

Vibroacoustic Therapy and Development of a New Device: A Pilot Study in the Health Resort Environment

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Abstract This study was motivated by the development of a new model of vibroacoustic (VA) therapy device which, in terms of its design and characteristics, could be used in various health promotion and treatment environments. In the case of VA therapy, a bed or lounge chair is used to transmit special low frequency sounds for the purpose of affecting the whole body. In the review of previous studies, the results of applying VA therapy in the case of somatic and functional disruptions are described. In this study a new VA device prototype was used. The study was carried out at a health resort where, over the course of a two month period, visitors had the opportunity to participate in VA therapy. Twenty-six volunteers participated in the study. Data was collected through self-rate scales, which were completed at the beginning and end of the VA treatment session. The results of the study indicated an improvement in feeling – a reduction in muscle tension, pain, fatigue, anxiety – as well as the suitability of the device and therapy for health improvement related purposes, integrated with other health services.

Keywords Vibroacoustic Therapy, Device for Vibroacoustic Therapy, Treatment Effect of Vibroacoustic Therapy, Perceived Health Condition

1. Introduction

1.1. Vibroacoustic Treatment Method

Vibroacoustic (VA) therapy is defined as a treatment method based on low frequency pulsed, sinusoidal sound vibrations and music [1-3]. Depending on the choice of sound vibrations, the effect is either relaxing or stimulating, which allows for VA therapy to be used for general relaxation, for the purpose of more specific physiotherapy and receptive music therapy [2-4]. A

possible interaction with brain activity has been considered; however, an effect on muscle and tissue has mainly been assumed [5].

Studies of the VA method have shown a significant improvement in many somatic and functional disorders, e.g. reduction in pain, including fibromyalgia [6-8], decrease in muscle tension and spasms [9-11], and a reduction in the parameters of blood pressure, pulse rate and muscle oscillation [12]. Experiments with the method have produced an improvement in motor function in the treatment of patients with Parkinson's disease [13]. VA treatment has also been shown to have the potential to help maintain cognition and functional ability in patients with Alzheimer's disease [14]. Relaxation is often a side-effect of VA treatment, influencing the overall state of health. According to the practice-based evidence of VA treatment, positive changes in indicators of the perceived health condition and emotional state [8, 15-17], and an improvement of physical self-awareness [14, 15], can be expected. The wide range of applications indicates that VA treatment could be a useful addition to multidisciplinary healthcare practices, having been used in rehabilitation programmes for patients with chronic pain, musculoskeletal problems, spasticity, and sleep disturbances [11, 17].

VA therapy uses low frequency sound vibration in the range of 30–120 Hz [3]. Throughout the duration of the procedure, music and/or sounds of nature suitable to the purpose of the procedure were often introduced in the therapy room as an auditory influence. The most common length of sessions is 10 to 45 minutes [18].

Vibroacoustic stimuli can be provided through various kinds of technical devices. According to Boyd-Brewer and McCaffrey [18], there have not been any reports of adverse effects concerning the VA method. Patrick [19] argues that a condition does not exist in which a single VA stimulation could give a negative result. Practitioners have observed that during or after the first sessions of VA therapy drowsiness, dizziness, and/or nausea may occur.

These side effects usually disappear within a short period of time. Based on their practical experience, Wigram [20] and Grocke, and Wigram [1:228-229] have listed contraindications and precautions regarding the use of the VA method: acute inflammation, pacemakers, psychoses, pregnancy (for the reason that there is a lack of any relevant empirical studies), acute physical states (first require consultation with their doctor), and hypotension (the method may further reduce blood pressure). There are also some psychological factors that should be taken into consideration, e.g. excessive sensitivity to vibration or subjective aversion or fear of the treatment may block the positive effect of VA therapy [11]. It must be emphasised here that VA therapy is a non-invasive, relaxing and enjoyable treatment, which was never intended to be administered as an aggressive treatment for any condition [1].

1.2. Development of the New Vibroacoustic Treatment Device

In Estonia, VA devices that mainly affect the entire body are used. Tallinn University has contributed to VA therapy practice, research and development of the equipment since the 1980s. The first model was produced as a small series in Estonia from 1990-1991. In addition, different models have been tested in terms of their design and sound transmission specifics. The prototype of the newest device (Figure 1) was developed by the Centre of Excellence in Health Promotion and Rehabilitation of Haapsalu College, Tallinn University¹. The prototype (Figure 1) and the pilot study in which it was used were introduced at the 1st International VIBRAC Conference in Lahti, Finland, in 2016, by the authors of the current article.

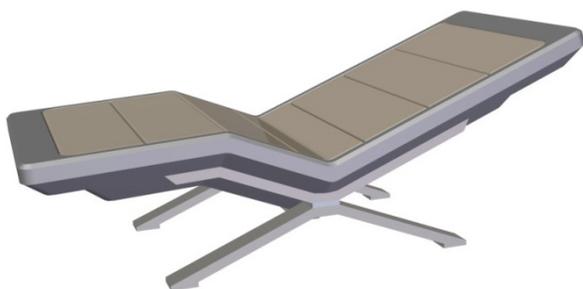


Figure 1. The prototype of the VA device 2015.

The goal of developing the device was to prepare an aesthetic design that was also convenient to use and, in terms of technical and acoustic indicators, a suitable device for carrying out vibroacoustic therapy, which can be fit into various environments and the production of

which is possible on an industrial scale. The speakers for both the vibrational and acoustic stimuli are placed into the main body of the device. The headphones for the acoustic stimuli can be plugged into the jack built into the lounge chair.

The ergonomic design of the lounge chair allows for improved relaxation as the position of the lower legs is higher than that of the thighs and back. Based on the incline of the upper and lower portion of the lounge chair the upper and lower parts of the body are located at the site of the corresponding speakers, and when the body is moved during the procedure it will not shift off of the speaker. The upper body is raised slightly, which allows for eye contact with the conductor of VA treatment. The comfort of moving onto and from the lounge chair was ensured by the fact that the hands can be placed higher than the lower back.

In order to minimise the sound transmitted into the environment from the lounge chair, eight air-filled rubber spacers are installed as insulation between the bottom of the lounge chair and the support structure. The lounge chair's support structure rests on the floor at the foot end with a tapered bottom and with little wheels on the end by the head.

2. Current Study

The purpose of the current study was to test the new VA device in the environment of a health resort and measure the effect of short-term VA treatment on perceived health. Väraska Health Resort is located in southeastern Estonia and offers various treatment and care procedures, and longer (5-10 day) spa treatment and relaxation packages, in which mineral water procedures play an important part. The list of services also includes VA therapy and music therapy. In this study, VA treatment was a supplementary procedure for those visitors who voluntarily wished to participate in the study and try the new VA device.

Based on previous studies with healthy test subjects [21] and rehabilitation centre patients [11], and experience with the application of VA treatment at Väraska Health Resort, improvements were expected in the indicators of perceived health after the VA treatment session. Since VA treatment and participation in the study was voluntary for visitors to the health resort, and the time spent in the health care institution was minimal, the number of VA treatment sessions taken by visitors was of interest, along with the changes in how they felt during the VA treatment process.

The goal of the study was to determine whether the changes in the indicators of perceived health indicate that the new VA treatment device can be used with clients with various health complaints for general health promotion purposes in the health resort environment.

¹ The software for the device was created for VA treatment practitioners and professionals in cooperation with SMARTdo Ltd, which obtained the licence to manufacture the new VA lounge chair from the Centre of Excellence and has named it healBED.

3. Method

The pilot study was carried out within the framework of naturalistic outcome research, using repeated measures design, in which participants served as their own controls. Pilot studies are not aimed to test hypothesis and therefore do not require sample size power calculations [22].

Participants

The participants were recruited from among the visitors to the health resort, with some participants being health resort employees. The study was carried out over a period of two months. The total number of participants was 26, aged 13-74; 23 (88%) women and 3 (12%) men. VA treatment was added to procedures selected beforehand by visitors (water treatment, mud bath, massage, physiotherapy, salt chamber or consultation with a psychologist or social worker) for general relaxation purposes after the health check during the consultation with rehabilitation physician. Participants had different health problems; the indicators for the selection were muscle pain, headache, fatigue, symptoms of anxiety and/or depression, heightened blood pressure. In the case of contraindications for the VA treatment or doubts thereof, the individual was not incorporated into the study. Background data associated with the health of participants was not collected by the VA treatment specialist.

Questionnaires and Data Collection

Data was collected through self-rate scales, which were completed at the beginning and end of each session.

The *Numerical Rating Scales* (NRS) with 11 divisions (0 – 10) were used to measure muscle tension, pain, tiredness, anxiety, physical discomfort, and general condition of health. Simple numerical rating scales are increasingly being employed to measure subjectively assessed health indicators like pain, fatigue, depression, anxiety, sleep, physical and social functions, irrespective of health condition, age or gender [23].

Health and Comfort Semantic Differential Scales (SDS) include six bipolar scales with seven divisions, which are used to describe changes taking place during the therapy session [21, 24]. Scales were completed at the beginning and end of each session.

Participants were asked to provide brief written feedback on the VA treatment after the last treatment session. The feedback questionnaire assessing the comfort of the lounge chair included five 7-point scales (sitting on the chair, rising from the chair, chair stability, comfort of the mattress, body position on the chair).

Equipment and Procedure

The VA treatment device was used at 40 Hz, which was recommended in previous research for general relaxation and pain reduction [2, 4, 6, 8], and improvement of

cognitive function [5, 25]. Based on the request of the client, relaxing music or a nature soundscape [26, 27] was added as an auditory sound. The treatment lasted 23 minutes, 3 times per week.

Data Analysis

Data was analysed using Wilcoxon matched pairs test. NRS-s was turned in such a way that greater numbers expressed a better health conditions; the aggregate indicator of six scales was found by totalling indicators of the scales. SDS-s were entered as 7 point numerical scales, with the greater number indicating a better state of health and comfort, e.g. the endpoints of the scale 1 = uncomfortable ... 7 = comfortable.

Ethical Considerations

Participants were recruited from visitors to the health resort, where the visitors had the opportunity to also select VA, among other treatments. A new VA prototype device model was used during the study, which was tested during the course of development and no harmful effects were found. Participation in the VA treatment was voluntary. The contraindications to VA treatment were taken into account in recruitment and in the event of the occurrence of contraindications or the suspicion thereof, the volunteer was not included in the study. All participants gave their informed consent to participate in the study. Participants were informed about the treatment method and that the objective of the study was to test the suitability of the device for use in a health resort environment for the purposes of health promotion. In the research data, each participant was assigned a code and data analysis was conducted using coded data.

4. Results

Changes in perceived physical condition

The changes during the first VA treatment session are shown in Table 1. Muscle tension, pain, fatigue and anxiety diminished and a general condition of health increased significantly.

Table 1. Wilcoxon matched pairs test of pre- and post-measurements of the 1st VA treatment session (N = 26)

	Before M/ SD	After M/SD	Z
Muscle tension	3.88/ 2.82	2.08/ 2.54	3.55***
Pain	2.04/ 2.76	1.11/ 2.25	2.80**
Fatigue	4.20/ 2.82	2.60/ 2.73	2.56*
Anxiety	2.58/ 2.76	1.35/ 2.13	2.47*
Physical discomfort	2.83/ 2.71	1.67/ 3.00	1.85
General condition of health	6.16/ 2.48	7.88/ 1.99	2.98**

* p < .05; ** p < .01; *** p < .001

Number of Therapy Sessions and Treatment Effect

Table 2 presents the number of participants in VA treatment and NRS aggregate indicators separately for those continuing and terminating VA treatment. The NRS aggregate indicator was calculated from the first to the fourth session, since in connection with being present for a short period of time in the health care institution most participants (77%) took part in 1-4 sessions. The table presents the average of the aggregate indicator of NRS for the number of completed sessions, comparing the pre- and post-measurements of sessions. For comparison, Wilcoxon matched pairs test was used.

Table 2. Number of clients and means/standard deviations of the aggregate indicator of the NRSs

VAT sessions	N	Continued			Terminated		
		N	Before M/ SD	After M/ SD / Z	N	Before M/ SD	After M/ SD/ Z
1	27	21	15.6/ 10.0	7.3/ 7.4/ 3.1**	6	16.3/ 17.1	11.3/ 17.3/ns
1-2	21	16	14.7/ 9.6	7.7/ 8.1/ 3.6***	5	9.0/ 7.5	4.6/ 4.5/ 2.2*
1-3	16	11	15.9/ 9.4	9.7/ 9.1/ 3.4***	5	8.5/ 8.6	3.7/ 3.1/ 2.2*
1-4	11	6	16.4/ 9.7	11.9/ 10.5/ 2.6**	5	13.0/ 8.9	7.0/ 7.3/ 2.3*

* p < .05; ** p < .01; *** p < .001

The data presented in Table 2 show that those who continued VA treatment felt the significant impact of the VA therapy session on their physical health. There was no statistical difference in the before and after session aggregate NRS for those who quit VA treatment after the first session and the effect was lower for those who withdrew after the second, third and fourth session.

Changes in the state of health and comfort

The direction of statistically significant change in the state of health and comfort measured by SDS are shown in Table 3. The significant change was towards comfortable, calm and loose (p < .001, N = 25). Measurements from the first session are presented in order to present the effect of the new therapy method on participants. The minimum and maximum value of the scale corresponding to the polarities is indicated in the table header.

Table 3. Changes in perceived state of health and comfort during the first therapy session

min = 1	Before M/ SD	After M/ SD/ Z	max = 7
uncomfortable	4.44/ 1.04	5.96/ 1.31/ 3.54***	comfortable
restless	5.04/ 1.72	6.40/ 0.76/ 3.07**	calm
tense	4.28/ 1.72	5.88/ 1.36/ 3.12**	loose
sad	5.44/ 1.66	6.00/ 1.44/ 1.65	joyous
fearful	5.40/ 1.71	5.92/ 1.19/ 1.60	courageous
sluggish	4.64/ 1.60	5.32/ 1.77/ 1.63	alert

** p < .01; *** p < .001

In addition to the results measured with scales, it became clear from the feedback of participants that they were satisfied with the shape and inclines of the lounge chair, the mattress and the chair’s stability. Sitting on and rising from the lounge chair were both suitable and acceptable. Feedback questionnaire was filled in by 24 participants (Table 4), 2 participants gave an oral positive feedback.

It was noted in the comments that the lounge chair is sufficiently comfortable, of appropriate height, and has a pleasant shape. Proposals were also made regarding the softness of the mattress and the height of the head support. It was difficult for participants in VA therapy to compare it with other treatments. It was claimed that it was so different. One participant described the experience as follows: ‘I believe that it really can’t be compared with other procedures. You don’t feel any warmth or direct physical effect. The vibration is only slightly perceptible. The therapy has a different kind of effect, through the body and the spirit. It is very difficult to describe what it is. It’s kind of like a process.’ Based on the feedback of participants as well as the observations of the specialist, carrying out the procedure, most of the participants fell asleep during the procedure. The comment was made that after the end of the affect, it would be nice to rest in the lounge chair for a while longer.

Table 4. Participants' feedback of the comfort of the lounge chair

Indicator	Valid N	Mean	Median	Minimum	Maximum	SD
Sitting on the chair	24	6.7	7.0	5	7	.6
Rising from the chair	24	6.7	7.0	5	7	.6
Chair's stability	24	6.9	7.0	5	7	.4
Mattress	24	6.8	7.0	6	7	.4
Body position on the chair	24	6.5	7.0	5	7	.7

5. Discussion

VA devices have a broad spectrum of use, having a therapeutic effect on physical health problems, such as pain and muscle tension and spasms, as well as cognitive decline and mood disorders. This creates the possibility to add the treatment method to various treatment and health programmes. This pilot study focused specifically on the application of the VA treatment on purposes of health promotion. The general relaxing effect of VA therapy is known to the practitioners of VA procedures. Campbell, Hynynen and Ala-Ruona [8] have pointed out that increased relaxation may help to reset the learnt response of dysfunctional pain processing associated with the cumulative negative effects of chronic pain, anxiety, and depression. They underline the relationship between increased relaxation, decreased stress, and regulation and resetting of learnt pain responses.

Despite the limitations of the pilot study (small sample size, different health problems of those participating in the study, lack of a control group) the pre-post session measurements showed promising changes in the perceived health indicators. The study design left health resort visitors with the freedom to decide whether they wished to try VA treatment and how many sessions they wanted to take. Typically, the required frequency and number of sessions that are necessary to achieve the goal of VA treatment and results is specified. An interesting result that was encountered was the clear distribution of participants into those who immediately felt a benefit from VA treatment, and continued with treatment; and those who cancelled the treatment, and in regards to whom, on the basis of the data, the claim can be made that they didn't feel a significant effect from VA therapy on their well-being.

In a previous study [11] the measurements of spasticity showed that the biggest decline in the indicator took place during the first three VA treatment days and the results of the study showed that the effect of the number of treatment days (four treatment days compared with five treatment days) on self-rated spasticity, fatigue, anxiety, and physical discomfort was not statistically significant. However, the number of treatment days had a significant effect on the general perceived health condition and pain.

Data from this study and the previous study permit the conclusion to be made that the addition of VA treatment, for example, weeklong rehabilitation, spa treatment and relaxation packages, is appropriate. Without a doubt, the effect of VA treatment in these packages must be more precisely determined. Certain assumptions may, however, be made based on a previous qualitative intervention study [28] conducted on teenage girls suffering from heightened anxiety, in which VA treatment was used as one influencer. The research provided essential information about the processes taking place during VA treatment. Participants emphasised the novel bodily sensation, which also appeared in the feedback of the participants in this study, and the importance of the physical component of VA treatment. In this previous research, participants emphasised the positive bodily experience that can be expressed through two categories: a) physical self-awareness – discovering the significance of bodily needs (rest, relaxation, care); and b) physical comfort – fulfilling bodily needs.

Campbell, Hynynen & Ala-Ruona [8] point out that the use of VA treatment is growing, but the evidence supporting its efficacy is somewhat lacking. However, they admit that even though non-controlled studies are unable to report on the efficacy of a treatment, reporting protocols followed in a naturalistic setting provide information on how a treatment may function within a larger context. Thus, even though the design weakness of the study must be taken into consideration when drawing conclusions about this study, it can still be admitted that the prototype of the new VA device felt comfortable to the user and the changes in the indicators of perceived health indicate that the procedure did not have a negative effect and can be used for general health purposes in the health resort environment. It also seems appropriate to combine VA treatment with other treatments and health procedures. In subsequent studies attention should be focused on the more specific role of VA treatment and the synergies in various integrated treatment programmes.

Conflicts of Interest

There are no conflicts of interest.

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