The PowerPlate

A new application in physical therapy?

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Foreword

At present time the media is a perfect mean to expose and introduce a large variety of products including medical and sports products. On television and in magazines for example the simplest products are praised with promising words like: “have a tight tummy in ten days,” or “no more back problems”, and “goodbye carpal tunnel syndrome”. The medical knowledge I have acquired as a student in physical therapy serves me well when I listen to advertisers’ reasoning to make the sale. I usually experience this as a commercial circus of sales and find it amusing.

About six months ago my attention was caught by a fitness machine that was incomparable to any other I know. It was the Power Plate. The explanation and instruction accompanying this machine was completely new to me and sounded too good to be true. The machine was not only praised as a sports/fitness product but also recommended as a therapeutic apparatus. As a future physical therapist I felt curious and it was my pleasure to explore this machine for my thesis.

A number of people cooperated with me while writing this thesis. People who were already familiar with the Power Plate (physical therapists and patients) who enthusiastically demonstrated and explained it as well as those who had heard of the Power Plate but were basically “non believers.” Both groups taught me a lot. They forced me to draw my own conclusions and to stay objective but critical. I want to thank Erik Kirchof and Guus van der Meer for their cooperation and information. I want to thank all the people I interviewed for their time and efforts.

I hope my thesis will give physical therapists a representative view of the Power Plate.

Contents

1. Introduction

My motivation for this thesis came about from the fact that within the treatments of physical therapy, time is of the essence. A treatment should take as little time as possible. This raises the demands on treatments and their applications. This trend has evolved because of stricter guidelines and regulations from the management of several big insurance companies. Therefore a new efficient method of training for physical therapy would be of great importance.

My goal for this thesis is to show an objective view for physical therapists in the application of a new method in training as with the PowerPlate. The question, if the PowerPlate is a new application of training in Physical therapy was the guiding principle for this study.
Vibration training or Whole Body Vibration (WBV) is the name of this new method of training performed on the PowerPlate.

The work method used consists of:

- A literary search on WBV
  The results get a closer look in Chapter 3 (Physiological Background 3.4 and Physical Background 3.5)
- A descriptive investigation describing in what capacity the PowerPlate is currently used in physical therapy.

I gathered my material from press releases, research papers, interviews and observations.
The thesis is presented in two segments; the first consists of the theoretical aspects which contain an in-depth literary search. The second segment consists of the practical part which is shaped by observations and interviews.

This thesis only addresses issues I consider relevant to physical therapy. Therefore I have drawn a line between the effects in sports and therapeutic effects (which they partially overlap). Therefore, not all suggested effects of the PowerPlate have been included in this thesis.

2. Synopsis

The PowerPlate is a fitness machine used in the WBV method of training. The machine consists out of a vibrating plate that transfers vibrations on the body of the patients.

Research into the WBV concept has been going on since the 60s. WBV especially effects the neuromuscular system which is responsible for increases in muscle strength. As opposed to conventional training methods, greater and faster results can be achieved. For instance, increases in muscle strength by using this method of training. It also shows that training on a vibrating plate positively influences blood circulation, mobility, muscular tension, passive structures and pain reduction. These influences make it believable that training on the PowerPlate can be of value for complaints pertaining to mobility.

Several contra-indications are emphasized for use of the PowerPlate. As a therapist it is imperative to know about the clear and clouded factors pertaining to the PowerPlate before entering into a training program.

For two years the PowerPlate is used in physical therapy as a supplement to regular treatment. This is called an empirical application. From various interviews one can tell that the therapists using the machine are convinced of its usefulness within the Physical Therapy. They use the PowerPlate for various conditions and there are great differences in exercises and settings per patient.

Patients using the Plate admit to having to get used to this form of training. But the exercises on the plate are pleasant and time saving. It is hard to give a concrete judgment about its results since they differ from patient to patient. Because there is no data about the results in groups sharing the same conditions it is hard to conclude exactly what the results are within the scope of Physical Therapy. Nevertheless the PowerPlate is a promising machine for Physical Therapy and definitely deserving of a closer look.

3. PowerPlate

The PowerPlate is a fitness machine used within a special method of training. This method is based on vibrational training. The goal of this method is mainly to increase the muscle strength. The machine transfers the vibration to the human body.

The PowerPlate has been used for about a year and a half in the Netherlands. Originally it was used by top athletes who were introduced to it through their sports. Currently the PowerPlate appears more and more in gyms and other fitness institutions. Within the medical world the PowerPlate is causing more and more curiosity while the number of users is growing consistently. The present number of Physical Therapists using the PowerPlate is hard to calculate since the number is increasing so rapidly. To be able to give an indication we use the information that about 100 Physical Therapists used the PowerPlate in February 2001 within their methods of treatment. At this time (October 2001) the number has grown to about 300.

Principle

Although the full spectrum of muscle development has not been mapped, it is documented that the greatest part played in causing mechanical stimulus for the development of muscle strength is gravity. To increase muscle strength one needs to train according to the principles of power training.
Training needs to include fast and intense shifts of gravitational speed. (Bosco)
To train the muscle strength faster and more effective one needs to produce an increased influence of gravity to the muscle. In practice that means motions are made with resistance causing the influence of gravity to increase. For instance, using weights (dumbbells, etc) while performing a squat to train the quadriceps will ensure a higher application of gravity. These influences of gravity can also be produced by the mechanical vibrations therefore they can be produced by the PowerPlate. Within the vibration there is a continuous change in the direction of movement, causing an increase in the speed while the directional change takes place. The increased speed component you are now producing with the vibrations will result in the desired increased influence of the gravity. This is now not caused by increased weight but through a fast and intense change in speed acceleration.
The short and intense vibration triggers a tendon- and muscle stretch reflex. These reflexes make the muscles, because of the vibration, change in length and tension. (contracting and relaxing) This contracting and relaxing of the muscles happens almost completely subconscious via the reflex bow and leads to a fast neuro-motoric learning and with that to a fast development of muscle strength.

Description of PowerPlate

The machine consists of a vibration plate measuring 50 cm by 80 cm. This vibrating plate houses a driving mechanism distributing the amplitude and acceleration evenly over the whole plate. The amplitude of the vibration lies around 2mm the frequency used in the vibration, depending on the application chosen can be set varying from 30 to 50 Hz.

(Picture of the PowerPlate)

The vibration the machine produces is 3 dimensional which means it vibrates around 3 axes. Front/back, left/right, and down/up. Connected to the base is a big vertical pipe of approximately 1.30 m high which holds the handrails and the control panel. On the control panel the variables can be selected:

1) The frequency: 30-35-40-50 Hertz
2) Vibration time: adjustable in seconds
3) The start/stop buttons: to activate the vibration according to the selected input. The machine will automatically stop when the set time has run out.

The bottom of the PowerPlate rests on pillows of a soft material. This material absorbs the shock effects on the floor and ensures the even distribution of the vibrations.
The weight of the machine is about 90 kg.
The plate is covered with an anti-slip material to make sure the body part contacting the plate will not travel during the exercise.
The PowerPlate can be connected on the regular 220 Volt electrical outlets.

Amplitude: extent of a vibratory movement Symbol "r" expressed in meters (m)
Acceleration: the power resulting from change in speed and direction of movement. Symbol "a" expressed in meters per sec squared
Frequency: number of vibrations per second. Symbol "f" expressed in hertz (HZ)

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3.1 Execution of the exercises

The vibration exercises are performed on the vibrating plate. The distal ends of the lower extremities or of the upper extremities make contact with the vibrating plate. A static or dynamic contraction will take place in which the joints associated to the affected chain, unlock. One holds a position passively (static) or actively engages in a motion (dynamic). This way the vibrations are primarily absorbed by active structures and secondary by passive structures. The concept of the exercises is in its execution almost the same as those of the conventional methods. It remains an exercise and is therefore subject to adhere to the same rules as conventional training exercises. Because you work out large muscle groups you can make a distinction between upper and lower body. Within these two groups there are plenty of variations regarding the types of exercises, the performance and the multiple parameters.

Brief reproduction of various types of exercises:

Upper body:
Push ups
Abdominal exercises (Picture of demonstration)
*Exercises for upper extremities**

*these exercises require use of the straps which are connected to the plate.

Abdominal exercises (Picture of demonstration)

Lower body

Squat
Lunge (Picture of demonstration)
Bridge

Variations in execution of exercises
Eccentric-contraction
Concentric-contraction
Static-contraction
Speed of motion

Variations in parameters
Amplitude
Vibration frequency
Length of time
Number of repetitions

When one starts a beginner program the chosen amplitude is low, the frequency 30 Hz, the time 30 seconds and a contraction is static. The total time of your workout is less than 10 minutes.
To increase your level of exercise one can increase or decrease the angle of the joints. Ultimately one can contract dynamically in all its forms. Additionally one can shorten the rest periods in between sets. Concerning the different parameters" from the low to high setting, increasing the frequency up to 50 Hz, increasing time to 60 sec. The final duration of the total program will be about 12 minutes.

Adjusting the level of training is subject to the progress of the patient.
The many varieties within the method of training make the PowerPlate suitable for various levels of intensity.

Training on the PowerPlate is done in whole chains of muscles. You can't stimulate one isolated muscle because of the training in a closed chain of muscles. The exercised target group is always distally fixated, (for example, hand or foot) and it concerns a resistance which has to be overcome. (Vibration Plate) This way of training gives much more sensory information than for example the training in an open muscular chain (as when stretching your leg into the air). In a closed chain patients can recognize the limitations of their mobility more easily. Because of the training in a closed muscular chain more physiological movement occurs than in an open muscular chain, therefore the closed chain training is safer.

(Picture of Quadriceps training in closed chain)

(Picture of Quadriceps training in open chain)

3.2 Effects

One of the greatest advantages of PowerPlate is that one can achieve great results in considerably less amounts of time compared to conventional methods. This advantage was the principle question behind most research and studies. The whole body is exercised or treated in about 12 minutes!
Along the way more positive effects surfaced within vibration training.
Many of which were already known through hands on experiences with vibration.

1.) Shorter time of training
2.) Shorter time for actual execution of exercise
3.) Low impact
4.) Sole use of closed muscular chains
5.) Increases muscle strength
6.) Improves flexibility
7.) Intense stimulation of neurological system
8.) Increases blood circulation
9.) Vibrations reduce pain
10.) Causes friction on various types of tissue
11.) Strengthens bone and tendon tissue
12.) *(Increased levels of release of training hormones*)*

**The influence of whole body vibration on hormone excretion has not been included in this thesis.*

3.3 Whole Body Vibrations (WBV)

The concept of the PowerPlate is based on Vibration Training. The initial thought behind it can be summarized as the transfer of mechanical vibrations onto the body (referred to as Whole Body Vibrations in most studies).

History

The origin of this training goes back over 20 years, in Russia, where in the late 70s a lot of studies were done finding the effects of Body Vibration. Initially the studies were directed, one toward Vibration Training in various branches of sports (mountain biking or skating) the other toward the trainings and therapeutic methods of vibration training as mostly in the end of the 80s was done in the former USSR.
The more recent studies of amongst others NAZAROV ’87, ISSURIN ’94, WEBER ’97, and BOSCO’98 focus especially on the increase of muscle strength and the mechanics causing this increase.
De Gail writes that starting out at 40 Hz the motor neurons are set off in synchronicity. “This leads to a higher efficiency in the use of power in the muscle group.” (De Gail ’66) This means that through WBV more motor neurons are chained than with a conscious contraction.
The use of the WBV system in athlete’s training programs already exists since ’87 (NAZAROV, SPIVAK ’87)

The interest was to improve the mapping of motor adaptation. A search to the answer of the question what part the muscular and morphological system play in the process of muscle development. The set up of the studies about muscle strength increases did not differ much from each other.
An experimental group with WBV opposed to a control group without WBV. (with conventional power training) There is often use of varying frequencies, training times, and muscle groups. Almost all the studies reveal the same conclusion. There is a faster increase in strength with WBV versus the conventional methods of training.
In a study by Bosco in ’91 it is concluded that in WBV the muscle strength increases in a shorter time and in a shorter training period than in conventional training. It is suggested that this rapid increase is generated because WBV has a stimulating effect on the reflexes like the tendon and myotonic reflex. The various studies conducted from the early 80s to the mid-90s by the various conductors are congruent to each other. It states that increased explosive muscle strength and flexibility is achieved through subconscious reflexes.

(Diagram)

A: increase of mobility in % of the course of the number of training

(Diagram)

B. Increase of isotonic muscle strength in 3 weeks

New Conclusions are not drawn.

Halfway through the 90s much criticism is made about the still unavailable information and requests are made for extensive expansion of the studies:
"To completely explain the purpose and its mechanics, deeper studies need to be done." (WEBER '96)

"Specific frequencies are required depending on goals and muscle groups." (NAZAROV '91)
"To conclude what role the various reflexes play one would have to measure EMG activity and perform muscle biopsies." (BOSCO '91)
"Interesting is the large spread of parameters used in the various studies." (WEBER '96)

In the late 90s a more concrete conclusion is drawn about the core mechanism (and side effects):

- WBV causes a fast biological adaptation concerning improved muscle strength, associated with a neurological potential.
- The results are influenced by the fiber types which are already present and the recruitment capacity. WBV influences the neurological ignored muscle contraction and length (BOSCO '98)
- The application of WBV by joint mobility as a result of chronic vessel insufficiency produces an improvement of the mobility. (KLYSCZ '97)
- WBV improves the blood circulation because the rapid rhythmical contradictions function as a pump (WAKIM '95). The friction causing these vibrations over the entire dermis produce a rise in temperature (OLIVERIE '89). A temperature raise lowers the blood viscosity (DE VRIES '83). The increased flexibility partly explains itself by this information. The time taken for the increased flexibility is different than the time taken for the increase in strength. (ISSURIN '94)
- In '99 BOSCO conducts a study where EMG-activity can be measured. During the WBV the activity is twice as much. After training with WBV the same EMG-activity is measured in the exercise without WBV while more strength has developed. "The WBV treatment is more capable of stimulating the neuromuscular system than previous methods."
- Application of WBV causes neurological and myogenic exhaustion and no cardio exhaustion. (RITTER '99)
- During training with WBV erythema and swelling may occur this is a reaction to the friction caused by the mechanical stimuli" (CISCAR '98).

Summarized these are the scientific facts:

- WBV increases muscle strength in short training periods and training times as opposed to conventional training.
- WBV training increases average and explosive strength.
- WBV training can increase flexibility.
- Treatments with WBV can influence the neuromuscular system that regulates the tension and stretch of the muscle.
- WBV training increases the level of recruitment of motor neurons more than a conscious contraction.
- WBV facilitates increased blood circulation
- WBV does not exercise the cardio system unless one performs a 15 minute dynamic exercise program without rest periods.

Unanswered questions

- What perimeters are preferred for optimal increase in muscle strength and/or flexibility? (amplitude, frequency, duration)
- Can you differentiate between muscle fibers you choose to train?
- What muscle strength is exactly increased and is this strength functional with non-athletes/patients?
- What are the results of WBV on specific medical conditions?
- Do the already determined fiber types influence the effects of WBV?

Interesting is that all literary works about WBV are about healthy participants. Studies conducted with participants who have complications pertaining to mobility are too few in numbers for acceptable conclusions.

3.4 Physiological Background

Within the various results and effects of WBV, different physiological reactions play a role. The most important and probable explanations will be systematically discussed in text below:

Power training

"Training is the systematical application of functional stimuli with as goal the improvement of the achievement as well as the form and function of the organs."
In power training the functional stimulance exits out an increased resistance which needs to be conquered resulting in adaptation of the body through increased muscle strength.

In everyday life gravity is the greatest stimulus responsible for the development of muscular structure. In specific training programs structured to improve muscle strength use is made of fast and abrupt changes in gravity (BOSCO 1995). It increases the gravity's influence on the muscle structure. To stimulate the increased influence of the gravity one uses weights and other forms of resistance.

(Picture of Body-bar) (Picture of dumbbells) (Picture of Dyna-band)

When you exercise a muscle group through resistance the muscle structure (after sufficient recuperation time!) will improve in muscle strength. This is called super compensation. Application of vibration training follows the same principles of conventional power training. The increased influence of gravity is caused by increased gravity acceleration. After the exercises, the muscle group receives enough recuperation time to adjust to the level of training.

Various studies about the WBV system indicate that compared to conventional methods, a greater result in less time is achieved in reference to muscle strength and mobility improvement. What mechanism is responsible?

The physiological system of this improved muscle strength is trademarked by:

A. Neurological adaptation
B. Myogenic adaptation

A. Neurological Adaptation:

The neurological adaptation first occurs when one exercises. Because of this it is often called, "the fast adaptation". The process can be summarized as a faster accessibility of the motor units and more effective execution of the contraction. This is achieved through:

1. Improved synchronization of the impulses.
2. Improve co-contraction of the synergists.
3. Inhibition of the antagonists.
4. Recruiting number of motor units.
5. Recruiting types of motor units.

The body learns to use the neurological possibilities available in an optimal way, called motor-learning.

B. Myogenic adaptation

The myogenic adaptation follows after weeks or even months of training. The adaptation of the muscular structure to power training exists of:

1. Hypertrophy (increase in size)
2. Intra-muscular coordination
3. Hyperplasia (increase in cell number)
4. Influences on fiber typification.

As for the PowerPlate the fast (less than one month) improvement surfacing finds its origin in a neurological adaptation. This is explained through the fact that adjustments in muscle structure only take place after several months of training. The first increase in strength springs from a neurological adaptation characterized by an improved neurological system. These neurological adjustments can set in after only a few days. The increased EMG activity during vibration training supports this statement. The way the vibration training stimulates the neurological system is therefore responsible for the fast power increase.

How is this fast neurological adjustment stimulated?

Through the transferred vibration various (subconscious) reflexes are originated. These reflexes lead to the relatively fast learning of the nervous system and therefore result in fast increase in strength. The various reflexes relevant to vibration training will be systematically discussed.

In the application of vibrations on the body, one assumes that especially the method of contraction is affected, in other words, the method of recruit ion of the motor units. By applying a vibration to a muscle group, this muscle group changes passively in tension and length.

This change is registered by the proprioceptors and channeled through the spinal cord triggering a response. The change in length is responded to with an ejection of motorical signals via the spinal cord by the motoric cortex to counter this change. These stimuli result in contraction of the muscle group, the stretch reflex, or myotatic reflex. It is assumed that this stretch reflex is responsible for the relatively fast increase of power by the vibration training. The receptor responsible for the stretch reflex is the muscle spindle

(Picture of muscle spindle, visible in the muscle belly)

During the change of length the tension of the muscle is also passively changed. The sensor registrating, and responsible for the response is the Golgi-apparatus. The reflex is the action to counter the increased tension by relaxing the muscle. This is called the tendon reflex. This mechanism is considered responsible for the increased flexibility of the joint after vibration exercises.

(Picture of the Golgi-apparatus. This sensor is primarily located at the muscle-tendon transition)

At about 40 Hz (vibration frequency) the release of motor units as a result of the reflex is synchronized, causing a stronger contraction. Therefore, this reflex includes the activation of more motor units than in a conscious contraction. Motor units that were inactive or worn down are included in the motoric response of the reflex. According to this model maximum recruiting takes place.

Conventional training allows about 45% to a maximum of 85% contraction rate of present muscle tissue. A higher percentage is involved when it pertains to electro-stimulation, a subconscious reflex or fear. (Basic Power Training, M. Grosser and others.)

Flexibility

An obvious effect of vibration training is improved flexibility. The term “flexibility” is used in the literature about WBV in various ways, sometimes to discuss muscle length and at other times to describe joint mobility. To avoid confusion the terms will be separated.

1. Joint Mobility
The mobility of a joint is the number of degrees in its range of motion (ROM). In a study by Dr. T. Klyscz about the effect of vibration training on the ROM of the joints, it is clear that the ROM improves dramatically; specifically the effect on the bottom tarsal joint is great. The explanation for this improvement, consists basically out of a summary of the vibration trainings effects: clinging passive structures of the joint are loosened through the vibration, the increased blood flow facilitates a better recovery, increased strength leads to improved mobility of the restricted joint.

2. Muscle Length
With WBV training the blood circulation and body temperature increase. Because of the increased temperature, as a result of frictions, a decrease of the viscosity of for instance the muscles and capillaries takes place. This can be the cause for the increased flexibility. (De Vries 1983)
Vibration training influences the systems, which regulate the muscle tension. (BOSCO) The Golgi-apparatus facilitates because of the vibrations a greater relaxation in the muscles and therefore allows a longer length of muscle.
This rapid increase in flexibility can only be created by elasticity reserves in muscles and tendons. A continuing increase can only be achieved through morphological adjustments which takes several weeks to months to develop.(ISSURIN).

Involved Reflexes

The muscle stretch-reflex or myotatic reflex is a reflex that occurs on the archaic-level, so the reflex is brought about unconsciously. The reflex is triggered by a change in the position of a joint. When the position is changed the degree of the joint’s angle changes resulting in a change in the length of the surrounding muscles. When a muscle is stretched the muscle spindle detects this and channels consequently via the Ia-afferents to the spinal cord where the sensory impulse via the *a*- motor neurons is responded to with a contraction of the stretched muscle (agonist). At the same time the antagonist is inhibited causing it to relax. The consequence of this reflex is that the change in the position of the joint will be restored as fast as possible. The myotonic reflex causes a constant length of muscle, the sensitivity of the muscle spindle can selectively be increased or decreased.

(Picture)

The myotatic reflex.
The function of this reflex is to
sustain a constant length of the muscle.

Tendon-reflex:
The mechanics of the tendon-reflex is opposite to the muscle stretch-reflex: when an increase in tension of the muscle takes place a decrease of the contraction follows. The tendon-reflex causes a constant level of muscle tension. The tendon reflex is created by the Golgi-apparatus. By an increase of the tension in the muscle-tendon transition the Golgi-sensor inhibits the α-motor neurons therefore decreasing the tension in the muscle.

Training with a great stretch, as is possible in Vibration Training, stimulates the stretch reflex and heightens the threshold of the Golgi-apparatus. The Golgi-apparatus consequently promotes a high measure of relaxation in the agonist.

The Golgi-apparatus is partly responsible for the regulation in muscle tension. (The Golgi-apparatus therefore facilitates the possibility to recruit larger numbers of motor units during the eccentric phase).

(Picture) The tendon-reflex.

The function of this reflex is the preservation of a constant muscular tension

1. In an article (by Burke, 1996) is demonstrated that vibration on the quadriceps facilitates an enhanced spinal reflex.
2. In an article (by Burke, 1976) a possibility is suggested that the reflex, created by vibration, mainly runs through α-motor neurons. It does not use the cortical afferent paths used in conscious movement.
3. An article (by Nazarov 1991) features the fact that with specific vibration frequencies a synchronization of the motor units will take place.
4. The article by hgbrth K.E., G. Ecklund (1965) states that mechanical vibration unto muscle tissue causes a reflexive contraction.

Influence on the explosive strength

Muscle tissue can be roughly divided into two types: the red and the white muscle tissue.
In reality there are many more types in between these two types who hold qualities of both but for a useable model we will work with two types.
The distinction made between the muscle tissues rests on the difference in strength and stamina of the tissue.

White muscle tissue *(also called anaerobic tissue, easily fatigued tissue, type II, A)*

The name 'white muscle tissue comes from the fact that this tissue which, contracts for a short period of time, delivering great strength, is a very light pink color under a microscope instead of deep red.

Compared to red muscle tissue:

- White tissues have a short span of contraction (10-50 ms)
- The maximum speed of contraction is high (42mm/s)
- The control is more specific because of the fast shifts from contraction to relaxation.
- The æ-I motor neurons
- High level of myofibrils

When delivering big strength the capillaries responsible for the blood flow may be squeezed shut. Because there is alack of oxygen, the energy supplying reaction (ATP) can no longer take place. The white muscle tissue can deliver energy without oxygen (anaerobic). This anaerobic supply is a less economical energy delivery because the energy delivered per carbohydrate unit is twenty times less than in an aerobic mode. Consequently this means that the white tissue is utilized in powerful and/or fast movements. This delivery system of power can only be used for short periods of time because it causes serious build up of waste. The muscle will quickly give in because of acidification.

Red muscle fibers *(also called tonic, slow tissue, type I)*

The name red muscle tissue comes from the fact that this tissue has a deep red color under the microscope. Typical for this tissue is it's ability to slowly contract and it's ability to stay contracted for long periods of time.

Compared to white muscle tissue:

- Red muscle tissue can handle long spans of contraction
- The maximum shortening time is low (17mm/s)
- Less specific control because of a slow shift from contraction to relaxation.
- Low levels of myofibrils

Because of these characteristics, the red tissue is addressed in small power utilizations (as in the sustenance of posture).

The oxygen supply is barely hindered during this light form of contraction and can therefore deliver continuous energy through the economical aerobic way. The red tissue cannot deliver any energy under anaerobic circumstances. To facilitate the most favorable conditions for the red tissue, the environment of the red tissue is high in capillarity. (adding to the deep red color).

(Pictures of mostly white and mostly red muscle tissues)

The contractions arising from vibration training are reflex related. The predominant tissue utilized in reflexes is the 'white' tissue. The reflex must counteract fast and/or strong directional changes. The training therefore shows its greatest effect on the white and fast tissues, the explosive strength.

In the various studies about muscle strength increase the greatest results are found in the improvement of explosive strength. There are also results achieved in average strength increase (ISSURIN and others 1999).

Blood circulation

The Vibration Training also increases the blood circulation of the muscular system. During contraction of a muscle group the capillaries are squeezed, during relaxation blood is again allowed through. When you alternate contracting and relaxing a muscle, a natural muscle pump mechanism is created causing an increased level of blood circulation. In conventional power training a specific muscle (group) is (sub) maximally contracted, this also causes a squeeze on the capillaries for several seconds resulting in a decreased blood flow. In WBV, depending on the selected frequency the muscle will be contracted thirty to fifty times per second. Because of this the capillaries are opened and squeezed shut thirty to fifty times per second. This way the muscle pump dynamic will be utilized optimally and so will the blood circulation during the training. This process has many advantages, among which the fact that the waste products can be easily flushed out and the fuel can easily be replenished. In a study by J. Ritter in 1999 it is shown that after exercising on a 'Vibration Machine ' the systolic pressure increased and the diastolic pressure decreased. Ritter concludes that the fatigue following extensive vibration training is caused by muscle tissue as well as nerve tissue. The cardio-vascular system is not responsible for the fatigue (measured among others in the oxygen absorption). Vibration training therefore does not stimulate the cardio vascular system unless a person exercises dynamically for fifteen minutes without resting

Erythema.

In some cases erythema will manifest itself during vibration training. Erythema is defined as redness of the skin. J. Ritter credits this, motivated by his study in 1999, to the skin reaction following mechanical stimulation. Friction of the cutis leads to redness and swelling (Wong and others 1984)

The reaction of the skin to mechanical stimulation is also called The Triple Response Of Lewis. The mechanical stimulation causes friction in the cutis, this friction can trigger a tripartite response:

1. In local stimulation the area will show redness caused by a dilation of the capillaries in the cutis.

2. Shortly after, more diffused irregular discoloration may appear as a result of the axon-reflex.

3. A third reaction may be a light swelling of the skin. This may occur because of an overflow in the bloodstream as a result of the increase of the capillaries' permeability.

In Vibration Training there is no isolated or local stimulation of the cutis. The friction takes place over a large area. The reaction of the axon-reflex becomes visible through a red discoloration of the skin over a large area. Because of this friction the temperature may rise and the permeability of the capillaries can change. (OLIVERI and others 1989)
The altered permeability may also cause people using the Vibration Plate to experience an itching sensation.

Pain reduction

In the (few) studies done about the effects of Vibration Training on people with mobility problems it is mentioned that pain is reduced during the vibration. This data has been used in Physical Therapy for years. For example, during the application of a first degree traction a rapid vibration (10Hz) is applied to reduce the pain in the joint. Within the classical massage treatments, painful spots are treated with vibrations, friction, tapping and shaking to relief pain and enhance relaxation.(A.J.J. VIS 1996)
A well known theory about this phenomenon is the theory of Melzack and Wall (1965).
"Stimulating II and IIIA afferents restrains the noci-sensoric inhibition. In application of vibrations one intensely stimulates the II and IIIA afferents. II afferents are among others the muscle spindles and mechano-sensors in the skin. IIIA afferents are mostly dynamic and static joint sensors. (H.C.F. van Zutphen and others- Dutch Study Book of Physical Therapy in a narrower sense). This reduction in pain does not always occur in every noci-sensoric input. Therefore stimulating the II and IIIA afferents will not always lead to pain relief.

Influence on bone density

It is generally known that movement favorably influences the bone breakdown and build up. The level of resistance (load) influences the reconstruction and quality of the bone.
According to an article by J Fliegel and others in 1998 WBV has a positive influence on bone density.

Pauwels set the physiological stretch limitations within which the bone density in- or decreases, 'Sollspannung'. This theory pleads for exercise (movement) if one wants to maintain 'bone quality'. It also shows that the bone responds better to dynamic- than to static exercises. The tempo of transformation is even more important stimulus for the grow of bone tissue than the size of the transformations. (Spoor 1983) In training on the Vibration Plate the tempo of the transformation is very high because of the vibration's rapid changes in direction. When adding this information it becomes very likely that WBV has a positive influence on the reconstruction of the bone.

Influence on tendons

Tendons depend on bearing forces just as bones do. Form and function influence each other. The general effects of power training on tendon tissue are: increase in diameter tensile strength, increase and decrease of elasticity. Al these effects apply with the use of the Vibration Plate The Vibration Plate may serve a significant purpose in repairing tendon injuries. In the phase that the new formed tissue is adjusting to the demands (after about three weeks), a just power is required concerning intensity and direction. The plate's vibrations regulate these forces on the body.

3.5 Physical backgrounds

The outcome of various formulas indicates what effect different settings on the machine can have and how it can be varied. This chapter is to illustrate different settings and influences of the Vibration Plate.

Gravity influences everyone, everyday at anytime. This gravity has a great effect on our daily movements. The muscle strength we develop is based on the way this gravity affects us. Within the power training the impact of the gravity (Fz) is manipulated by the use of extra weights. The formula below elucidates why this is done.

The F_z affects the body in accordance with: $F_z = m \times g$
F_z = the gravity in Newtons
m = the mass in kg.
g = the acceleration of the gravity (10 m/s^2)

From this formula can be concluded that the heavier the mass (m), the greater the gravitational force will be. If we use this information in an example of power training, it will show as follows:

A.) When a person weighing 70 kg performs a squat, the gravitational force is:
F_z = 70 kg. X 10 m/s^2
F_z = 700 N

B.) When a person weighing 70 kg performs the same exercise with a 10 kg weight (dumbbell etc.) the gravitational force is:
F_z = (70 kg + 10 kg) X 10 m/s^2
F_z = 800 N

Concluding that the use of extra weight (load) increases the influence of gravity. This increased influence results in an adjustment for this increased input and therefore the increase in muscle strength. In many strengthening exercises use is made of an extra load in the form of dumbbells, elastics or manual resistance.

In the Vibration Training the gravitational forces are also manipulated. The extra load is not incorporated in the mass (m) but in 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 you are riding a roller coaster ride and your body feels heavier or lighter at times.

The acceleration as in 10 m/s^2 is the constant acceleration assigned to gravity. When you are launched in a roller coaster ride, the acceleration is caused by a different force (the drive of the roller coaster). The Vibration Plate quickly changes direction in short periods of time. This increases the acceleration (a). The force working on the body is also increased. This is explained in the next formula:

F = m X a
F = 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 must also increase.

A. A person weighing 70 kg. stands on a plate. The force working on him at that moment is the force of gravity.

   F = 70 kg. X 10 m/s^2
   F = 700 N

B. The person weighing 70 kg. stands on a plate that vibrates at 40 Hz and has an amplitude of 0.005 m. The force working on this person now is the force that results from an increased acceleration.

   F = m X a

To calculate ***a*** you need the following formula:

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

1. In 1 sec. the plate produces 40 vibrations. 1 vibration takes 1/40 = 0.025 sec.
   In that 0.025 sec it travels 0.02m

   V = 0.02 / 0.025
   V = 0.8 m/s

2. a = V / t
   = 0.8 / 0.025
   = 32 m/s^2

3. This means the acceleration is three times greater than under regular circumstances.

If we now fill a into this formula: F = m X a
F = 70 kg. X 32 m/s^2
F = 2240 N

Hence the force working on a person during the vibration is 3.2 times greater. In other words a force of 3G is applied to the body. Proving a definite increased input.

It is said about Vibration Training that a greater result is achieved with smaller loads.
It is unclear about what kind of load they are talking.

- When one speaks about the burden of time one can say the load is lighter in Vibration Training.
- When one speaks about the stress on the joints in relation to the range of motion, one can say the stress is less in Vibration Training.
- When one speaks about the resistance of Vibration Training on the locomotor's apparatus in the form of the force straining it, one can conclude that this force is greater than in conventional training methods.

It would be more correct when in the various texts about training with the Vibration Plate it would define exactly which load is less versus the conventional methods of training.

A significant aspect in the application of Vibration Training is the footwear used.
When someone wears shoes with shock-absorbing soles the effect of the vibration may be reduced by 50%. Conversely the effect is optimal when one stands on the plate without any shoes. The Vibration Plate's affecting forces on the distal ends of the body (the first part of the body contacting the plate) have to be absorbed there.

The type of shoes worn by the patient certainly influences the effect of the Vibration Training. It is imperative that the physical therapist pays close attention to this fact.

In calculating the effect of the Vibration Plate one needs to consider that this calculation is done on a simplified model.
The formula F = m X a is only applicable in a constant situation.
In the Vibration Plate's case the value of a is never constant but varies continuously. The calculation is made with an average of speed and therefore also with an average for acceleration and force. Within the average value that is calculated, the three parameters (F, a and V) vary enormously. This should not be overlooked. The vibration of the Vibration Plate is introduced as a 100% vertical motion. In reality the executed vibration move towards all three axes. The rough calculations in this chapter are of a higher value than if one would have used a formula trisecting the force onto the three axes.

4. The PowerPlate in practice (Vibration training and physical therapy)

The articles about the effects of Vibration Training describe mostly the improvements in strength and the neurological mechanism which form its foundation. There is barely any literature about the applications in the medical environment. Vibration Plate companies publish materials stating the promising results which are obtained with their patients through Vibration Training. Unfortunately the publications about their applications show few participants or vague parameters and situations. This makes it hard to draw concrete conclusions from these documents.
It is not suspicious that there are still a lot of questions unanswered pertaining to the vibration plate's application in physical therapy; since this method of training has only been used in P.T. for two years. The therapists working with vibration plates do so because of the empirical value. (the experience). The experiences show positive results. The core mechanisms, information and effects have not been completely mapped for application in various conditions/complaints. Working according to the empirical principle fits well in the physical therapy, it's been done for years.

Empirical = based on observation and experience. (Kramers dictionary)

The future of physical therapy will consist more and more out of methods created from evidence based experiences. This strategy of treatment is demanded more and more by insurers and the guide lines from the KNGF, to work as effectively as possible. When working with the PowerPlate it is important to know this because the PowerPlate has not (yet) been added to the insurers' physical therapy 'package'.

There are various points of view about empirical treatments:
The use of new methods of training and new training equipment unfamiliar to the industry can be construed as unnecessary risk taking for the patient. This viewpoint pleads for more certainty through results of studies before treatments with vibration plates can be approved.

The use of new training methods and new training equipment unfamiliar to the industry can be acceptable when the results are positive so we can map the positive results.
This point of view pleads that you need to keep an open mind as a therapist for new interventions and methods. Therefore some will move into the vanguard and apply the new intervention or method. The health of the patient will be approached with the philosophy: If it doesn't help at least it won't hurt.

4.1 Contra- indications and indications

When you as a physical therapist decide to use this method of training, it is imperative to have a clear view about the possibilities as well as its obscurities.

The therapeutic possibilities for the physical therapy with the PowerPlate are:

- Training of the neuromuscular system.
- Greater strength in a short time. (especially explosive strength).
- Increased blood circulation in the extremities.
- Improved flexibility/mobility.
- Pain reduction/relief.
- Bone reconstruction
- Proliferation of active- and passive structures.

Mechanisms or effects still unclear about Vibration Training.

- What parameters can be best applied (amplitude, time, frequency)?
- Can you differentiate between different therapeutic goals?
- How functional is the strength-increase attained for ADL- activities.
- Is the stress on capsulated areas, ligaments and joints really less than in conventional methods of training.?
- Which conditions/illnesses will benefit from the use of the machine?

4.1 a Contra-indications

The contra-indications for the use of a vibration plate are based on general contra-indications for (power) training, vibrations or other trainings effects. At the same time preventive contra-indications are given for still unknown effects of vibration training. Because vibration training can lead to an increase in temperature and blood circulation, arterial conditions and inflammations are included in the contra-indications.

- Serious heart and/or vascular diseases
- Fresh wounds as a result of surgery or outpatient procedures
- Hip or knee replacements(implants)
- Acute hernia, discopathy, spondylolyses
- Severe diabetics
- Epilepsy
- Tumors (negative effects pertaining to the use of the PowerPlate and its effect on tumors have not been established)
- New inflammations
- Acute migraine
- When using a pacemaker
- Recently placed metal pins, bolts and/or plates (www.power-plate.com)

4.1 b Indications

There really is an infinite number of diseases and/or conditions that would be influenced positively by vibration training/treatment. Before one starts the application of vibration training it is useful to be aware of certain aspects.

Patient	**Vibration Training**
What disease/condition	Positive effects
What tissue is affected	Contra-indication
Contra-indications for Vibration training	Unclear issues
Are the effects of importance in this specific diagnosis	Parameters

A general list with conditions and diseases with examples remaining after these considerations:

Neurological Conditions:

- **ALS**
- **MS**
- **ME**
- Paresis

Muscular Conditions:

- **Fybromyalgie**
- Muscular atrophy
- Shortening of the muscle

Bone/cartilage conditions

- Rheumatism
- Osteoporosis

Circulatory Problems

- **RSI**
- Posttraumatic dystrophy
- (O)edema

Tendon conditions

- Achilles Tendon Irritation
- Whiplash
- Tennis elbow
- Regular rehabilitation

In use of the PowerPlate it is specified that results can differ from person to person. The experiences of and the effects on the patient decide the intensity of the training. The settings are adjusted to fit the client's need(s).

The conditions above give an impression of what is possible. This does not mean that every scenario has an equally great positive effect.

The large list of indications show various therapy goals. The advantage of the PowerPlate is that one can work toward more than one goal.
When you as a Physical Therapist have a long term immobilized patient and have set the following therapeutic goals:

- Improve muscle strength
- Lessen shortening of muscle (contraction)
- Train stability
- Train coordination

You can train all goals in less than 12 minutes. As a supplement to regular treatment a small investment of 12 minutes can prove very valuable.

4.2 First Introduction to PowerPlate

In Physical Therapy practice Reysenbach-Kirchhof in Amsterdam, I have had the opportunity to practice on the PowerPlate under supervision of Physical Therapist Erick Kirchhof I performed a complete training session.

It is impossible for me to comment on the effect of the training since I only tried it once. To achieve a training effect it is necessary to workout on it at least two or three times a week. I can comment on the experience of exercising on the PowerPlate. This chapter is written to feature occurrences that caught my attention during the use of the PowerPlate.

I worked out my whole body allowing me to experience many exercises. I have together with a patient completed all the exercises so I was able to also closely observe how the exercises look on someone else.

- Regular workout clothes are required in using the PowerPlate.
- There is no warm up prior to the training.
- The settings are low because I am a first timer: frequency: 40 Hz. The average duration of an exercise was 30 to 60 seconds.
- I was personally coached in every exercise by the Physical Therapist.
- The exercises I did were static, eccentric and concentric.
- The starter exercises kept both my feet on the plate.

Experience:

- The first sensation on the vibrating plate is difficult to describe. The impact of the vibrations on the body is enormous. You feel it in every part of your body.
- In the beginning I found it hard to concentrate on anything else (such as verbal instructions) because I was preoccupied with the sensation of the vibrations.
- Initially it is hard to find your balance. For example, the posture of the squat feels awkward because you feel unstable but after three exercises my insecurities disappeared and I became more aware of my surroundings.
- You experience a great pressure, specifically the distal parts of the leg (Achilles tendon, tarsal joint and the knees) are affected and can be felt when both feet are on the plate.
- The vibrations feel strange in your head at first but after sometime you get used to it.
- The console is easy to use. The physical therapist instructed me how to set it per exercise. After that I could easily work the settings by myself. With the exercises that do not require you to stand on the plate but sit complicate the use of the console and require assistance. (You can not start the vibrations by yourself [1])
- While training the abdominal muscles (sit on the plate) you mat feel the need to go to the bathroom. I was instructed before the training not to panic and contract my pelvis.
- In the same abdominal exercise I had kind of a "catapult" feeling. I know how hard this exercise is (without the plate). I have a hard time coming up so I contracted my abs as hard as I could. To my surprise, doing a crunch on the vibrating plate was really easy. A weird sensation!

[1] *The current PowerPlate has a repeat-button low on the console so the machine can be started without help.*

- After my leg-extension[2] exercise it felt very light (like I was walking on a trampoline).
- During a hard exercise (like pushups) I did not really feel tired. You do not feel what you have done until you have your minute rest.
- During the execution of the difficult exercises I got hot and started perspiring.
- After the exercises I was told that I might experience some muscle pain (soreness) in the next couple of days. (It was nothing really)

[2] *When extending the leg, one never fully extends since the vibration has to be absorbed actively. In maximum extension the vibration would be absorbed almost completely by passive structures.*

Extra

To add to my experience on the PowerPlate, the Physical Therapist made me stretch on the PowerPlate:
First I stretched to the ground to kind of measure my reach. Then the same stretch on the plate (20 seconds) after that once again on the ground. I was clearly closer to the ground but I can not give an objective scientific explanation because I was just trying it for the experience.
The catapult sensation I felt with the abdominal exercise usually occurs in muscle groups that are relatively better trained. (said the Physical Therapist)

For a short time I also experienced what it is like to stand on the vibrating plate with my legs straight and my knees fully extended. The vibration experience on your body is magnified many times from the experience without the full extension. Not a good feeling and in practice, it is absolutely prohibited to train this way on the PowerPlate.

Remarks/Observations

- In many exercises there is heavy impact on the wrist joint
- The machine is noisy. (Some frequencies are louder)
- With some frequencies the machine travels a little bit.
- The Physical Therapist finds working on it less labor intensive. Proper instruction about how you will feel and how to perform the exercise will ask the most energy. When the patient becomes experienced on the machine he can find another patient and workout with a buddy. This will give the Physical Therapist more of a role as a coach. The extra supplement to the treatment does not put any pressure on the therapist.
- All the exercises are performed in a closed chain with the only exception of abdominal exercises.

4.3 Opinions about the PowerPlate

4.3 a Physical Therapists about the PowerPlate

Physical Therapist Erik Kirchhof works at a Physical Therapy practice Kirchhof Reysenback in Amsterdam. He has worked with the PowerPlate for two years in the treatments and training of his patients.

The first thing he heard was that 10 minutes on the PowerPlate was equivalent to 1 ½ to 2 hours of intensive Power training. He found that hard to believe but after several "vibrations" he became a believer and is up to today still surprised about the results. Erik applies the PowerPlate in a variety of patients and the results are especially noticeable with the neurological patients (ALS, MS) and he is also achieving great results with minor conditions like Achilles tendon-disorders (complaints)

It is still experimental to find different ways and conditions that will benefit from the PowerPlate but to this day no harmful effects have been reported.

During the training on the PowerPlate all aspects of exercise are applied; exhaust, repair, increase of load (stress), etc. A muscle group does not have to be trained in three sets because one minute of vibrations compares to 12 minutes of conventional training. The recommended minimal is two times a week, preferred is three times a week.
Most of the time he pairs patients and alternates them on the plate. (one rests, one trains)
From the different settings he chooses low when he treats a beginner. Subsequently he adjusts frequency and time according to the results and the patient.
I have guidelines regarding the frequency and vibrating time per exercise but the patient will guide me in the training intensity. The training schedules used are not absolute conditions but guidelines. It is important that the Physical Therapist supervises the exercise. I instruct the patient to stop when it truly becomes arduous.
The training on the PowerPlate is never a complete treatment but it part of the Physical Therapy entirety.

When the PowerPlate program is properly built up there is little or no myalgia (muscular pain). The increased blood flow and heightened discharge of hormones prevent the pain. The first time one "vibrates" it is only the vibration that is experienced because it dominates all other sensations. After several sessions the patient will experience the muscle tonicity of the exercised muscle group.

I have noticed a lot of skepticism in the (para) medical industry, which is absolutely understandable in a virtually new method.

Because of my own positive experiences with the PowerPlate I am convinced that it is useful in Physical Therapy. The many positive reactions of my colleagues and the new applications that will be discovered will in my opinion lead to accepted use of the PowerPlate within the framework (scope) of therapeutic treatments. It in only a matter of time.

April 20th 2001 I spoke to Rianne (Physical Therapist with van Asperen in Rotterdam about the use of the PowerPlate in Physical Therapy. The questionnaire is included in the appendix.

The PowerPlate has been used in this practice since five weeks.
The PowerPlate is used in various complaints/disorders. The training is used as a supplement to regular treatments. The first two sessions the patients are coached during the exercises and informed which exercises have been selected in the room that houses the machine hangs a big poster with numbered pictures of specific exercises. This simplifies things when the patient has to train independently (before or after regular treatment).
The first timer will engage in standard training 30-30. If a patient experiences discomfort the exercise is stopped and removed from the training program.
No negative effects have been reported except for some whiplash patients who immediately complained about dizziness. *(P.S. the PowerPlate" These patients can exercise with the PowerPlate bands (straps) if they stand in front of the plate*) The machine is therefore not used by whiplash patients but in other patients. NO contra-indications showed. If the patient indicates discomfort, the exercise is terminated.
The greatest results have been achieved with RSI complaints and with (symfysiolyse[1]). Almost all day long people occupy the machine.

The only inconvenience of the PowerPlate is that it needs to be placed on a concrete floor because of the vibrations it produces. (P.S. Mats are available now to compensate)
Rianne's opinion about the PowerPlate is very positive, "If I have to choose between the PowerPlate and the available machine pertaining to the physical techniques I would choose the PowerPlate."

Summary

- The PowerPlate has a positive effect with various kinds of patients.
- The PowerPlate is easily used by patients.
- Physical Therapists have the opinion that the PowerPlate is useful within the Physical Therapy.
- In most cases the application of settings and effects are still experimental.
- Harmful effects have not been recorded by the therapists.

[1] *Translator could not find the translation to this word, so it is used in its original form.*

4.3 b Patients about the PowerPlate

Interview with Deborah Balder

Friday April 13th I had a telephone interview with Deborah Balder. The MS society gave me her number because she knows about the PowerPlate. She has used the machine for five months. The report below is her story; in the appendix you can find the questionnaire use for this conversation.

Deborah Balder is 44 years of age and lives in The Hague, Holland. She was diagnosed with MS 10 years ago. Before her diagnosis she was extremely active. She worked as a tennis instructor (40 hours a week) and trained several horses near her home. At this time her condition does not permit such level of activity. I am very sporty by nature and like to keep moving, this is why I kept trying to play tennis but in the end it became impossible, mostly the pain in my back prevented me from playing.
The course of the disease is not aggressive but did lead to more restrictions and a decrease in load-bearing capacity. There are no outbursts. Sometimes there are attacks. These attacks are tough setbacks (mentally and physically) and can be described as total dejection.

Because of MS I have been under medical treatment for quite sometime by a neurologist and physical therapist. A real medical treatment is not available for MS therefore I continuously search for new means.
A friend brought a newspaper article to my attention and since mid-November 2000 I have been exercising on the PowerPlate.. My physical therapist read the literature and agreed to try it. We stopped conventional Physical Therapy to be able to read the effects optimally. My neurologist concurred and agreed. I will report to him in six months.

The exercise took place in Zoetermeer where sports instructors instructed me on the machine. Initially we explored how to determine what doses to use and which exercises to do. I was inclined to overdo it (in frequency and time) because I enjoy the feeling of accomplishment. During the training you do not feel how much you have done but on the drive home you do. This complicates the choice of settings because it was hard to establish boundaries and avoid transgression. At this time there was no variation in the low or high setting* which made it even harder. As time went by I learned to properly estimate what settings to use.

My first impression of the PowerPlate was immediately positive. It was a strange experience but not uncomfortable.

I already felt a difference after just a few sessions. If I walked in with back pains, they would be gone for hours after my training. I really felt good after my training even though it takes a little time. My muscle strength has dramatically improved. Previously, a pushup was an impossibility. Not anymore, I even serve in tennis again.

*In chapter ‘the operation’ the high-low setting is explained.

I work independently three times a week for 15-20 minutes on the low setting. In between exercises I do not rest but change targeted muscle group so the worked group can rest.

The backaches I had before the PowerPlate were completely gone. Unfortunately, I experienced another attack recently resulting in another setback. I do feel that his attack was less severe than previous ones and the back pain it causes is also less prevalent.

I was never afraid to use such a relatively new method, I am more afraid of a new medication. My fear was also lessened by the approval of my neurologist and Physical Therapist.

I see the PowerPlate as a machine for life. In any case for healthy people, but especially for people with complaints. The leap to active movement can be bridged by this machine. For me it was such a godsend that I decided to buy one personally.

Friday April 20th I interviewed PowerPlate patients in the Asperen Practice in Rotterdam. In the report below the interviews are elaborated on. In the appendix you can find the questionnaire used to base all interviews on.

Kathelijne Lemmens is 25 and experienced RSI problems in July 2000. The complaints revealed themselves in stiffness in both upper extremities, shoulders and neck. At times prickling in the fingers was experienced. The complaints occurred kind of instantaneously and working was out of the question because of the symptoms.
She consulted a doctor directly after the symptoms developed who referred her to a physical therapist.
The first weeks of physical therapy led to a decrease in symptoms but reached a point in stagnancy, it did not get worse but also did not get better.
As soon as the practice purchased a PowerPlate I started exercising on it. The first time was a weird feeling. Especially the vibration in my head felt strange to the extent that it mildly nauseated me. After this first time also experienced muscle pain. I was insecure about the machine and wondered if it was appropriate for me to use.

Currently I exercise three times a week in the low setting 30-30. My physical therapist instructed me on the exercises and the PowerPlate is now a supplement to the regular treatments I receive. The exercises I do are always static. I always start with a leg exercise and then train the arms (shoulder girdle). It takes me about 10 to 15 minutes. I do not rest just work different muscle groups. After my first week on the PowerPlate I already noticed obvious progress. I finally felt advancement. I got used to the PowerPlate and did not experience the vibration on the head as much as before. It was not uncomfortably anymore. Now I enjoy my workouts on the PowerPlate and the exercises leave me feeling good.

The first two times I worked out under supervision of Rianne, the physical therapist, but since then I workout independently. I work out before or after my regular Physical Therapy treatment. I have been doing this for five weeks now and there is a clear improvement in my mobility and pain reduction. I feel I gained overall strength and returned to my job half a day two times a week. My symptoms have not disappeared so we are continuing my training on the PowerPlate. I am very happy with the arrival o the PowerPlate in the practice.

The interview below also took place in the van Asperen practice on April 20th 2001.

Hennie van Roon received about 18 months ago after a long stretching course the diagnosis fibromyalgie. It is hard to describe the symptoms since they vary daily. One day the existent pain is in the arms, other days the pain in the back dominates. The fatigue aspect is also really bothersome.
She worked with many Physical Therapists before arriving at van Asperen's Practice where Rianne treated her.
Per treatment the focus is what is most helpful to Mrs. Van Roonen and what is emphasized most. Mrs. Van Roonen states she benefits tremendously from her treatments and feels comforted knowing her condition is understood by the Physical Therapist.
In her daily life she tried to be as active as possible. For example, she bikes a lot. Four weeks ago she started the exercises on the PowerPlate. She goes two times a week for about 15-20 minutes in low settings (30-30). The exercises attend to the whole body. In between the exercises I rest and my exercises are static.
The Vibration training is a supplement to my normal physical therapy treatments.

"In the beginning I had to get used to the plate. I itched on my legs which was explained by my Physical Therapist as caused by the opening of the blood vessels. It also flushes the skin of my arms during the vibrations."
After the first few times Mrs. Van Roonen felt generally more fit. The exercising on the PowerPlate feels great. "It is nice to be able to train and to be active after such a short time!" The PowerPlate training is therefore continued and who knows, if it does not help at least it will not hurt. Within her therapeutic approach, Mrs. Van Roonen prefers conventional treatments and regards the PowerPlate as supplementation.

Summarized

- First exercises (treatments) are experienced as strange and patients have to get used to this new feeling.
- Patients can exercise independently on the PowerPlate.
- The exercises are experienced as pleasant (enjoyable).
- Patients are motivated to try something new.
- Especially the ability to train with low impact is important to the patients.

5. Conclusions and Recommendations

5.1 Conclusions

The PowerPlate is a promising training apparatus for Physical Therapy that is deserving of a closer look.

According to the results of studies done about the influence of Whole Body Vibrations, can be concluded that the PowerPlate positively influences several physiological processes:
Average and explosive strength both increase faster in PowerPlate training than in conventional training.
The PowerPlate training influences the neuromuscular system.
The blood circulation during training on the PowerPlate is much greater than in conventional Power Training.
The training on the PowerPlate has a favorable effect on the density of bone and tendon tissue.

The use of the PowerPlate offers many advantages for the Physical Therapy:
The PowerPlate can be used at various levels.
The PowerPlate is easy to use for Physical Therapy as well as the patient.
More than one therapy goal can be taken on at the same time.
The time of training is short (compared to other methods of training)
The exercising on the PowerPlate is less labor intensive for the physical therapy than conventional methods of training.

These facts confirm that the PowerPlate can serve a purpose within Physical Therapy as a supplement to the regular treatments of various complaints of the locomotive system.
It would be more conclusive if one would have the disposal of the effects and results that are at the moment still incomplete or unknown;

Results with specific patient groups
Results of the influences in use of different parameters.
Influence of the already existing muscle fiber characterization on the accomplished effects?
Is the trained muscle strength a representative sample for functioning in everyday life?
The real load of the vibrating plate on the locomotive system (outside of the training time)

This lack of information causes the use of the PowerPlate in Physical Therapy to still be experimental.

5.2 Recommendations/Suggestions

The lack of information to determine the usefulness of the PowerPlate within the Physical Therapy are the results of concrete studies to the influence on specific clinical pictures and conditions.
The following recommendations co relate with;

- Studies about the results in specific patient groups.
- Studies about the results in various parameters

The indistinctions remaining about the application of vibration training and of the importance for the Physical therapy:

- What is the influence of the already existing muscle tissue typification on the obtained effects?
- Is the trained muscle strength representable in the functioning in daily life?
- How great is the true load of the vibrating plate on the locomotive system (outside of training time)?

Appendix 2

Questionnaire for PowerPlate users

1. Name
2. Age
3. Reason for use of PowerPlate
4. Since when have you been using the PowerPlate?
5. How were you introduced to the PowerPlate?
6. How long have you been under medical treatment?
7. How long have you been receiving Physical Therapy?
8. What was your first response to the PowerPlate?
   - What impression did you have?
   - What was your own perception about the machine?
   - How did you feel the first time?
   - What was the response of your body to the training?
9. How do you use the PowerPlate now?
   - How often a week?
   - How long per session?
   - What exercises do you do on the PowerPlate?
   - What settings do you use? (minutes, frequency)
10. What does your current therapy look like?
    - What part does the PowerPlate play?
11. What effect does the PowerPlate have on you?
12. (Negative) remarks about the PowerPlate?

Appendix 1

Questionnaire for Physical Therapists

1. How long have you used the PowerPlate?

2. How were you introduced to the PowerPlate?

3. For which patients do you use the PowerPlate?

4. How do you determine the different settings?
   - Vibration frequency
   - Time per exercise
   - Duration of whole therapy
   - Treatment period

5. How do you use the PowerPlate?
   - According to personal insights/experimental
   - According to instruction

6. Have you encountered problems?
   - Technical natured
   - Medical natured
   - In implementation

7. Do you consider it (in some cases) an independent treatment or do you see it as a supplement treatment?

8. What is your opinion on the PowerPlate?
   - Remarks or comments
   - Improvements, etc.

Appendix 3

Advantages and Disadvantages

Disadvantages

General:

- The many obscurities make it difficult to have a clear judgment about the PowerPlate. There is a lack of research information about the use of the PowerPlate with various patients. The judgment rests on an addition of all the loose facts available which do not necessarily indicate that the judgment is presentable for application with (on) patients.
- The exercises that can be done on the PowerPlate do not have a high value in functionality. For the function in daily life exercise on the PowerPlate holds no necessity. The vibrating plate does train the functions required for the execution of functional movement.
- The price of the PowerPlate is high. For the machine it is a normal price but in an absolute perspective it is a chunk of change.
- Because the vibration plate is not included in the Physical Therapy Insurance Package there is no compensation to claim from Insurance companies. The purchase of the PowerPlate is therefore purely an investment of the therapist. (and not a minor one)
- The current use of the PowerPlate in the Physical therapy environment principally holds an empiric foundation. The future of the PowerPlate requires more evidence based practise through more rigid guidelines and compensation from insurance companies.

Application:

- Because of the vibrations the PowerPlate generates its needs to be placed on a stable base such as a concrete floor. The placement of the PowerPlate is therefore not unlimited.
- The PowerPlate I worked with started creeping with a couple of frequencies (this creeping was not more than a half an inch but it is annoying if this happens regularly). (P.S. PowerPlate: Placing the PowerPlate on a judo mat will eliminate the problem).
- During the vibrating the machine makes a noise. This sound is not overwhelming but it may induce agitation. (P.S. PowerPlate: The level of noise has been greatly reduced)
- In many exercises there is a lot of strain on the wrist-joint because it closes the chain for the upper body exercises.
- In the majority of the physical therapy exercises the therapist has to improvise for patients with less mobility. The PowerPlate limits the use of improvisation.

Advantages

- The PowerPlate trains the neuromuscular system.
- Training on the PowerPlate leads to a faster increase of muscle strength in a shorter time span than a conventional method of training.
- Training on the PowerPlate has a favorable effect on the density of bone and sinew tissue/
- During the training on the PowerPlate the supply and drainage function at a higher level than in conventional methods of training.
- Training on the PowerPlate influences the system that regulates the tonicity.
- Vibrations of the PowerPlate can be pain-reducing in several conditions.
- Training on the PowerPlate almost always uses a closed sequence.
- The use of the PowerPlate is suitable for a variety of levels of resistance.
- The PowerPlate may be used for different goals in training.
- Several training goals can be persued simultaneously while exercising on the PowerPlate.
- The comparative time of training is short on the PowerPlate.
- Working with the PowerPlate is less labor-intensive than the practice with conventional training methods for several objectives with in therapy.
- The use of operation of the PowerPlate is simple for both Physical Therapists and patient.