The anti-gravity treadmill: its application and considerations in sports performance, injury rehabilitation and health

Dr Lance Doggart FBASES, Ben Anniss and Sarah Catlow discuss its application and considerations in sports performance, injury rehabilitation and health.

Strategies to provide partial body weight support during locomotion have become increasingly popular within the fields of rehabilitation and sports performance. Although numerous methods of achieving body weight support exist, including harness systems, underwater treadmills and hydrotherapy, the most recent technological advancement involves the use of air pressure to support the lower body. Essentially, the theory dictates that whilst on a treadmill and sealed into an airtight bag at the waist (approximate centre of gravity) the external force experienced by the lower body, can be controlled, when a difference in air pressure exists between the sealed unit and outside atmospheric pressure. The anti-gravity treadmill has reversed the difference in air pressure to reduce ground reaction forces and provide body weight support to the user. Thus, a lifting force (counteracting gravity) is created as the pressure inside the chamber is greater than the pressure outside of the chamber, referred to as lower body positive pressure. When the treadmill is in operation the performer is supported from the waist down due to the pressure differential. This allows movement, inhibited only by the condition affecting the performer's range of movement, without full weight bearing forces at the joints dependent on the air pressure differential.

Having recently taken delivery of an anti-gravity treadmill we were keen to explore the contexts in which it could be used, the potential benefits within those contexts, the associated considerations and how the user perceived the experience. During our pilot exploration we introduced the anti-gravity treadmill to a number of individuals including high mileage road running athletes and professional team sport athletes, sports performers recovering from injury and patients who had been prescribed exercise as part of a health programme. The anti-gravity treadmill was incorporated into their existing training, recovery or health programme and utilised as a different training aid within their schedule. No additional data was recorded other than that required by the supervising practitioners of the associated programmes. However, we did request feedback on their experience of using the anti-gravity treadmill.

In theory, the sports performance application is about maintaining a cardiovascular and metabolic response, similar to that of land-based training, whilst reducing the risk of injury onset through lower ground reaction forces (Figueroa *et al.,* 2011). This is probably more specific to the endurance athlete ensuring the mileage/training volume is maintained whilst minimising the injury risk and hence why we included this type of athlete in the pilot project. However, one of the key considerations if using the treadmill in this way would be the maintenance of a similar physiological response, and corresponding limb velocity, when compared to land-based training.

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The high mileage athletes reported a perceived discrepancy in treadmill velocity, heart rate and their leg speed; something that they found difficult to adjust to. Therefore, to ensure a close training replication a strict protocol would need to be considered and developed to ensure that the settings for the anti-gravity treadmill allow for a similar cardiovascular response to that of land-based training. These settings would need to include not only the treadmill speed and incline but also the magnitude of the pressure differential to accommodate leg speed. The balance and fine tuning of these components would appear to be fundamental to a successful programme that replicates training for performance when compared to that of land-based programmes.

We introduced the treadmill to some of our clients attending our sports therapy and rehabilitation clinic to observe how their lower limb injuries and gait may respond to such an environment within their rehabilitation programme as well as the experience of using the treadmill. Svedenhag and Seger (1992) and Liem *et al.* (2013) have already noted that including the anti-gravity treadmill in the rehabilitation process could have positive benefits; most notably the reduction in time taken to restore full movement patterns. The feedback from the rehabilitation practitioners overseeing the client's recovery were positive in that they appreciated the potential to restore gait patterning without unnecessarily loading the joint but were unsure of exactly when, and at what stage, to introduce this into the rehabilitation programme. Introducing it too early could result in the client being over confident at an early stage of the healing process of the injury and thus decide to load bear too early, outside of the rehabilitation programme, and potentially cause more damage. In addition to this, there is little or no evidence to direct rehabilitation practitioners on the treadmill settings specific to the pressure differential and how this is adjusted according to the stage of the rehabilitation process and the type and severity of the initial injury. This would appear to be a key consideration for the practitioner in the use of the treadmill in this context. Nonetheless, the clients who used the treadmill in this context reported enjoying the experience, gaining confidence in their functional movement of the injured lower limb under the anti-gravity condition.

In addition to the performance and injury rehabilitation contexts, we were able to introduce the treadmill to patients who had been referred to our sport and health science lab for guidance and support on exercising as part of the recovery process following a health or chronic condition. The literature has not reported on the treadmill being used in this way and so this was an opportunity to gauge patients' views in this context. Patients with a variety of conditions attended the lab to experience the treadmill. No objective monitoring took place but each patient provided feedback on the experience. The feedback was unequivocally positive with the patients noting a perceived increase in confidence in their ability to exercise unaided and pain free. This outcome is something that health practitioners and sport and exercise scientists should consider as a potential area for developing the necessary empirical evidence to support these subjective perceptions.

Our pilot exploration into the use of the anti-gravity treadmill produced some interesting observations. There would appear to be an opportunity for sport and exercise scientists to further quantify these observations in the contexts noted. However, careful consideration must also be given to clients, athletes and patients within these contexts and the outcomes sought from the introduction of an anti-gravity treadmill to established performance, health and injury recovery programmes. The key considerations appear to focus around the timing of the introduction of the treadmill in relation to the context, as well as the manipulation of the settings, to achieve the desired outcome. The anti-gravity treadmill may not replace existing established methods associated with sport performance, rehabilitation or health programmes however, if substantiated with empirical evidence, it may optimise existing practice. ■

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