Gait Retraining

Altering the Fingerprint of Gait

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KEYWORDS

• Running injuries • Gait retraining • Biofeedback • Faded feedback

KEY POINTS

- Evidence links faulty running mechanics with injury and provides a justification and need for altering these mechanics.
- The human body has an amazing ability to adapt and leveraging this ability in order to reduce injury risk is very powerful.
- Altering habitual movement patterns requires practice and adherence to well-established motor control principles.
- More work is needed to determine optimal methods of retraining gait patterns.

INTRODUCTION

Why would it be necessary to alter someone's natural running gait pattern? Running gait patterns are not self-optimized for each individual. Despite Nigg and colleagues'[1] theory of natural movement patterns, individuals often run with patterns that have been shown to be related to injury.[1–4] Some patterns have also been associated with reductions in economy, such as increased vertical oscillation, increased stride length, and excessive arm motion.[5] Although economy is important to overall running performance, this article focuses on the retraining of gait patterns with the goal of reducing the risk of running injuries. Because running injuries result from musculoskeletal overload, the issues contributing to this overload are reviewed first, with a focus on biomechanical factors. The inability of strengthening to alter running mechanics is discussed next. The important components of a retraining program are described,

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followed by a review of the literature on gait retraining to reduce injury risk in runners. The article concludes with a discussion of the future of conducting gait retraining in runners' natural environments using wearable technology.

FACTORS ASSOCIATED WITH RUNNING INJURIES

Running is a repetitive activity that typically occurs in a linear, forward direction resulting in a fairly invariant load with each foot strike. Because each foot strikes the ground approximately 625 steps per kilometer (1000 steps per mile), musculoskeletal tissues of the lower extremity become susceptible to cumulative overload, leading to overuse injuries. It can be assumed that every runner has a threshold for injury and that this threshold depends on several factors (Fig. 1). The runner's overall structure and static alignment plays an important role. For instance, foot structure has been implicated in different types of running injuries.[6] As an example, high-arched runners have been shown to be prone to bony injuries, whereas low-arched runners are prone to soft tissue injuries.[6] Although these structural factors need to be considered, they are effectively nonmodifiable. Dosage is another factor that can influence cumulative load. Training aspects such as how quickly the runner increases mileage, cross-training, and variation of running surfaces all contribute to the overall dosage of running. Dosage is clearly a modifiable risk factor, but there is a subset of runners who, despite reducing their mileage and resting appropriately, are unable to resolve their injuries, and these are the runners who most likely have an underlying mechanical factor that is not being addressed. This observation may explain in large part why the most common risk factor for a running injury is a previous injury.[7] Mechanical factors can be divided into forces (kinetics) and movement patterns (kinematics). A runner showing abnormalities in either of these areas can experience excessive loading in their musculoskeletal systems. Runners experiencing both excessive forces and abnormal movement patterns are likely to have an even greater risk for injury.

The impact transient of the vertical ground reaction force is the immediate increase in force shortly after the foot contacts the ground (Fig. 2). A sudden, large impact transient has been associated with injuries. In particular, greater vertical impact peak along with higher vertical average load rates (VALRs) and vertical instantaneous load rates (VILRs) have been linked to tibial stress fractures, plantar fasciitis, and

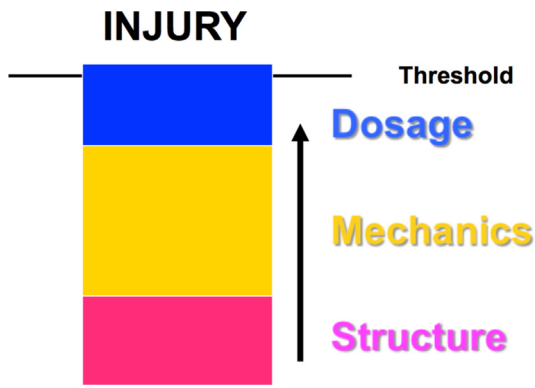

Fig. 1. Basic factors contributing to running injuries. Any 1 or a combination of factors can cause runners to reach their injury thresholds.