



# Going Mobile

## Using whole body vibration to prevent athletic injury

By Gabriel Ettenson, PT, MS

**A**s the field of neuroscience continues to undergo a rapid paradigm shift, the fields of exercise science and rehabilitation technology are following suit. With these exciting changes, unique and promising treatment options are emerging. One of these is the subject of an increasing amount of international research: whole body vibration (WBV) technology.

Despite being dismissed by skeptics for many years, mostly due to misinformation, cheap manufacturing, and the lack of qualified instruction on its usage, this technology has been shown to increase muscle strength and flexibility,<sup>1-3</sup> increase bone density<sup>4,5</sup>

and improve sports performance.<sup>6,7</sup>

Given this growing body of support, it also represents an effective tool for not only enhancing the ability of an athlete to perform, but reducing their risk of injury. The result of combining innovative mechanical engineering with basic principles of physics and human neurophysiology, this treatment and training technique uses reflexive muscle contractions against an onslaught of ground reaction forces to improve muscle force and power, muscle fiber recruitment and muscle flexibility. Along with these improvements, the use of WBV enhances the speed of energy conversion within the muscle as well as the body's maximal level of inter- and intra-muscular coordination—all of which comprise a strong, stable and efficient system built for competing without the risk of trauma.

### Vibration Therapy

Vibration “therapy” (or “training” when used preventively) involves performing specific strength training, flexibility, and mobility/proprioceptive exercises on an oscillating platform that moves at a specific speed (frequency) over a specific distance (amplitude). Although two types of platforms exist, both of which have been shown clinically to provide benefit, the preferred system for most athletic training specificity is referred to as a pivotal system (a.k.a. “oscillating” or “side-alternating”). This platform’s motion simulates the frontal plane portion of the reciprocal motion patterns occurring at the spine and lower extremities during most athletic activities (e.g., running, biking, skating, cross-country skiing, swimming).

Although the exact mechanisms through which WBV influences the body are of continued debate, most researchers have accepted the theory that the motion of the platform causes the nervous system to activate the myotatic (“stretch”) reflex.<sup>8,9</sup> Unfortunately, this is where most discussions on the subject to date have ended. In an effort to go one step further, however, the question of how these reflexive contractions may result in improvements in the above-mentioned parameters requires understanding a bit more. First, it requires understanding that WBV isn’t about shaking, but rather repeatedly accelerating the ground (the platform’s plate in this case) up into the body in order to elicit a neuromuscular or musculoskeletal response.

Once this is clear, the rest can be understood through basic physics. Through the comprehension of these basic principles, the proposed benefits of vibration therapy and training, particularly those that enhance performance and reduce injury in athletes, is more easily clarified. Let’s look at one of the most important variables for withstanding the abuse of athletic training, muscle strength, and the true measurements of muscle strength, namely muscle force and muscle power.

### Muscle Force and Power

Muscle force is defined as the force a muscle can generate and is measured in Newtons (N). It is a reflection of muscle fiber recruitment. Muscle power is defined as the rate at which a muscle performs work. It is measured in watts (W). Vibration therapy and training is administered through the manipulation of the variables of amplitude (distance the platform

travels) and frequency (cycles per second). These two parameters combine to establish the platform's acceleration (described as the platform's "G-Force").

Since the user's mass (M) is constant and there is a specific acceleration established by the vibration platform (A), there is a resulting force. This is measured using the physics equation  $F = M \times A$ . This force is what the user's muscles must react to (whether purely reflexive or not). This is based on Newton's 3rd law, stating "If a force acts upon a body, then an equal and opposite force must act upon the body that exerts the force."

Therefore, by manipulating the variables of mass and acceleration, we are able to increase the peak force that must be generated in the muscles being trained. Due to the fact that the muscles are required to generate force at increasing speeds (a component of velocity) with vibration therapy and training, improvements in muscle power are also obtainable; power being a reflection of force and velocity ( $P = F \times V$ ).

The ability to increase muscle force generation also suggests that WBV influences the recruitment of fast-twitch muscle fibers. Once again, with the proper selection of training parameters, it is possible to recruit fast-twitch muscle fibers, particularly IIAB and IIB fibers. These fibers, not typically recruited with steady-state training methods, are used in response to the need for higher force generation in the muscle. Through the improvement in fast-twitch fiber recruitment, a high-intensity training effect can be achieved. This not only improves anaerobic and aerobic metabolism,<sup>10</sup> but can also induce hypertrophic effects leading to better shock absorption and improved energy storage capability. This allows for more energy to be available during strenuous periods of training and competition—where most muscle failure and the resulting trauma occurs.

#### Energy Conversion

Arguably one of the highest contributing factors to athletic injury and often something overlooked by most athletes is muscle flexibility. It

is also, as mentioned above, another area of interest in the growing body of whole body vibration research. As mentioned, several recent studies have not only shown its effectiveness in increasing muscle flexibility, but have also shown the effects to last for extended periods of time.

The mechanisms behind the incredibly effective and rapid improvements in flexibility that WBV provides are, once again, unclear. Theories ranging from neurophysiological inhibition and neural stretching to myofascial release to isometric stretching are all floating around. Nonetheless, what is clear is that it works and can be achieved in extremely brief periods of time, seemingly exceeding anything else we have seen to date.

On energy conversion, the training effect of WBV via the stretch reflex further perfects the energy conversion capabilities of the muscle systems involved. This reflex involves the rapid stretch of a muscle fiber and through the gamma and alpha neuron systems response to

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that stretch, a corresponding muscle contraction. Through repeatedly eliciting this reflex at increasing speeds, the potential neuroplastic effects on the speed of potential to kinetic energy conversion are quite evident.

### Muscular Coordination

While muscle force and power, flexibility and energy conversion are of utmost importance to an athlete, the degree of muscular coordination between and within the postural and phasic muscle groups may be the ultimate deciding factor between optimal performance and sustaining injury. Postural muscles, which act predominately to sustain your posture against gravity, contain mostly slow twitch muscle fibers and therefore have a greater capacity for sustained work. Phasic muscles, on the other hand, are more suited for movement, contain fast twitch muscle fibers and are more easily capable of fatigue. Impairments in the coordination of both phasic and postural muscle systems causes joint instability, structural compensation, and inevitably, tissue trauma.

Due to the unique nature by which WBV works on the body, both postural and phasic muscle systems can be trained simultaneously with maximal levels of muscle recruitment. This enhanced state of inter and intra-muscular coordination, driven directly by the central nervous system and its response to the repeated stimulus, allows for better support, reduced compensatory mechanisms during movement and proper stability during sport.

### The Future

Despite the fact that whole body vibration technology has been around for more than 15 years, its popularity throughout most of the world has grown surprisingly slowly. Fortunately, the continued growth in supporting research forces us to keep an open mind toward it. With a continued effort to understand the most fundamental formulas in physics, we can see this technology from a more accurate angle. ■

References available at [www.advancweb.com/pt](http://www.advancweb.com/pt) or by request.

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