

Mini Review

The Historical Evolution of the Therapeutic Application of Whole Body Vibrations: Any Lessons to be Learned?

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Received: February 19, 2016; **Accepted:** March 08, 2016; **Published:** March 10, 2016

Abstract

Introduction: In the last decades vibration training became more and more subject of scientific research and is frequently used in practice. It is considered to be effective and well-suited for older patients and a safe and effective preventive intervention for unfit people. The purpose of this review is to describe the historic evolution of WBVT and what we can learn from it for research and the nowadays application of it.

Vibrations were already used for therapeutic purposes in ancient times. In the early 19th century vibrations applied on humans were regularly used in therapy using devices which were forerunners of today's devices.

In the 1960s Professor Biermann developed a direct forerunner of today's devices. Vladimir Nazarov transferred it in actually realizable exercise interventions. In the late 90s the to date most popular device for WBVT, the Power Plate, was developed. Meanwhile, also a device that applies RWBVs is available. Nowadays a wide range of different devices is available on the market.

Conclusion: Since the early 19th century no important technical advances were made, except the nowadays possible application of random vibrations and a more precise application of vibrations with larger spectrums of frequency and amplitude. It remains to be seen which technical and/or methodical advancements will be made in future.

Former research on historic aspects of vibration training might have led to an acceleration of the identification of possible fields of application as well as an adequate controlling and designing of such interventions.

Keywords: Vibration; Exercise; Historic evolution; Therapy

Abbreviations

PBV: Part-Body Vibrations; WBV: Whole-Body Vibration; WBVT: Whole-Body Vibration Training; RWBV: Random Whole-Body Vibration

Introduction

In the last decade, WBVT has become an increasingly popular subject of scientific research and is used in practice for instance in the field of sports medicine [1-3]. To date, WBV training is considered to be effective and well-suited for older patients and is considered a safe and effective preventive intervention for unfit people [4,5]. The intensity of WBVT basically is regulated by the frequency, the amplitude and the body position on the device [1]. It must be differentiated between PBVs, where only parts of the body were exposed to vibrations and WBVs. Also it must be differentiated between methods using indirect applications of vibrations like WBVT, where the vibrations travel through some parts of the body to the muscles the intervention aims at, and directly applied vibrations on the muscle belly or the respective tendon [6,7].

By engaging in WBVT, an increase in muscular capacity (maximum force, speed and strength) can be achieved that is comparable to effects of strength training, as well as positive effects

on the postural control, the flexibility and the bone health [4,5,8,9]. An advantage of WBV training is that the effects on the muscular capacity can be achieved by performing 2 to 3 training sessions per week, each lasting only 10 to 15 minutes [4,5]. Additionally, WBV training requires fewer skilled employees, as participants can perform the exercise independently after appropriate instruction. Furthermore, the highly stimulatory nature of a WBV training device as well as the minor expenditure of time, potentially causes a high compliance rate.

Manufacturers often state, that WBVT was invented for the prevention of the negative effects of zero gravity on astronauts respectively cosmonauts. It is a fact, that the therapeutic application of vibrations is not an independent development of the 20th century. This article will give an oversight on the historic evolution of WBVT and shows what we can learn from it for research and application of such interventions nowadays.

Historic evolution of WBVT

The therapeutic application of vibrations in fact is a very old method. There is evidence on the therapeutically use of vibrations already in ancient times by the Greek and the Romans [10,11]. For example, WBVs were applied by riding on horses or donkeys as well as the ride in a two wheeled carriage with irregular wheels driven

on rough stone-flagged roads [10]. For the therapeutic application of vibrations on parts of the body the Greeks used saws wrapped in cotton fabric [12]. Also Lucius Annaeus Seneca (1-65) described the ride in a carriage as beneficial for preserving health [13].

In the 16th century a Japanese book describes the potential benefits of vibrations for the health [14]. In this case the application of vibrations for the relief of rheumatic disorders and the support of the cure of fractured bones by the application of vibrations was described. Nowadays, acute rheumatic diseases are often mentioned to be a contraindication, but studies on this topic are currently underway. In contrast, contemporary studies confirm a general positive effect of WBVT on the bone health [15]. In the 18th century Charles Irenee Castel de Saint-Pierre, better known as “Abbe de Saint-Pierre” (1658-1743), invented the so-called “tremousoir” respectively “fauteuil de poste” for the use on infirm persons to achieve positive effects on their nervous system. With this device he actually convinced the outmost critical François Marie Arouet, better known as “Voltaire” [16,17].

Forerunners of the 19th century

In 1808 John Barclay wrote the book “The Muscular Motion of the Human Body”, in which he described a case muscular spasm cured with the application of vibrations [18]. Contemporary studies underline this effect, by indicating that there is a positive effect of WBVT on muscular spasm [19]. Overall, in the early 19th century vibrations applied on humans by mechanical devices (forerunners of modern devices) were frequently used in therapy to reduce morbidity, support the cardiovascular system, digestion and to treat nervous diseases [10,17]. Today, such devices are used in therapy to treat chronic diseases, like neurodegenerative diseases or chronic low-back pain, and physical infirmities [20]. In the late 19th century mechanical devices for the application of WBVs were highly recommended and at the same time criticized [11]. Below, three outstanding examples for forerunners of today’s devices are described.

Zanders medico-mechanical therapy

Since approximately 1864 the Swedish physician Gustav Zander (1835-1920) build and tested mechanical devices able to apply WBVs driven devices predominantly used for therapeutic purposes and used them later in his numerous institutes. One of these devices was the “Zanderapparat F2”, which simulated the jog trot on a horse [11,17,21,22]. Already the frequency as well as the amplitude could be varied on this device.

Jean-Martin Charcot’s vibrating chair

Based on anecdotic reports of his patients suffering from Parkinson’s disease indicating that longer train-or carriage rides lead to a considerably reduction of their pathology, the French neurologist Jean-Martin Charcot (1825-1893) started to experiment with WBVs at the end of his career [16,17,23]. He simulated the at train-or carriage rides occurring vibrations with a specially invented chair. Hereby he was able to reduce their pathology and enhance their well-being by a daily application of 30 minutes [16,23]. Today’s studies underline these positive effects of vibration training on the symptoms of Parkinson’s disease [24]. Charcot was able to vary the frequency, the vibration direction and its intensity. Much more important, he noticed that a therapeutic intervention with WBVs has to be tailored to the individual patient and his needs. Today, this is discussed intensely again [16,25].

John Harvey Kellogg: pioneer of modern WBVT

John Harvey Kellogg (1852-1943) might be the most popular pioneer of modern WBVT [12,26]. He invented vibrating chairs, bars and platforms as can be found on the market today and used them in his “Battle Creek Sanatorium” for therapeutic measures. The first generations were steam driven and these devices allowed to applicate WBVs as well as PBVs and could be used by up to five individuals [11].

Further development and improvements between 1960 and 1985

At the beginning of the 20th century the therapeutic use of WBVs seemed to be vanished into thin air, maybe due to the impact of the two world wars.

In the 1960s Professor Biermann developed the “Rhythmischeneuromuskuläre Stimulation” (RNS), which is the direct forerunner of today’s devices [12,27]. Since 1970 this method was further developed by Vladimir Nazarov and used by the athletes of the Russian Olympic team in numerous disciplines [12,28]. Nazarov transferred the RNS in actually realizable exercise interventions [12,20,25]. Nazarov and Spivak were the first to realize that there is a connection between an increase in muscular capacity and the application of WBVs respectively PBVs [20,25]. Today, WBTV is widely used in competitive sports in many team sports and individual sports, like Basketball or Golf. It seems to be especially reasonable during warming up and cooling down and for flexibility training [29].

WBVT: Entry in popular sports and modern therapy

In the late 90s, one of the first to engage in the use of WBVT in popular sports was Guus van der Meer (former coach of the Dutch Olympic team. He developed the probably to date most popular device for WBVT, the Power Plate [12]. In 1996 the first side-alternating device was certificated in Germany [20]. This specific kind of device is frequently used in therapy today (Figure 1).

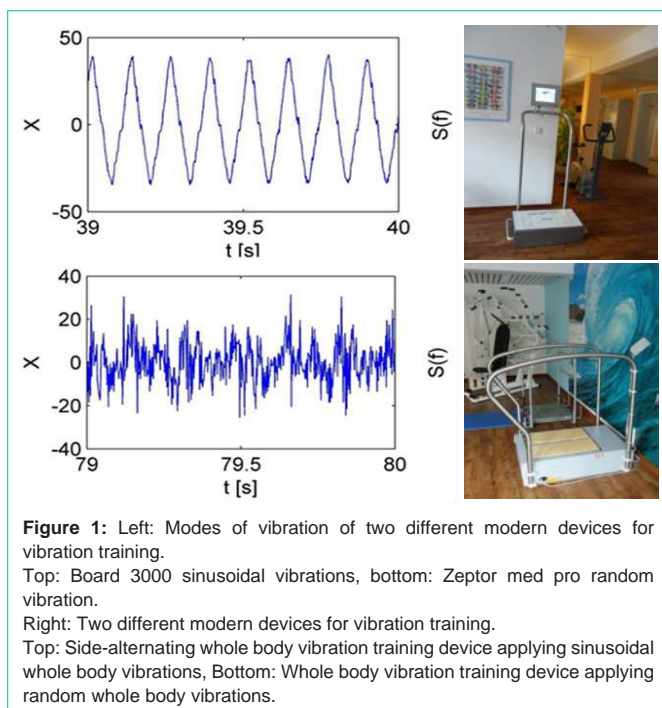
Nowadays a wide range of different devices is available on the global market using different techniques and drives, most of them applying sinusoidal vibrations. Accordingly, the range of indications for the application of vibrations had grown. Mostly, devices applying relatively high-frequency sinusoidal vibrations mainly in vertical direction and build as a platform or side-alternating working are used in popular sports, competitive sports and therapy as well as in prevention. Since approximately 15 years a device is available that applies RWBVs. This mode of vibration is widely used in the field of medical therapy, especially in patients with neurodegenerative diseases (Figure 1) [22].

Foresight

In future, preceding measurements before each training session, maybe by electromyographic recordings, might help to identify the most effective exercise parameters [30,31]. Besides, to date no device is able to applicate sinusoidal and random vibrations. Because of different effects of these two modes of vibration it might be desirable to develop a device which is able to apply both modes of vibration.

Discussion

It is surprising, that already in the 19th century vibrations were



successfully applied for therapeutic reasons on humans by mechanical working devices with technical standards comparable to those used today. The effects which were described in historic sources were underlined by results of contemporary studies.

Using Gustav Zanders "Zanderapparat F2", it was possible to vary the applied frequency as well as the amplitude. Additionally, Jean-Martin Charcot could change the direction of the vibrations his vibrating chair applied. Probably he was the first to realize that a therapeutic intervention with WBVs has to be tailored to the individual patient and his needs. John Harvey Kellogg not only developed and used devices applying WBVs, he also developed and used devices for the application of PBVs. Therefore, the technical innovation since the early 19th century to date is basically restricted to the application of RWBVs, except a more precise application of vibrations regarding the frequency and amplitude as well as larger spectrums of frequency and amplitude that can be applicable with modern devices. However, great strides were made within the last years regarding a safe and effective controlling and designing of such interventions [32]. Especially the adaption of the principles of training, respectively those of the therapeutic-medical training science, has contributed to this [33]. It remains to be seen which technical and/or methodical advancements will be made in future.

A former research on its historic aspects of vibration training might have led to an acceleration of the identification of possible fields of application as well as an adequate controlling and designing of such interventions. Looking on the historical evolution of the therapeutic application of WBVs, it seems to be advantageous to do research on historic aspects of any kind of movement related interventions before starting new research projects. This source of knowledge seems to be mostly ignored by today's researchers.

Conclusion

Already in the 19th century vibrations were applied for therapeutic

reasons on humans with technical standards comparable to those used today and comparable effects like identified in contemporary studies. In the case of the evolution of vibration training, it must be stated that a former research on its historic aspects might have led to an acceleration of the evolution of this kind of therapy. Therefore researchers in the field should do an inquiry on possible relevant historic facts. Besides, it seems to be advantageous to do research on historic aspects of any kind of movement related interventions before starting new research projects.

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