Full-Length Article

Vibroacoustic Treatment for Chronic Pain and Mood Disorders in a Specialized Healthcare Setting

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Abstract

Much of what we know about vibroacoustic (VA) treatment and its efficacy has been published in case reports. Recent clinical trials have increased awareness of this treatment for target groups such as those with Parkinson's Disease and Fibromyalgia Syndrome. Protocols for using VA treatment have not been concreticized although there has been a focus on using 40Hz. Seinäjoki Central Hospital has used VA treatment for more than two decades, with patient reports on Visual Analogue Scales being systematically recorded and showing positive outcomes on several measures including pain and mood. This treatment is offered on the rehabilitation unit as part of specialized heathcare in the South Ostrobothnia healthcare district in Finland. This paper describes VA treatment utilized within this unit, with a focus on pain and mood outcomes as reported by subjective patient reports, and practitioner and patient comments.

Keywords: ***vibroacoustic treatment, chronic pain, mood, music listening*** multilingual abstract | **mmd.iammonline.com**

Introduction

According to the World Health Organization, 1 in every 15 Europeans suffers from major depression, whilst anxiety affects nearly 4 out of 15 people, with rates in women significantly higher than in men [1]. Furthermore, musculoskeletal pain is prevalent, with one fifth of adult populations reporting widespread pain, one third experiencing shoulder pain, and up to one half suffering from lower back pain [2]. Musculoskeletal conditions are the most common reason for chronic pain and disability in the EU and lead to significant healthcare and social costs. Interest in using music interventions within medical settings has been growing in the past decades. Vibroacoustic treatment is an example of such an intervention, yet an exploration of this used within a multidisciplinary team has been sparsely reported.

Vibroacoustic (VA) treatment – otherwise known as Vibroacoustic Therapy (VAT), Physioacoustic Therapy (PAT), and Rhythmic Sensory Stimulation (RSS) – is low frequency (30–120Hz) sound vibration, with music listening, applied for therapeutic purposes [3]. It has been shown to increase pressure-to-pain thresholds [4], to increase ability to work, improve quality of sleep, and help in reducing or discontinuing analgesic consumption [5] in people with fibromyalgia. VA treatment has also been shown to improve cognition in Alzheimer's patients [6], and decrease pain [7] and improve functional capacity, and increase blood circulation in the elderly [8]. Improved passive range of motion during physical therapy [9], and improved mood, coping skills, and concentration have also been reported [10], among others. The range of applications indicates VA treatment could be a useful addition to multidisciplinary healthcare practice.

Mechanisms

Pain mechanisms are not well understood. Continued nociception can lead to dysfunction in the messages conveyed to the central nervous system. These changes indicate plasticity in the nervous system, perhaps leading to neural sensitization. The Neuromatrix Theory proposes the importance of learned responses to persistent pain. It is suggested that pain may be suppressed by sensory and evaluative processes, as well as by the activation of our endogenous opioid system [11]. The cumulative negative effects of stress are argued to account for individuality in pain responses, thereby highlighting a person's personal pain history as a factor in their present-day pain responses.

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Chronic pain has been shown to alter thalamocortical connections resulting in disrupted thalamic neuronal behavior [12]. VA treatment may drive neural rhythmic oscillatory activity, thereby resetting this dysrhythmia [5]. Relaxation is one of the effects reported by patients and is described as resonant oscillation achieved by the targeted area's specific frequency matching that of the low frequency sound [13]. Increasing relaxation and decreasing stress may help to regulate or reset pain responses that have been learned over time.

Rehabilitation within Specialized Healthcare at Seinäjoki Central Hospital

VA treatment is offered as part of specialized healthcare at the rehabilitation unit of Seinäjoki Central Hospital in Ostrobothnia, Finland, by a full-time VIBRAC-practitioner.[1] (Although the general protocol for these patients will be discussed in this paper, further information on the treatment protocol used at this facility can be found in a clinical report on pages 184-186 of this issue.) This multi-modal treatment setting is used to treat either in- or outpatients whose multiple symptoms have been especially difficult to treat. These patients may have received previous treatments, yet their symptoms persisted. Patients referred to this unit suffer from various physical, psychological, and emotional symptoms. Multidisciplinary rehabilitation programmes are beneficial in addressing sensory, physiological, emotional, and social issues, and can be a catalyst for patients' discharge after intensive multidisciplinary rehabilitation [14]. Such outcomes work towards increasing patient autonomy; Bettger and Stineman [ibid.] also explained that measures of depression, anxiety, or stress could be important elements to consider in understanding how patients react to an intervention.

This paper presents the use of VA treatment for pain and mood disorders within the specialized healthcare rehabilitation unit at Seinäjoki Central Hospital. These cases are extracted from a naturalistic setting, meaning there was no control group for comparison. These rich data afford a unique opportunity to examine VA treatment use within a medical setting.

2. Method and Materials

Case reports and VAS measurements from 29 chronic musculoskeletal pain patients with comorbidities of mood disorders treated within specialised rehabilitation during 2014-2015 were selected. As per standard protocol, the patients' pre- and post-treatment outcomes were recorded using Visual Analogue Scales (VAS) assessing general arousal, vitality, mood, relaxation, pain, sleep quality, range of movement, limb temperature, and quality of life. A VAS is a single-item continuous scale consisting of a horizontal 100-millimeter line, which is anchored by two descriptors. These scales are self-administered, with patients asked to mark a perpendicular line at the point that best represents their current state. This is then measured with a ruler to determine the numerical value [15].

The anchors for the pain VAS were *unbearable pain* and *no pain*, and *depressed* and *happy* for mood. The pre- and post-treatment measurements were recorded as part of standard hospital protocol, as such that the patient does not see the pre-treatment measurement when completing the post-treatment scale. In addition to these VAS outcomes, the VIBRAC-practitioner took general notes on the patients' state and recorded their statements/reactions to the treatment (see Table 4).

2.1. Treatment Protocol

Patients typically receive 10 weekly sessions. This varies depending on the patients' individual needs however and they may initially receive treatment twice a week. The patient receives the treatment in a Physioacoustic chair (Next Wave), a recliner with in-built loudspeakers located at the neck, back, thighs, and calves. The low frequency sound waves are computer-generated and controlled, and are transmitted through loudspeakers built into the chair. The stimulation software used at this healthcare unit is Sonus Health Editor v3.26c. In this system, the frequencies range from 27.13–113.22 Hz. The device is approved by the Food and Drug Administration (FDA) in the USA, the Canadian Standards Association (CSA), and the British Standards Institution (BSI), and is classified as class-II, low risk, and non-invasive. Three claims are permissible: muscle relaxation, stress and pain reduction, and increased blood and lymphatic circulation.

The program parameters include time, frequency, scan, speed, cycle (or pulsation), strength, and action (direction). The programme is divided into phases of various lengths measured in minutes. The frequencies are measured in Hertz (Hz) and range from 29.15–61.04 Hz. Scan refers to the range of frequencies above and below the fundamental frequencies in each phase, which is done so as to avoid numbness. For example, in phase 1 of this programme, the fundamental frequency was 40.27 Hz and the scanning action moved from 39.26–41.34 Hz. Speed refers to how fast the frequencies in this scanning action change. Here, the frequencies modulated every 16 seconds. Cycle is the speed of the pulsation (volume change). This varies from silence (amplitude = 0 dB) to the set maximum ($n > 0$ dB), then returning to silence. The length of this pulsation cycle was an average of 11.09 seconds (range 7.76–16.25 seconds). The strength of the program is set for each speaker location. These values are presented as dBC (decibels relative to the carrier) and were 53.6–103.1 dBC,

[1] The VIBRAC-practitioner has been trained by the VIBRAC Skille-Lehikoinen Centre for Vibroacoustic Therapy and Research.

52.6–103.9 dBC, 56.5–108.2 dBC, and 59.7–103.5 dBC for the neck/shoulders, back, thighs, and calves respectively. Finally, action refers to whether the sound moves from head to toe, or vice versa. The direction varied almost every second phase, except for the last phase in which there was no directional movement. The speed of the direction is also influenced by the cycle: the faster the cycle, the faster the directional movement.

Music listening is often part of the treatment and patients listen either by headphones or via speakers. They were asked what kind of music they would like to listen to and instructed to choose music that relaxes them. If they did not have anything in particular in mind, the practitioner offered suggestions. Usually they decided to listen to instrumental/classical music, however client preference also meant that patients chose to listen to more rhythmic music such as heavy/symphonic metal. All patients presented here listened to music during their treatment sessions; the full discography of music choices is shown in Appendix A presented according to genre.

Music is used in addition to the low frequency sound to encourage relaxation and as a means of offering a multi-modal treatment experience. As described by Chesky and Michel [4], this combination takes a "two-pronged" approach to pain management, with the music listening working on a psychological level, and the physiology being affected by the transcutaneous- applied sound vibration. The low frequency sound vibration works on its own, however the experience is enriched when music listening is also a part of the treatment. Patients have the choice whether they would like to listen to music or not and it may occur that clients wish to listen to music through the speakers whilst talking with the practitioner about their illness/situation throughout the treatment program.

A session typically begins with a discussion between the VIBRAC-practitioner and the patient, followed by the VA treatment with music listening, and again ending with a discussion on the potential sensations, experiences, and/or emotions evoked during the treatment. The choice of program and frequencies administered is also based on the patients' diagnoses, but the strength of the program can be varied during the treatment program if a patient feels the stimulation to be either too much or too little. The most commonly used programme is *General Relaxation*, which centers around 40 Hz, lasting usually between 20–40 minutes. The program used with these patients ranged from 27.13–61.04 Hz and lasted 36 minutes. This programme is most often used at this facility as it tends to elicit a strong relaxation response, and clinical practice has shown patients tend to respond better to frequencies within the lower frequencies of the 27.17–133.22 Hz range. If a patient responds especially well to a particular frequency, this part may be lengthened. The program is usually started at a lower intensity when a client begins these sessions to avoid possible side effects and so the client becomes accustomed to the sensation.

The VAS outcomes, the practitioner's clinical observations, patients' comments, and the music listening choices are recorded in an electronic medical record system. In interpreting these VAS outcomes, the minimal clinically important difference (MCID) was selected. MCIDs are scores that reflect changes that are meaningful for a patient. Although caution should be used when applying this principle to group scores, these may nevertheless show a general trend. Accepted changes in numerical rating scales for pain intensity are 10mm reduction corresponding to a minimally important change, and 20–27mm reduction associated with fewer requests for medication and relating to "much" or "some" improvement [16]. As there is no way to determine group differences in these data (because there is no control condition), the MCID is applied here only as a means of attempting to contextualize the outcomes reported.

Results

Data on 29 patients treated during 2014–2015 are presented. They received treatment for chronic musculoskeletal pain, depression, anxiety, or a combination. The demographic data are shown in Table 1. As this was part of multidisciplinary rehabilitation, some patients underwent other treatments simultaneously, which does not allow for efficacy assessment, rather gives a picture of VA treatment protocol within a specialized healthcare unit. All patients presented in this study listened to music during their treatments.

Table 1. *Demographic data, other treatments, and medication intake*

Characteristics of n=29 patients	
Age [Mean (SD)]	49.67(10.92)
Gender [n (%)]	
Female	19 (65.52)
Male	10 (34.48)
Weight in kilograms [Mean (SD)]	86.55 (23.09)
n (%) undergoing other treatments:	21 (72.41)
Physiotherapy	11 (37.93)
Psychotherapy	4 (13.79)
Intermittent massage	1 (3.45)
Discussions with/support from a psychiatric nurse	4 (13.79)
n (%) taking medication	26 (89.66)
n (%) of these taking:	
Analgesics & mood regulators	11 (42.31)
Analgesics alone	4 (17.39)
Mood regulators alone (anti-depressants, anti-psychotics, anti-anxiety)	5 (21.74)
Other (hypertension, insomnia, muscle relaxants)	8 (34.78)

89.66% of patients were taking medication in addition to VA treatment, with 42% of these patients taking a combination of analgesics and mood regulators. 72.41% of patients also received other treatments before, during, or after VA treatment. For patients in need of psychotherapy, the waiting list is quite long and is separately organised and coordinated by the Finnish Social Insurance Institution, Kela. Data are not available if the patient was undergoing psychotherapy elsewhere. As discussed earlier, all patients listened to music during their sessions, with these choices ranging from heavy metal to ambient/easy listening. Table 2 outlines these patients' psychological and physical symptoms. Some VIBRAC-practitioner clinical observations and patients' comments are presented in Table 4.

Table 2. *Most common symptoms*

Symptom category	Descriptor
Psychological symptoms	Depression, social anxiety disorder, panic attacks, somatic symptom disorder, Obsessive Compulsive Disorder, trauma-related symptoms
Physical symptoms	Rheumatoid arthritis, spondylitis, osteoarthritis, neck tension, neck/shoulder pain, upper arm pain, Degenerative Disc Disease, neck tension, fibromyalgia, chronic pain syndrome, whiplash

Of the 29 patients presented, 23 received VA treatment in one phase (monophasic), whilst 6 patients returned for a second series of VA treatment sessions after a pause (biphasic). After preliminary analysis, in order to better understand the patients' outcomes – and because post-treatment relaxation is reported by most patients – the relaxation VAS pre- and post-treatment measures were also extracted. Table 3 shows the mean improvement (in mm) and standard deviations from baseline to the final pain, mood, and relaxation assessments for patients who received treatment in both one and two phases.

Table 3. *Average VAS improvements in mm*

Groups	Mean (SD)		
	Pain	Mood	Relaxation
Monophasic patients' scores (n=23)	18.96 (25.37)	16 (16.45)	34.22 (26.42)
Biphasic patients' scores (n=6)			
Phase 1	16.83 (13.41)	21.5 (18.81)	37.83 (21.57)
Phase 2	10.67 (17.87)	0.67 (8.40)	29.33 (14.99)

Monophasic patients' data are presented as VAS pre- and post-treatment scores for pain (Figure 1), mood (Figure 2), and relaxation (Figure 3).

Monophasic patients

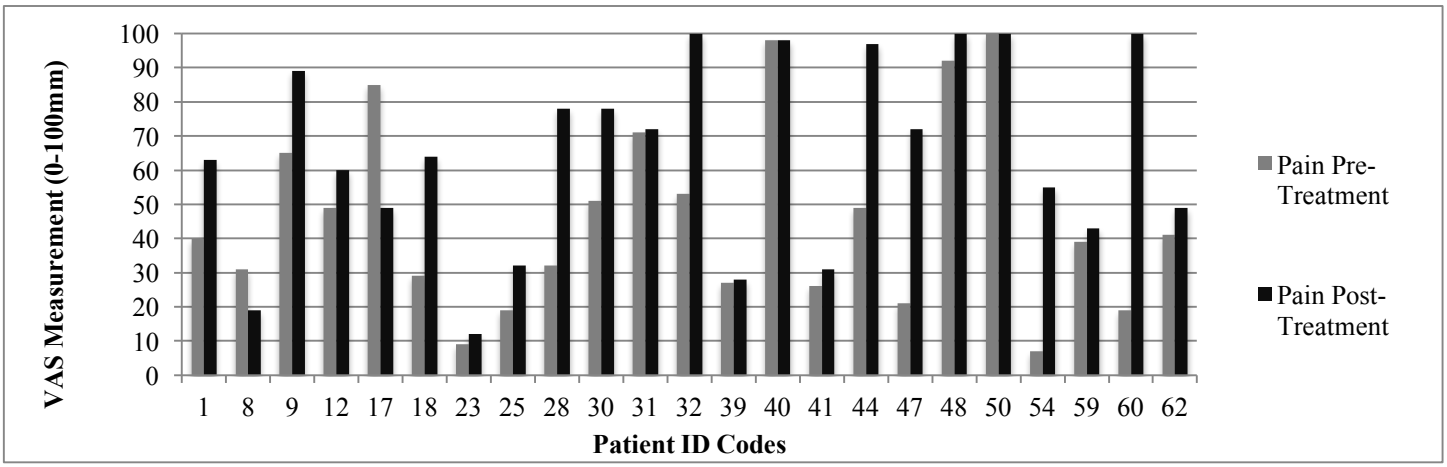

Figure 1. *Monophasic patients' (n=23) pain levels pre- and post-treatment*

The majority of patients (n=23) received treatment in one phase, with a mean mm improvement (and standard deviation) of 18.96 (25.37) in pain, and 16 (16.45) in mood, corresponding to a minimal–moderate MCID. Some patients reported quite drastic pain improvements, with similar improvements in relaxation (Figure 3), as shown by, for

example, patient 60. Others presented a worsening in pain levels (e.g. patient 17) but an improvement in mood (Figure 2) and relaxation (Figure 3).

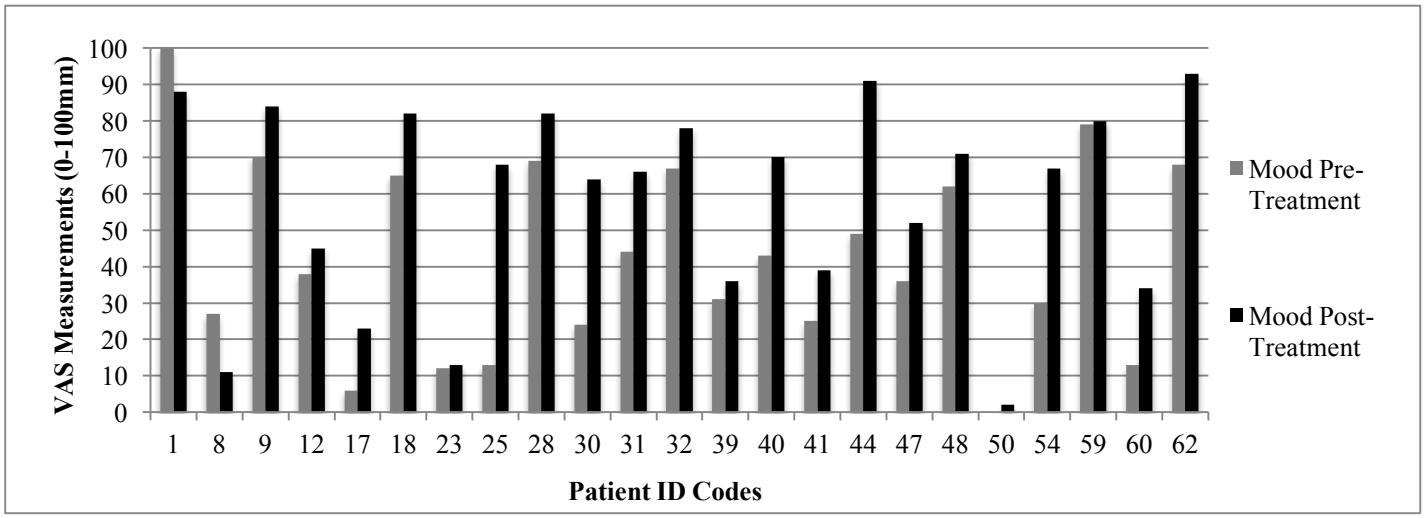

Figure 2. *Monophasic patients' (n=23) mood levels pre- and post-treatment.*

Although patient 23 reported barely any improvement in pain or mood, her relaxation score had very much improved after the treatment. As with many of these patients, it is clear that relaxation is a relevant factor. The small sample size prevents any in-depth or subgroup analyses.

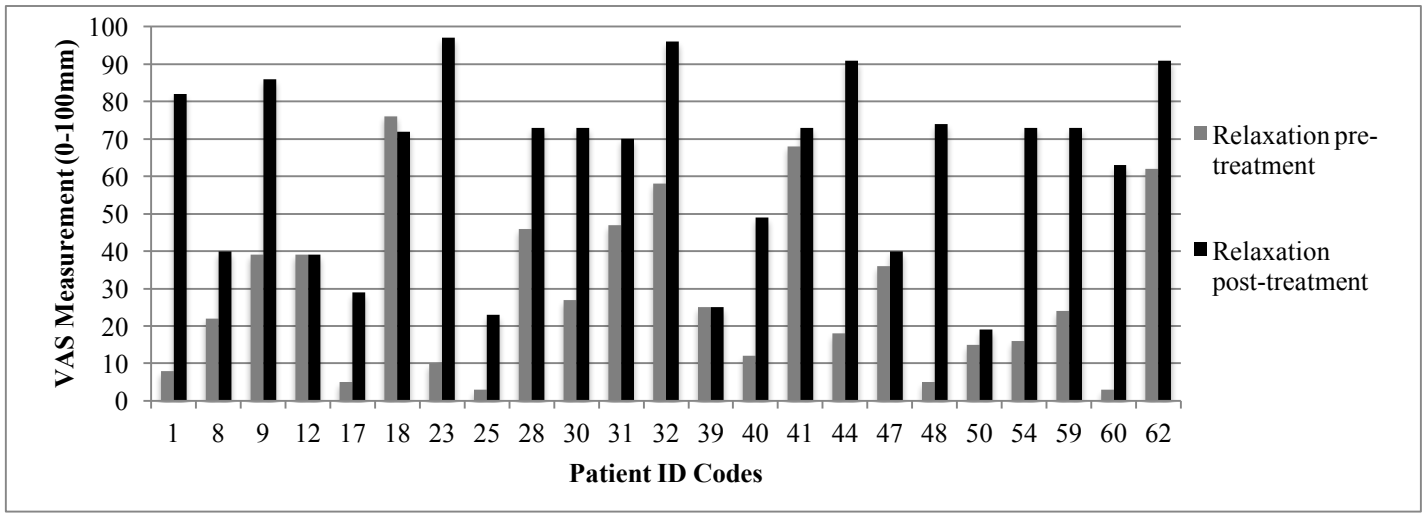

Figure 3. *Monophasic patients' (n=23) relaxation levels pre- and post-treatment.*

Biphasic patients

For patients who received treatment in two phases (n=6), the results are presented according to the pre- and post-treatment pain (Figure 4), mood (Figure 5), and relaxation (Figure 6) outcomes for the first and second treatment periods. Each

grouping of four columns represents one individual patient's outcomes.

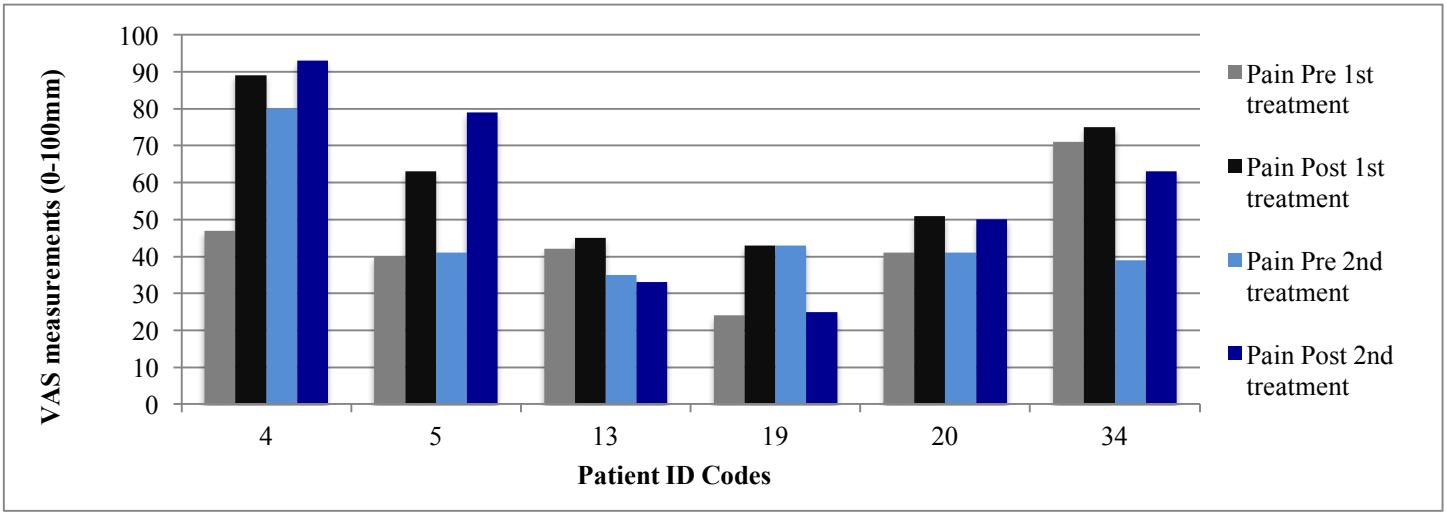

Figure 4. *Biphasic patients' (n=6) pain levels pre- and post- treatment*

Again, the scores showed – to some degree – improvement in pain scores, however, these remain somewhat difficult to interpret conclusively. Patient 19 shows improved pain post-phase 1, which then returns to baseline post-phase 2. A slight decrease is also reported in mood scores. Contextualizing the pain and mood outcomes within those of relaxation help to give a clearer picture. This patient appeared much more relaxed after both phases 1 and 2, leaning towards a positive outcome for this individual.

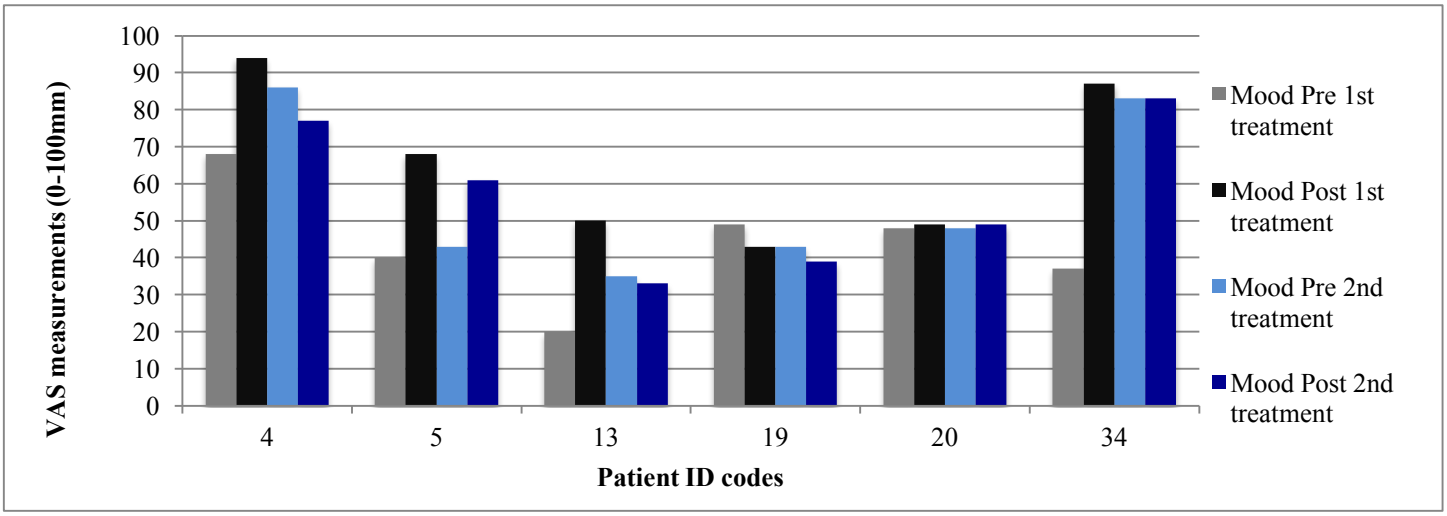

Figure 5. *Biphasic patients' (n=6) mood levels pre- and post- treatment*

Again, patient 20 shows that the relaxation outcomes reflect another dimension to the pain symptoms and mood disorder, thereby highlighting the importance of appreciating the patient's pain story in its entirety.

However, the relaxation outcomes did not consistently clarify the pain or mood outcomes. Patient 13 reported deterioration in pain and mood, but relaxation remained somewhat similar after both phases. This patient presented with fibromyalgia and comorbid depression; the difficulty in treating this syndrome is highlighted by this patient's VAS scores. She reported feeling much better afterwards, especially the day of and day after receiving the low frequency sound stimulation. This improvement, the practitioner noted, was not reflected in the VAS reports.

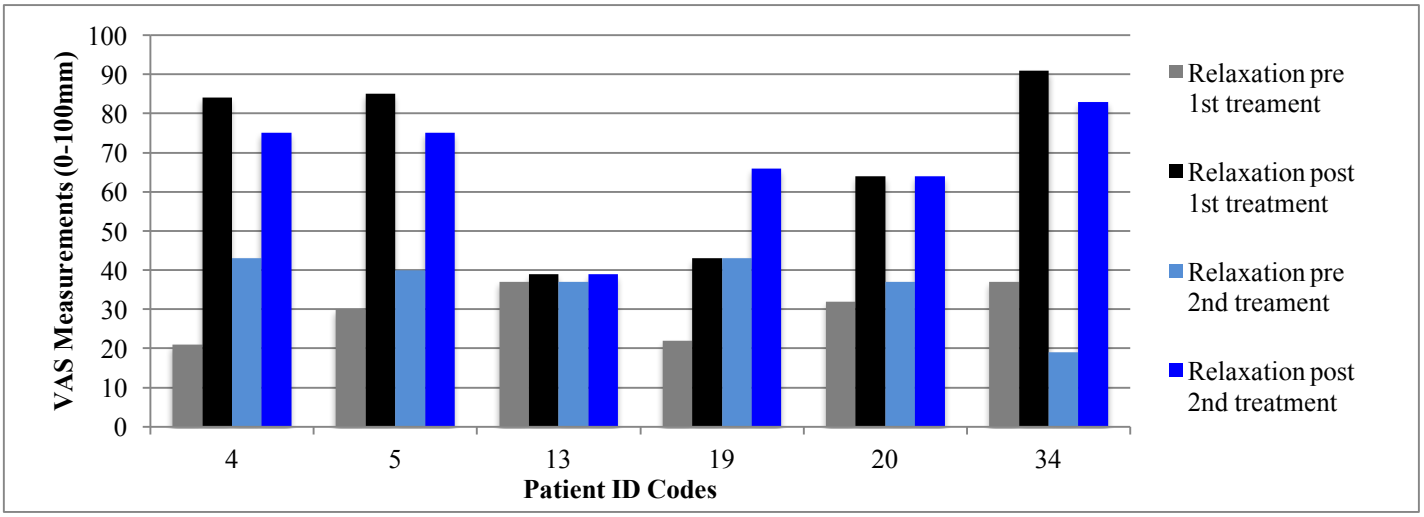

Figure 6. *Biphasic patients' (n=6) relaxation levels pre- and post- treatment*

The pain, mood, and relaxation scores across all patients (n=29) show quite a lot of individual variation. VAS and verbal reports made by the same patient were sometimes antagonistic; even if the VAS outcomes showed very little improvement, the patients verbally expressed feeling better after the treatment. Some of these verbal reports are presented in Table 4.

Table 4. *Patient responses and practitioner notes on the treatment.*

Pain relief	*Significant improvement in the situation; easier to undergo physiotherapy in the absence of pain.*
Relaxation	*Easier to fall asleep; surprised at the ability to relax; improved mood; improvement in neck/shoulder tension.*
Reduction in medication	*Reduction in Mirzapin – from 30mg to 15mg after only one month of treatment.*
Quality of sleep	*"I fell asleep faster and listened to the same music at home when going to sleep; the treatment forced me to relax."*
Duration of effects	*He slept for 15 minutes in the first session. Slept without needing medication that night, slept through until morning. After the treatment, his anxiety melted away and stayed away for a few days. After the third visit, he didn't need relaxation medication for three days (normally only one day).*

Discussion

The implementation of VA treatment at a rehabilitation unit as part of specialized healthcare has been presented. Decreased pain, improved mood and sleep, reduction in analgesic intake, and increased relaxation are among the effects often reported after VA treatment [4,6,8,10]. These effects have also been shown in the 29 patients presented here, although interpreting results within a multidisciplinary setting is complex.

Zisapel and Nir [17] showed that a statistically significant change of 10mm in VAS scores is clinically significant for both pain and mood, corresponding to patient ratings of "a little better". Furthermore, a 20-27mm increase corresponds to ratings of "much" or "some" change [16]. Large improvements can be seen here in individual patients' pain, mood, and relaxation scores, particularly in monophasic patients. However, Katz, Paillard, and Ekman [18] caution that relying on the MCID as a determinant of clinical decisions may not be the best approach; the changes in pain scores do not tell the whole story. The patient may report clinically relevant changes in other measures, such as relaxation, as was shown here. Exploration of the whole patient's experience is essential; by focusing only on one aspect of the pain experience, only a part of the outcomes are understood. This also recapitulates the complexity of the data presented here.

Patient comments

An interesting observation of these patients' experiences is the incongruent responses between the subjective verbal comments and the VAS outcomes. Patient 19 reported sleeping much better after the treatment even though this was not reflected in the VAS outcomes – rather her condition appeared to have deteriorated. This discrepancy between

subjective verbal reports and VAS outcomes has also been reported earlier [19]. Although the VAS outcomes did not support the comments this patient made on the process, it is prudent to remember that pain experiences are unique to the individual. Practitioners treating a patient with chronic pain cannot define or understand the subjective experience, further stressing the importance of multiple outcome measures. The catalyst for improved wellbeing may be the combination of factors addressing sensory, physiological, and emotional needs. Chronic pain is a multi-layered phenomenon, affecting the patient in many facets of their lives, and the aim should be to address all of these aspects.

Interpreting outcomes

Relaxation is often an after-effect of VA treatment and the pre- and post-treatment scores presented here support this. Increased relaxation may help to reset the learned response of dysfunctional pain processing associated with the cumulative negative effects of chronic pain, anxiety, and depression. If stress is accountable for individual differences in pain perception – and thereby an agent of chronicity – increasing relaxation so as to decrease stress may aid in regulating and resetting learned pain responses. However, as neither the underlying mechanisms of chronic pain nor those of low frequency sound stimulation are fully understood, further research is needed to delve into the multifaceted nature of chronic pain and comorbid mood-related phenomena and the effects VA treatment exerts thereafter.

One limitation of the data presented here may be that only pre- and post-treatment process VAS measurements were taken. Punkanen and Ala-Ruona [2012] explained that in recording only the two measurement points, we might not see the range of a client's experiences of a process. This indeed may be the case, as the measurements are simply recorded on the first and last day of the treatment, rather than throughout the entire experience. Although patients give a subjective account of how they perceived VA treatment, this does not show as much detail as would weekly measurements. Taking a patient's final measurements on a day they experience especially high pain levels, for example, may potentially skew an effective measurement of the process.

Conclusion

The positive outcomes of the patients at Seinäjoki Central Hospital support current knowledge on the effective application of VA treatment and music listening for both chronic pain and mood disorders. Most patients were undergoing or had received other treatments around the same period, such as physiotherapy. Objective markers, such as cortisol levels, should also be explored in future research. Although pain is a subjective experience, interpreting patient experiences according to standardized frames - such as the minimal clinically important difference – increases validity and generalizability in experiential reports.

These data were collected as part of standard hospital protocol and represent the application of this treatment in a naturalistic setting. Therefore, it is not possible to ascertain which treatments – or whether it was their combination – were the catalysts for change due to the lack of a control group. However, the narrative presented shows that VA treatment can be beneficial when used within a multidisciplinary unit, and that the subjective differences presented by patients are moderately clinically relevant. This account affords an interesting insight into the workings of a multidisciplinary treatment process.

VA treatment is growing but the evidence supporting its efficacy is relatively sparse. Non-controlled studies cannot report on the efficacy of a treatment, yet reporting protocols followed in a naturalistic setting provides information on how a treatment may function within a larger context. A plurality of methods and reports is necessary for the future of VA research. Randomized controlled trials are indeed needed to discuss the efficacy of the stimulation, yet these should not detract from qualitative reports of patient experiences.

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Appendix A

Discography

Classical
Johansson L. Bach for Meditation. [Album]. Naxos. 2004.
Johansson L. Beethoven for Meditation. [Album]. Naxos. 2003.
Johansson L. Mozart for Meditation. [Album]. Naxos. 2004.

Easy Listening/Ambient
Clayderman R. All by myself [Album]. Recall (UK). 2000.
Enya. A day without rain [Album]. WEA. 2000.
Enya. The magic of Enya. [Róisín and Celtic Spirit. Album] Newsound. 2000.
Enya, Ryan R. The very best of Enya. [Enya]. Reprise. 2009.
Gregorian. Masters of Chant. Edel America Records. 1999.
Oldfield M. Voyager [Album]. Voyager. 1996.
Vinkel I. Meri Panga Panga All [The sea below the cliff of Panga]. [Album]. Orbital Vox Records. 1999.

Electronic
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