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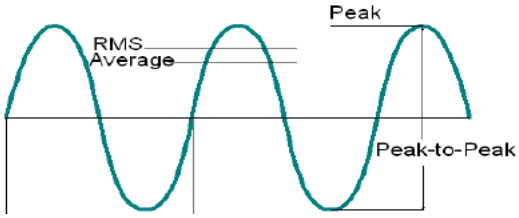
Vibration and the Neuromuscular System

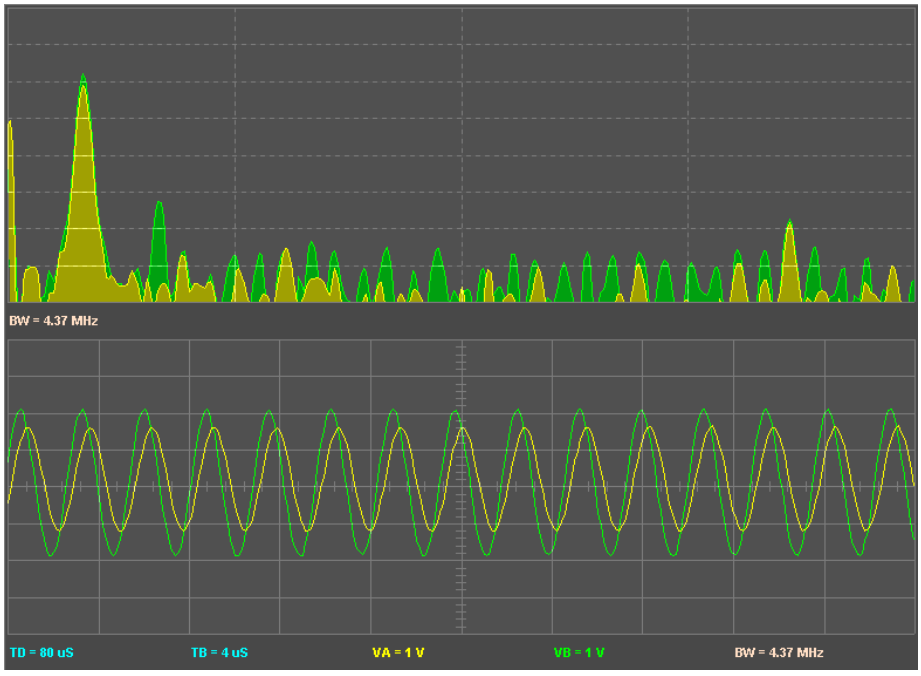
Definitions:

Vibrations: Vibration refers to mechanical oscillations about an equilibrium point. The oscillations may be periodic such as the motion of a pendulum or random such as the movement of a tire on a gravel road



Resonance: when one object vibrating at the same natural frequency of a second object forces that second object into vibrational motion. The result of resonance is always a large vibration. Regardless of the vibrating system, if resonance occurs, a large vibration results

The picture below shows the resonance frequency being found for an antenna. The green shows the generated sine wave and the yellow shows the circuit response. The highest peak in the spectral graph shows the fundamental frequency in near prefect resonance



wbv WHOLE BODY VIBRATION

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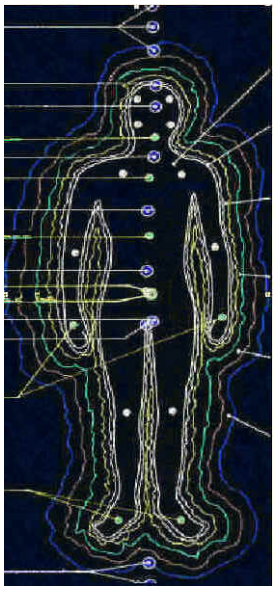
Neuromuscular System: The nervous system and our muscles operate together to control, direct and allow movement of the body.

Recent studies have suggested that low amplitude, low frequency mechanical stimulation of the human body is a safe and effective way to exercise musculoskeletal structures, increasing muscular strength and power.



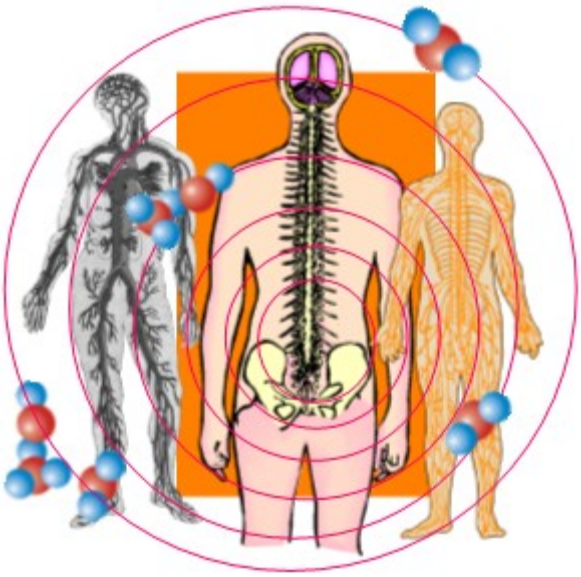
During everyday activities our bodies interact with the external environment and experience externally applied forces. These forces induce vibrations and oscillations within the tissues of the body. Tissue vibrations can be induced from impact related events where either a part of the body or sporting equipment in contact with the body collides with an object. Examples of this are the impact shocks that are experienced through the leg when the heel strikes the ground during each running stride or the impact shock that occurs when a racquet is used to hit a ball. The initial impact causes vibrations within the soft tissues, after which the tissues continue to oscillate as a free vibration—that is, vibrating at their natural frequency, with the amplitude of these vibrations decaying because of damping within the tissues.

Tissue vibrations can also be induced when the body experiences more continuous forms of vibration, such as may occur through the legs during skiing across a groomed slope or through the arms during bike riding. A continuously oscillating input force drives the soft tissue vibrations to be at the same frequency as the input force, but the amplitude of the vibrations will be greatest if the natural frequency of the tissues is close to that of the input force (resonance); however, the amplitude of these larger amplitude vibrations can be reduced by damping from the tissues. Therefore we can expect to experience soft tissue vibrations in all sporting activities, and the amplitude and frequency of these vibrations is partly determined by the natural frequency and damping characteristics of the tissues.

The body relies on a range of structures and mechanisms to regulate the transmission of impact shocks and vibrations through the body including: bone, cartilage, synovial fluids, soft tissues, joint kinematics, and muscular activity. Changes in joint kinematics and muscle activity can be controlled on a short time scale and are used by the body to change its vibration response to external forces. It has been proposed that the body has a strategy of ‘‘tuning’’ its muscle activity to reduce its soft tissue vibrations in an attempt to reduce such deleterious effects. This idea would predict that the level of muscle activity used

for a particular movement task is, to some degree, dependent on the interaction between the body and the externally applied vibration forces.

WBV relies on the resonance theory when used in Neuromuscular Therapy. Our bodies have their own natural frequencies and are constantly vibrating. When the Neuromuscular System is out of balance and consequently presenting with symptoms such as pain or muscle tension, the body interacting with the external environment causes changes internal to the body and more specifically, the vibration of the tissues. When standing on the WBV, the vibrating mechanism counteracts the vibrations within the body and muscular system, to bring the body back to the natural vibrating frequency (through resonance).



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Types of Whole Body Vibration Machines: The effects of whole body vibration (WBV) have been studied with subjects exercising on specially designed vibrating plates producing sinusoidal vibrations. The exercise devices currently available on the market deliver vibration to the whole body by means of oscillating plates using two different systems, reciprocating vertical displacements on the left and right of a fulcrum and the whole plate oscillating uniformly up and down. WBV exercise devices deliver vibrations across a range of frequencies (up to 40Hz) and displacements (up to 14mm). Considering the numerous combinations of amplitude and frequencies possible, there are a wide variety of WBV protocols that could be used on the body. Research has been conducted using both forms of machines without a greater benefit being seen by one type of design compared to the other. The most important aspect to the design of these WBV machines is that they have a solid base that prevents excessive vibration of the machine and column for two main reasons, one, to maintain life of equipment and, two, so that the effects WBV are not being reduced by external damping of the vibration. Use over 12 weeks is seen to produce the most benefits.