Case Report

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Effects of a zero-gravity treadmill on body composition and cardiorespiratory fitness after Achilles surgery in a Masters runner

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Abstract

Zero-gravity treadmills allow alterations in training load. Data are lacking on the utilization of this strategy to allow injured Masters-level athletes to return to activity and regain their fitness. A 6-week training program was designed for a 39-year-old male runner recovering from Achilles surgery using a zero-gravity treadmill. Three training sessions per week were performed with gradually increasing loads. Cardiopulmonary exercise testing and bioelectrical impedance analysis were performed before and after program completion. Following the training program, the athlete was able to return to full weight-bearing running. On cardiopulmonary exercise testing, there were improvements in peak oxygen consumption (42.9 vs 47.3 mL/min/kg; 118.6% vs 130.5% of predicted). On bioelectrical impedance analysis, there were small improvements in total weight, skeletal muscle mass, and adiposity felt to be within the standard of error for bioelectrical impedance analysis. In conclusion, load-altering exercise may be helpful for the Masters-level athlete recovering from Achilles tendon surgery.

Keywords

Zero-gravity treadmill, Alter-G, Masters athlete, load-altering exercise, rehabilitation

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Introduction

Master-level runners (age 35 years and older) when injured often have a longer recovery time and greater loss of fitness compared to younger athletes.[1] Treadmills that alter the training load from 20% to 100% of body weight, such as zero-gravity treadmills, can decrease the load on the lower extremities during exercise and have been used to rehabilitate patients with osteoarthritis and following a total knee replacement, among other pathologies.[2,3] Limited data have been published on utilizing this technique in Masters athletes, and no data have been reported on whether zero-gravity treadmill rehabilitation programs can help regain lost measures of fitness in these athletes. The purpose of this case report is to describe the feasibility of utilizing the zero-gravity treadmill (Alter-G Pro; Alter-G; Freemont, CA) and the subsequent fitness adaptations and body composition changes in a Masters athlete following rehabilitation from an Achilles surgery. This case report was exempt from review by the Cincinnati Children's Hospital Institutional Review Board.

Case

A 6-week rehabilitation program was designed for a 39-year-old male runner recovering from Achilles surgery that occurred 10 weeks prior. The patient was cleared for physical activity by his surgeon before the start of the exercise. Three self-administered training sessions per week were performed with lighter loads (20%–40% body weight) earlier in the program and gradually progressed to heavier loads (80%–100% body weight) over the 6 weeks (Supplemental Material). Each training session started at 45 min in duration and progressed to 60 min by the end of the program. The first and

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Table 1. Results of the pre- and post-intervention bioelectrical impedance analysis and cardiopulmonary exercise test data.

	Pre	Post	Change from baseline
Weight (kg)	73.4	73.7	+0.3
Body mass index (kg/m^2)	21.7	21.8	+0.1
Skeletal muscle mass (kg)	35.3	35.7	+0.4
Percent body fat (%)	14.9	14.2	−0.7
Left leg muscle mass (kg)	10.4	10.7	+0.3
Previously injured right leg muscle mass (kg)	10.4	10.6	+0.2
Exercise time (min)	10.0	10.5	+0.5
Peak work (W)	296.0	308.0	+12
Respiratory exchange ratio	1.34	1.39	+0.05
VO_2peak (mL/min)	3155.0	3484.0	+329
VO_2peak (mL/min/kg)	42.9	47.3	+4.4
VO_2peak (percent of predicted)	118.6	130.5	+11.9
Peak heart rate	171.0	165.0	−6
Peak oxygen pulse (mL/beat)	18.4	21.1	+2.7
Peak blood pressure (mmHg)	185/70	192/74	–
Peak VE (L/min)	113.3	144.8	+31.5
Peak respiratory rate (breaths/min)	32.0	44.0	+12

VO_2: oxygen consumption; VE: ventilatory equivalents.

last 5 min on the treadmill were dedicated to warm-up and cool-down. Running speed was chosen at a long-slow run pace. No other cardiovascular or resistance training was performed during this time. Cardiopulmonary exercise testing (CPET) and bioelectrical impedance analysis (BIA; InBody 370; InBody; Cerritos, CA, USA) were performed before and after program completion, per local standard.[4] Breath-by-breath analysis was performed using a metabolic cart (Ultima CardioO2; MCG Diagnostics; Saint Paul, MN, United States) and data were averaged every 30 s.

No injuries occurred during the training and following completion of the 6-week program, and he was able to resume standard outdoor running. His pre/post-testing had several notable results. On CPET, there was a longer exercise time (10.0 vs 10.5 min) and a stable respiratory exchange ratio (1.34 vs 1.39) (Table 1). There was a higher oxygen consumption (VO_2) (3155.0 vs 3484.0 mL/min; indexed 42.9 vs 47.3 mL/kg/min) and a lower peak heart rate (171.0 vs 165.0 bpm), resulting in a higher oxygen pulse. When predicted peak VO_2 was calculated per Wasserman et al.,[5] the percent predicted peak VO_2 increased from 118.6% to 130.5%. The peak minute ventilation (113.3 vs 144.8 L/min) and respiratory rate (32.0 vs 44.0 breaths/min) both increased following training. On BIA, there were modest improvements in total weight, total and segmental muscle mass, and body fat percentage felt within the margin of error for BIA. Finally, subjectively, the athlete reported feeling stronger and fitter than before this training, and there was no pain reported during training. Three months following this training, he has remained injury-free with increasing non-treadmill-based training volume and he has resumed competitive running.

Discussion

We presented a case of a Masters athlete who utilized the Alter-G Pro zero-gravity treadmill to rehabilitate muscular strength and cardiopulmonary fitness after Achilles surgery. The athlete was able to complete the 6-week training program without injury and has restarted running. He demonstrated improved cardiopulmonary fitness as evidenced by higher peak VO_2. Additionally, over the 6 weeks, he demonstrated a slight decrease in overall body fat and an increase in total and lower extremity muscle mass, although this was likely within the expected variation for BIA.[6,7] Research by Saxena and Granot[3] has tested whether the use of a zero-gravity treadmill may help athletes recover from Achilles injuries compared to standard rehabilitation. This study is similar to our case in that our athlete returned to outside running 16 weeks after surgery as opposed to 18 weeks post-surgery.[3] Additionally, our case study differs in that the primary outcomes we measured were improvements in exercise testing parameters and body composition in addition to a return to running, allowing further objective outcome data for this rehabilitative strategy.

The number of middle age to older athletes has increased dramatically over the past 4 decades. Unfortunately, this increased training predisposes these athletes to lower extremity injury.[1] Multiple different strategies have been used to treat lower extremity injuries, including orthotics, corrective exercise prescriptions, and resistance training.[8] These strategies may improve muscular strength but offer little in recovering lost cardiorespiratory fitness. The zero-gravity treadmills through the alterations of weight and training loads are occasionally used in the rehabilitation of these oft-injured athletes, perhaps earlier and during periods of partial weight-bearing.[2,6]

We were able to show that utilizing this technology early in the rehabilitation process resulted in a higher peak VO_2, which is higher than the expected test–retest variance.[9,10] A probable mechanism behind these improvements is the conditioning-related augmentation of cardiac stroke volume, demonstrated further through the improvement in oxygen pulse. In this study, the athlete had an almost 15% increase in oxygen pulse and 10% increase in his percent predicted peak VO_2 in only 6 weeks. This improvement in such a short time is noteworthy in that most rehabilitation programs are often structured over 12 weeks as this is often felt to be the minimal period to exact meaningful change in peak VO_2. This patient's response to the 6-week program is not consistent with these recommendations but is consistent with other studies that have shown improvements in peak VO_2 in shorter time frames.[11,12] This hints that a subset of athletes are quick responders to training-induced fitness changes. On the other hand, the increase in oxygen pulse may be secondary to a decrease in peak heart rate on the second CPET pointing toward this being a submaximal effort test, although the increase in respiratory exchange ratio and minute ventilation would contradict this point.

The modest improvements noted on body composition testing were likely within the expected margin of error for BIA.[6,7] This may be secondary to the short length of time in utilizing the treadmill as 6 weeks may not allow for meaningful change. Additionally, dietary history was not obtained in this history and a sharp increase in calories could have also affected these measures. On the other hand, zero-gravity treadmills through the alterations in training loads may instead overly reduce the training stimulus resulting in a lower metabolic expenditure compared to traditional treadmills.[13] Additional studies should be performed in more patients, over a longer time frame, and with a precise dietary history to see if continued training on the zero-gravity treadmill affects body composition.

Conclusion

We were able to demonstrate improvements in physical fitness without significant change of body composition in a Masters-level athlete rehabilitating from Achilles surgery with a 6-week training program on the Alter-G Pro treadmill. The utilization of a zero-gravity treadmill may be a useful adjunct in the training and rehabilitation of an injured Masters-level athlete, but this should be confirmed in larger studies.

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Author contributions

A.W.P. participated in study design, initial draft formation, and final manuscript approval. W.A.M. and G.D.H. participated in study design and final manuscript approval.

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Ethical approval

This case report was exempt from review by the Cincinnati Children's Hospital Institutional Review board.

Informed consent

Written informed consent was obtained from the patient(s) for their anonymized information to be published in this article.

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Supplemental material

Supplemental material is available online for this article.

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