis system. To measure biomechanical changes during the run, range of motion (ROM) of the lower limbs (i.e., hip, knee, and ankle sagittal ROM, and hip and ankle frontal ROM), spatiotemporal parameters (i.e., step width, cadence, stance and swing time), and segment velocities (i.e., thigh, shank, and foot) were extracted.

For motion analysis, medial markers were removed during the run and rigid segment methods were used as follows:

- To track the medial knee marker: tibial tuberosity, fibular proximal head, and lateral knee markers were used.
- To track the medial ankle marker: knee joint center, and mid-shank and lateral ankle markers were used.

Joint ROM was calculated relating the distal segment to the proximal segment. Cadence was calculated as the number of times the heel markers were positioned at the lowest vertical position in a minute. Step width was calculated from the mediolateral position of the right foot center at the left foot's mid-swing event, to the mediolateral position of the left foot center at the right foot's mid-swing event. Stance phase is the time the foot is in contact with the treadmill band, defined between the foot contact and toe-off events, while the swing phase is when the foot is in the air, defined between the toe-off and the foot contact events. Finally, the segment velocities were calculated as the first derivative of the segment positions.

RESULTS AND DISCUSSION

Our results showed consistency of measurements in joint angles (Table 1), spatiotemporal parameters, and segment velocities through the initiation and ending of the 30-minute high intensity run.

	Early ROM	Late ROM
Hip	71.83	70.87
Knee	119.21	120.55
Ankle	72.08	73.61

Table 1. ROM (reported in deg) during the early and late stages of the run

SIGNIFICANCE

This pilot study showed that the proposed methodology can correctly report kinematic and spatiotemporal parameters during a long-distance run. The next step of this study is to investigate running biomechanical effects of ITBS and compare them to healthy matched participants. From this comparison, we intend to give a better picture of the effects of ITBS and to improve training programs to avoid further injury.

REFERENCES

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