Analysis of Walking and Running Gait Kinetics on a Novel Unweighted Treadmill Device

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Introduction

Body weight supported treadmill training is commonly used in clinical practice with broad applicability including gait, endurance, and balance interventions[1]. A novel treadmill system, the LightSpeed®, has been developed by a physical therapist to capture the benefits of body weight support for both clinical and recreational use. The LightSpeed® has been utilized for physical training in running and for individuals with orthopedic pathologies. The device offers several proposed benefits including decreased impact forces, decreased risk of repetitive stress injuries associated with endurance training, and partial unweighting for gradual return to weight bearing activity after injury [1-2, 4-6].

Purpose

To determine the effect of the LightSpeed® treadmill system on contact time and kinetic parameters in healthy, young adults while walking and running on a treadmill.

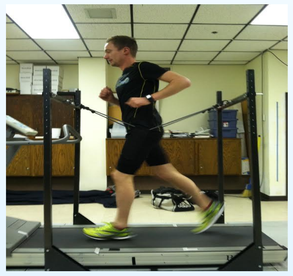
Hypothesis: Decreased kinetic forces will be observed during walking and running in the LightSpeed® body support system.

Methods

Researchers recruited 15 healthy participants who reported a minimum of 5 hours experience of treadmill running. The subjects determined a self-selected walking and running speed during a 2-3 minute warm-up period. Participants then donned LightSpeed® neoprene shorts and were fitted with PEDAR® insoles. Subjects walked/ran at a self-selected pace with full weight trials followed by unweighting walk/run trials while in the LightSpeed®. A total of 20 sequential steps were collected randomly during each of the 2 minute bouts. A paired t-test (SPSS®) was conducted comparing the differences between the weighted and unweighted walking and running conditions.

Results

DEMOGRAPHICS	Mean (range)
Age (years)	27.15 (20-44)
BMI (Kg/m^2)	23.1 (20.6-25.7)
Walking Speed (mph)	2.99 (2.4-3.5)
Running Speed (mph)	6.06 (5.2-7.0)



WALKING	Weighted	Unweighted	% Difference (Unweighted)
Contact Time (ms)	632.2	615.2	**- 2.7% ***
Force-time integral (N·s)	47.9	36.3	**- 24.2% ***
Pressure·time integral (N·s/m^2)	89.3	76.2	**- 14.7% ***
Peak Pressure (N/m^2)	259.2	225.7	**- 12.9%***
Maximum Force normalized to body weight (N)	108.0	90.8	**- 15.9%***

RUNNING	Weighted	Unweighted	% Difference (Unweighted)
Contact Time (ms)	273.2	247.0	**- 9.6%***
Force-time integral (N·s)	31.5	26.5	**- 15.9%***
Pressure·time integral (N·s/m^2)	54.2	44.5	**- 17.9%***
Peak Pressure (N/m^2)	318.6	289.0	**- 9.3%***
Maximum Force normalized to body weight (N)	181.4	160.5	**- 11.5%***

- * P-value < 0.001
- ms = milliseconds, s = seconds, m = meters, N = Newtons (1 N = 1 kg·m^2)

Discussion

Unweighted treadmill devices provide a means of exercise for those with cardiovascular, neuromuscular and/or musculoskeletal pathologies [1-4, 6-7]. Very little research has investigated the actual kinetic and kinematic changes that occur during unweighted gait. The results of this study support the hypothesis regarding decreased impact forces during the use of the LightSpeed® unweighting treadmill device. All force and pressure measurements taken during unweighted conditions were significantly decreased by an average of 15% as compared to weighted trials. The findings of this study have clinical implications for the physical therapist in that the Lightspeed® is an affordable unweighting device compared to those of other manufacturers, and may provide a means of decreasing risk for injury amongst healthy individuals. Future research in this area should focus on evaluating the efficacy of the LightSpeed® as an intervention and further evaluate the kinetic and kinematic effects on varied patient populations.

Conclusion

The LightSpeed® created both statistically and clinically meaningful significant unweighting effects in the realms of pressure and force during both walking and running. This body weight support system may reduce lower extremity joint reaction forces, and thus serve as an effective gait intervention for both prevention and rehabilitation.

References

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