

Physical backgrounds

In order for one to understand the principle of vibration training, and why Power Plate training is as effective, if not more effective, than conventional weight training, we need to understand the differences between both training methods.

Conventional weight training

Gravity influences everyone, everyday, everywhere and at all time. Gravity has great effects on our daily movements. The strength of the muscles we develop is based on the way that gravity has an effect on us. With conventional weight training the impact on the body (and thus on the gravity (F_z)) is manipulated through the use of extra weights, extra load. The formula below elucidates what happens once additional load is used.

The F_z (gravity) affects the body in accordance with the (science) formula: $F_z = m \times g$, whereby
 F_z = the force of gravitational force measured in Newton
 m = the mass measured in kg.
 g = the acceleration of the gravity (this is standard 10 m/s^2)

This formula will show you that if we increase the weight (thus mass (m)) for instance by picking up a dumbbell, that we will have a larger gravitational force because of this additional load. If we use this information in an example of conventional weight training, it will read as follows:

A person weighing 70 kg performs a squat; the gravitational force in this case will be:
 $F_z = 70 \text{ kg} \times 10 \text{ m/s}^2$ results in a total gravity force of 700 N

If the same person (weighing 70 kg) would perform the same exercise with an addition weight of 10 kg (by using for instance a dumbbell.) then the gravitational force will be:
 $F_z = (70 \text{ kg} + 10 \text{ kg}) \times 10 \text{ m/s}^2$ totalling 800 N

Conclusion: the use of extra weight (load) increases the influence of gravity.

As a result of the increased influence of gravity, the body will have to adjust in order to cope with this increased force, and the body will therefore increase in muscle strength. In many strengthening exercises extra load is used in the form of dumbbells, elastics or manual resistance. By constantly adding additional load when exercising, the body will have to keep adjusting and therefore the muscle strength will increase. One will become stronger and stronger. A good example of this is the story of Milo. Milo was a wrestler who trained for the Olympic Games in the 6th century BC. Day in day out Milo carried a bullcalf on his shoulders around the stadium. He did so until the calf was a year old. Milo's body adjusted itself to the increasingly strenuous conditions (the calf grew bigger and thus heavier). Nowadays people are still training according to this principle.

Power Plate training

When training on the Power Plate, thus through vibration training, we are still training the body by manipulating the effects of gravity. The big difference compared to conventional weight training as described above, is that with vibration training we do not influence gravity by adding extra load (mass (m)), but that we influence the acceleration (g). When an object or a person changes speed in a short period of time, the acceleration assimilation is magnified. This happens for instance when stand in an elevator your body feels heavier or lighter depending on going up or down.

10 m/s^2 is the constant acceleration caused by gravity. Again, when you are standing in an elevator acceleration is caused by either going up or going down. The vibrations caused by the Power Plate are very rapid, but small, changes in a vertical direction. This increases the acceleration (a). Therefore the force working on the body is also increased immediately and very rapidly. This is explained by using the same formula:

$F_z = m \times a$
 F_z = the force in Newtons.
 m = the mass in kg.
 a = the acceleration in m/s^2

This formula shows that if the acceleration (a) is increased the force working on the body will also increase.

A person weighing 70 kg stands on the Power Plate. The force working on him at that moment is the force of gravity. In this case the Power Plate is NOT vibrating:

$$F_z = 70 \text{ kg} \times 10 \text{ m/s}^2$$

$$F_z = 700 \text{ N}$$

Now the same person weighing 70 kg stands on the Power Plate, and the Power Plate vibrates with a frequency of 40 Hz High, the Power Plate then generates a amplitude of 0.005 m. The forces working on this person now, is the force that results from increased acceleration. The double-blind research project done in Belgium, we measured the acceleration of the Power Plate:

Acceleration Power Plate

| <u>Amplitude(mm)</u> | <u>Frequency(Hz)</u> | <u>Gravity Force</u> | <u>Acceleration (m/s²)</u> |
|----------------------|----------------------|----------------------|---------------------------------------|
| Low (2-4 mm) | 30 | 1.80 | 18.00 <u>m/s²</u> |
| | 35 | 2.28 | 22.80 <u>m/s²</u> |
| | 40 | 2.71 | 27.10 <u>m/s²</u> |
| | 50 | 3.41 | 34.10 <u>m/s²</u> |
| High (4-6 mm) | 30 | 3.10 | 31.00 <u>m/s²</u> |
| | 35 | 3.91 | 39.10 <u>m/s²</u> |
| | 40 | 5.09 | 59.10 <u>m/s²</u> |
| | 50 | 6.24 | 62.40 <u>m/s²</u> |

N.B. Measured by Katholieke Universiteit Leuven, Motor Control Laboratory, Faculty of Physical Education and Physiotherapy (2002). Measured with accelerometer attached to the Power Plate

$$F_z = m \times a$$

In order to calculate "a" you need the following formula:

$$a = V / t$$

V = velocity in m/s
t = time in sec.

In 1 second the Power Plate produces 40 vibrations (being the 40 Hz). 1 vibration therefore takes 1/40 = 0.025 sec. In this 0.025 seconds the actual plate you stand on moves in total 0.02m

If we now fill out the information into our formula:

$$F_z = m \times a$$

$$F_z = 70 \text{ kg} \times 59.10 \text{ m/s}^2$$

$$F_z = 4137 \text{ N}$$

Comparing the conventional weight training (thus by adding weight) to Power Plate vibration training you will see that with no additional load/weight to the locomotive system (the body), one is able to influence gravity and therefore it effects the muscles in the body. Because the gravity effects are so much more intense in Power Plate training (4137 Newton compared to 800 Newton with conventional weight training) one will achieve training results faster.