Foot Loading Differences During Overground and Treadmill Walking

Milad Zarei, MaCalus H. Hogan, William J. Anderst
Biodynamics Lab, Department of Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, PA, USA
Biodynamics Lab Website: bdl.pitt.edu

Introduction

Background
• Although there are studies comparing treadmill and overground walking in terms of joint kinematics and kinetics, there is a paucity of data comparing foot loading during treadmill and overground gait [1-5].
• The natural side-to-side variability in foot loading is unknown in healthy individuals.
• The difference between overground and treadmill walking on foot loading is unknown as well.

Aims
• Establish the natural side-to-side variability in healthy subjects.
• Determine if there are any differences in plantar pressure during overground versus treadmill walking.

Hypothesis
• The plantar loading is lower in treadmill walking due to the backward motion of the tread relative to the body in comparison to overground walking.

Methods

Subjects
• 20 healthy subjects (30.7±6.3 years old, 10 Male/10 Female) provided informed consent prior to participating in this IRB-approved study.

Data Collection
• Subjects walked 4 times across a 6.9 m walkway at a self-selected speed.
• Subjects then walked 8 times on an instrumented treadmill at a speed that matched their overground walking speed.
• Reflective markers were placed on the torso to determine the walking speed using a conventional motion capture system (Vicon Vantage) (100 Hz).
• An insole pressure system (Novel) was used to collect bilateral plantar pressure data (100 Hz).

Data Processing
• The foot was divided into 9 regions [7] (Figure 1).
• The plantar pressure was normalized to body weight.
• The peak of the average plantar pressure within each area was calculated for each step and averaged over overground and treadmill walking trials.
• The average absolute value of side-to-side difference (SSD) in plantar loading was determined for each of the 9 regions.
• Left and right foot regional loading values were averaged within each subject to compare overground and treadmill walking.
• Paired t-tests were performed to identify significant differences between overground and treadmill plantar pressure within each of the 9 regions.

Results

A total of 304 overground and 615 treadmill steps were analyzed.
• The SSD of plantar pressure was less than 17% in overground walking. (Figure 2)
• The SSD of plantar pressure was less than 19% in treadmill walking. (Figure 2)
• The SSD was significantly different (p<0.05) in: lateral heel, lateral middle foot, and lesser toe (Table 1).
• The peak pressure was significantly different (p<0.05) in: lateral heel, medial mid foot, medial fore foot, lateral fore foot, lesser toe, and greater toe.

Discussion & Conclusion

Findings
• The plantar loading at heel strike is higher in overground walking in comparison to treadmill walking.
• The plantar pressure in mid foot and toes walking is higher during treadmill walking.

Limitation
• These results are limited to forward walking.

Significance
• Plantar pressure data obtained during treadmill walking likely underestimates heel plantar loading at impact and overestimates medial midfoot and lesser toe plantar loading in comparison to overground walking.
  o These results have implications for laboratory-based research that uses treadmill walking rather than overground walking.
• The SSD demonstrates the natural variability in plantar pressure.
  o These differences should be taken into account when performing clinical assessment of foot loading.

References & Acknowledgements


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