Clinical Perspectives

A Clinical Case of Insomnia due to Tinnitus Treated with Music Integrative Neurotherapy™

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Abstract

Tinnitus is defined as the perception of sound in the absence of an acoustic stimulus and as a subjective experience of the patient. It is a symptom in nearly all ear disorders and has an obscure, still unknown mechanism of install and development. The actual methods of treatment employed mainly a “sound mask” aimed to cover in loudness the audio volume of tinnitus. Music it is often implied in the process by producing play lists according to the personal preferences and musical cultural background of the patient or the therapist, trying to offer an alternative to the usually unpleasant and permanent sound heard by the patient. But music it is not implied in treating the tinnitus itself. The medical treatment of the presumed causes involved consists usually in lowering blood pressure medication, hearing aids, a.s.o. The clinical case presented in this paper is quite different, because the patient’s otolaryngology and audiology tests shown a physiologically intact hearing apparatus, a normal SRT (speech reception threshold), with no modifications of the hearing capacity or ear disorders in act. No medication was undergone which could allow the suspect of influencing the tinnitus phenomenon (hyper/hypo tension medications, for example). The tinnitus appears after a Radiation Therapy applied locally in the parietal zone as a treatment for a malign skin tumour, and generated a sleep deprivation symptom which affected the personal and social life of the patient. The role of Music Integrative Neurotherapy™ in this clinical case had multiple finalities. First of all: to reduce the impact of the tinnitus on the mind’s processes. Second: to allow the mind to produce a pattern recognition path which brings to the assimilation of the tinnitus with other known body sounds; in this case with the heart beat sound. Then to help to store this information at the level of long term memory data bank. Third, to allow the therapeutic intervention on the sleep disorder (insomnia) produced by the tinnitus. The novelty of this therapeutic application consists both in the approach to the patient’s problems and in the technique implied in therapy. This is the first time Music is used as a science, by composing it based on the medical data of the patient and aiming to specific regions of the brain in order to help the organism to create by itself the defence mechanisms. There is no precedent published material describing similar clinical case, approach to it or a similar therapy method, as by author knowledge.

Key Words: tinnitus, insomnia, music integrative neurotherapy, graur, neuroscience

Music Integrative Neurotherapy™

The basic principle of Music Integrative Neurotherapy™ is that in order to really heal, the music used for therapy must be composed based on the medical data of each patient and must act beyond the psychological conditioning and cultural background of the patient.

The ultimate goal of the therapy is to transmit to the mind pre-determined information to be stored in the long term memory banks for to be used as reference for future decisions. (Rewiring the mind to rewire the brain and organism).

To reach this goal the laws of Music Science are employed to build the final musical form, the audio information as it is received by the listener/patient’s brain. This information is processed by the mind, decoded and transmitted to various parts of the brain. From these centres the decoded information goes to various organs. In turn, the organs/plexuses feed the result of their reaction to this input as new information, back to the brain. The continuous process of feed forward-feedback is piloted from start, by building the original musical material based on the patient’s medical and psychological data. This therapeutic musical and visual material elicit changes in homeostasis, feeds the desired new information to the memory mechanism and fixed it in the long term memory banks. As an immediate result changes in behaviour and the bettering of the general health state, prevalently mental health state of the patient, are evident and quantifiable.

In composing the music for therapy the parameters of musical language are employed. Many people think that music is like a language. No, music it is not like a language. Music is a language. It presents therefore the basic four parameters which defined the phenomenon called language: the pre-speech (visualization/vocalization); a vocabulary (made by different sounds); a grammar; syntax and the specific natural logic laws governing the phenomenon itself. In the presenting clinical case the musical vocabulary is made exclusively of electronically generated sounds; consequentially, the grammar and syntax of the musical material created for therapy had to follow the rules of electronic music grammar and syntax. That implied the use of packs of waves as generating basic musical cells, their organization in logical structures building the final musical form, and the sound processing techniques related to the final goal of therapeutic material elaborated. This organization of the electronic music vocabulary permits, between other benefits, to calculate when the single pack of waves will collapse in time at the level of the limbic system, and where in the brain the resulting single wave stream will be directed as a consequence; a process that allow the therapist to calculate and plan better the final results of the therapy.

The results after eight sessions/once a week/50 minutes each in my private practice were:
1. Improved: lesser insistent tinnitus;
2. Improved sleep activity: during the sessions (third part of the session, starting with the fourth session) the patient slept for about 20 minutes while in therapy and beyond;
3. Tinnitus is still present, even at a softer level; but it is not perceived anymore as fastidious, the patient can cope with by herself without external aids;

Insomnia it is not diminished by itself in time, except +/- 30 minutes after the patient finished to listen to the Music Integrative Neurotherapy™ personalized Audio CD received by the patient at the end of the sessions of therapy (the patient doesn’t took all the cycle of ten sessions, for economic reasons; this information arrived to me a couple of month after, from the patient’s husband). The personalized CD contained mainly Music Integrative Neurotherapy™ material for Sleep Disorders- Insomnia (NEC)
stimulated via specially composed music, to elicit the creation of a process of pattern recognition changing the unpleasant reality of tinnitus in an understandable, known image/concept; and to store the final pattern of information in the long term memory as reference for future decisions. The results obtained shown also that music can be used directly for the treatment of the disease, not only as an entertainment background, as usually is used at present time;

This case and the treatment implied open also an interesting perspective regarding the origins of some tinnitus and schizophrenia forms (see Discussion section at the end of this paper).

Background

The patient S.R. was referred to me by her family physician. She was a 48 years old female, married, two children; a full time housewife. One year before our first encounter in my private practice she was diagnosed with a tumor affecting the left ear and the zone between the ear and the lower maxilla, expanding toward the neck and the thyroid gland. The tumor, diagnosed as a mesodermal dermis (second layer skin) tumor of unknown origin, seemed to be malign and progressive. The patient undergone local radiation therapy for some three month, twice by month. One week after the end of the RT she sensed the tinnitus effect (patient's statement confirmed by her physician). The tinnitus progressively affected heavily her capacity of sleeping, with the negative personal and social consequences. She presented all the symptoms of sleep deprivation, unable to take care of herself or the family and related social cores; the verbal communication was slow and blurred, the body movements were uncertain, barely coordinated; she moved with a gait. The presenting physiological state of the patient was, according to the medical test's results, in-between the normal values regarding: the auditory apparatus, the hearing capacity and speech reception threshold (SRT). The auditory apparatus seemed intact with no audiological pathology present. The chemical treatment consisted mainly in a mild painkiller (Ibruprophen/Tylenol); no medications were giving for insomnia. The ears were clean, without cerumen. The blood pressure and pulse rate were at normal values for a person at her age. During the M.I.N.T. assessment, after verifying and confirming the above mentioned data, I presented her with the usual types of sounds described as tinnitus: the “sounds like”: crickets, frogs, bells, wind, rain and water, neutral white noise and pink noise. None was recognized.

Then I proposed to her sounds starting at a 220 Hz frequency and going lower at a rate of 2 Hz each step; every sound wave being presented as: sinus, triangular, saw, squared, white noise, pink noise (a sound generator NCH Tone Generator was employed). At a 56 Hz sound (sinus wave) the patient recognized it as similar in pitch with the tinnitus she heard (Figure 1).

I then presented her with a complex sound (different single sound layers over imposed) composed by all the aspects before mentioned, in a division by ear (stereo audio channels Left/Right) made by sinus+ white noise (left ear, the one affected by the tumor: Figure 2) and triangular+ saw+ pink noise (the right ear; Figure 3). She confirmed it as the audio image closest to her tinnitus.

I used these data to compose the therapy material for her treatment (for the left ear: Figure 4; for the right ear: Figure 5).

A Sony Sound Forge Pro 9 software was used for the recording and processing of the sounds generated by the NCH Tone Generator.

Methods

The problems with tinnitus, in this case and others, are both physiological and psychological.

An unknown, undefined and unclassifiable sound it is perceived by the
mind like a foe and elicits a reaction of defence. Louder and persistent the tinnitus, stronger the reaction of reject is.

The whole mind’s activity is permanently focused in fighting the intruder, neglecting the other cores. The first goal of M.I.N.T. in this case was to help the mind in the action of pattern recognition and classification. By giving a known and understandable explanation to the cluster of sounds composing the tinnitus, the mind of the patient can elaborate a pattern of recognition and accept the tinnitus as a normal component of the general and permanent audio information received by the brain via internal sound sources (heart, blood circulation, liquids and gases). In time, this pattern is stored in the long term memory data bank, and it is used by the mind as a reference in classifying the audio input (the tinnitus itself) as an aspect of the heart beat sound.

In order to reach this goal I used Music Integrative Neurotherapy™; a method on the borders between Music as a Science, Medicine, Molecular Biology and Quantum Mechanics.

M.I.N.T. uses the Brain-Mind-Brain-Organism system: the ways in which (a) the Brain receives the information (in this case, audio, or audio and visual information); (b) the Mind processes this information transmitting (c) the decoded results to specific parts of the Brain; which transmitted them (d) to specific organs.

These organs, in turn, transmitted to the (a) Brain the information regarding the effects upon them of the decoded original information. The process of feed forward and feedback of the information is cyclical and progressive and determines changes in the body’s functions, which determine consequently changes in the behavior of the patients. The general mechanic is: \[a \rightarrow b \rightarrow c \rightarrow d \rightarrow [a \rightarrow b \rightarrow c \rightarrow d] \rightarrow [a\rightarrow \ldots \text{and so on (cyclical)}\].

It can be programmed from the beginning (a), creating the original musical information by using the medical data regarding the parts of the brain and organism interested in a determined disturb, along with the personal medical data of each patient, all giving the parameters necessary to compose the music accordingly.

![Fig.1: the tinnitus’ wave shape](http://medicamus.com/tinnitus/00%20sr%20tinnitus.mp3)

Listen to: ex.00: the tinnitus [http://medicamus.com/tinnitus/00%20sr%20tinnitus.mp3](http://medicamus.com/tinnitus/00%20sr%20tinnitus.mp3)

![Fig. 2: left ear raw wave shape](http://medicamus.com/tinnitus/01%20sr%20LE%20A1%20imp.mp3)

Therapy goals

**Short term goal, four sessions:**

1. To find out the values regarding the tinnitus frequency range and loudness.
2. To present the tinnitus as a normal heart beat sound
3. To start a pattern recognition process in which the tinnitus is the equivalent of the heart beat sound.

**Mid-term goal, three sessions:**

To consolidate the information previously presented and further reinforcing it; control the effect of the treatment on patient’s behaviour.

**Long term goal, three sessions:**

1. To treat (M.I.N.T. method) the insomnia as a Sleep Disorder Insomnia, NEC (DSM V)
2. To further enhanced the image of tinnitus as a heartbeat and help to stored it in the long term memory
3. Follow up: Produce a M.I.N.T. Personalized Audio CD containing the most efficient therapy material according to the therapy sessions results. Duration: 50 minutes. Delivery: 1 hour prior to go to sleep.

**Compositional techniques**

The first step I took was to transform the cluster sounds (tinnitus) in a regular rhythmical ostinato, heart beat like, with the basic rhythm cell (eight+dotted quarter in musical notation) at a Metronome (musical value a quarter)=72 beats per minute and a frequency of 28Hz (half the central frequency of the tinnitus), in a sinus wave form (Figure 6).
That was intended for the mind to first equal the tinnitus with a normal heart beat sound and then substitute this image to the tinnitus.

This permanent background element (rhythmical ostinato) is present in all the nine pieces composed for the therapy of this case, at different levels of intensity (volume/amplitude).

In the pieces made for the third part of the session it appears at a subliminal level.

A brief analysis of a therapy piece

Title: Complex A

Duration: 5 minutes

Use: second part of the session

Delivered at a general volume of -12 dB

Vocabulary: based on tinnitus sound (cluster/pack of waves) around 56 Hz and multiples. Frequencies presented in different forms: sinus, triangular, saw, squared, with the white noise and pink noise aspects of each frequency inside of the packs. Derivate packs around: 28Hz; 112 Hz; 224 Hz; 448 Hz; 896 Hz; 1792 Hz; 3584 Hz. Cluster's components: + and – 5 Hz around the center frequency

Grammar: continuous variation technique in short periods (a=proposition; b= phrase; c= period); a= [Subject= tinnitus; predicate= heart beat; adverb= pack of waves from 28 Hz to 56 Hz; complement= 56 Hz to 112 Hz; attribute= 112 Hz to 224 Hz and 28 Hz) Rate: 2a=1b; 2b=1c

Background elements:

1. Tinnitus
2. Heart beat

Middle ground elements (packs of waves):

1. Frequencies between 112 Hz and 224 Hz, sinus wave form:

2. Frequencies between 224 Hz and 448 Hz, triangular wave form:

3. Frequencies between 448 Hz and 896 Hz, saw wave form:

4. Frequencies between 896 Hz and 1792 Hz, squared wave form:

5. Frequencies between 28 Hz to 3584 Hz, white noise form:

6. Frequencies between 28 Hz to 3584 Hz, pink noise form:

Front elements (packs of waves):

Frequencies between 28 Hz and 3584 Hz, sinus wave form, sliding down/up and back.

Syntax: A general ternary form ABA’ where a= proposition, ascending melody line, and b= proposition, descending melody line organized as:

A= c1 = [(aba”) (b”a”) (a”b”a”)] x 2
B = c2 = [(b”a”) (a”b”a”) (aba’)] x 2
A’= c3 = [(a”b”a”) (aba’) (b”a”)] x 2

and where the variations affects the whole pack of waves as follow:

[‘’] = pitch (+9 half steps= major sixth (up); +12 half steps (perfect octave up) and FM processing [‘’”] = amplitude (2 dB up/down; reference value: a/b at Odb, and AM processing

[‘’”] = processing both FM and AM in a Surround Sound movement.
Panoramic: Front: Left- Center- Right
Back: Right- Middle-Left

Rate of change: 0.004 seconds

General musical form: field heterophony made of inner organized string heterophony, where:

X axis (time) = 5 minutes; inner division 9+1 seconds blocks = 30 blocks total

Y axis (frequency/pitch) = 28 Hz to 3584 Hz

Z axis (spatial dimension) = (x) x (y) = z = ([9” x 1Hz to 112 Hz] + (1” x 56 Hz) + (9” x 1 Hz to 224 Hz)+ (1’x 56 Hz)...etc

Encounter point:

X axis= 1 second every 10 seconds
Y axis= 56Hz, sinus wave shape

Fig.7a: complex A score, first period (fragment). Software: Sony ACID Pro 7 Digital Audio Workstation/Mixer

Sound processing


For string heterophony the main procedures employed in processing the sound were, in order and as follows starting from the initial aspect of the final audio file (Figure 7b):

- FM processing (Figure 7c): frequencies up to 500 Hz modulated with a rate of +and-0.5 Hz arround the carrier pack of waves, left channel;the same rate for the frequencies arround 8,000 Hz, right channel;

- AM processing (Figure 7d): modulating the initial amplitude with a 50% in a 270° width in a 360° general range; adding the saw form of the pack of waves to the existing general sinus form in order to enhance the perceptibility of the whole pack;

- To expand the audible range of the wave’s pack (amplitude and frequency), additional filters were employed (Figure 7e);

these filters acted as follows on the single inner string of waves:

- for 24 Hz: AM -11.0/FM 1.6;
- for 59 Hz: AM + 7.0/FM 7.0;
- for 189 Hz: AM -4.6/ FM 7.0;
- for 510 Hz: AM +11.6/FM 7.0;
- for 1345 Hz: AM -15.6/ FM 7.0;
- for 2074 Hz: AM +1.7/FM 7.0;
- for 5907 Hz: AM +12.4/FM 7.0;
- for 16951 Hz: AM 15.7/FM 1.9.
fig. 7b: initial

fig. 7c: FM processing

fig. 7d: AM processing the precedent FM processed
**fig. 7e:** additional filters expanding Hz range

*For string heterophony:*

**fig. 7f:** main filter
Additional filters:

For the field heterophony the main filter applied to the pack of waves (Figure 7f) was first FM processed (Figure 7g) with a depth of 70% in a 180° width in a 360° general range and adding the saw wave form of the pack as in the string heterophony processing; the resulting pack of waves was then processed for the AM (Figure 7h) by increasing the depth with a 76% in a 270° in- phase in a 360° range. The final resulting audio file was processed with a Vocoder filter having as attractor Human Voices centered on C4 frequency (Figure 7i). This last process was implied in order to give to the patient a known audio image (human voices) and help to assimilate the tinnitus and related sounds to familiar representations of the sounds.
Therapy session

Each M.I.N.T. session is divided in three parts (Graur, 2003):

1. Introductory: The goal of the first phase is to prepare the patient to the impact of therapeutic music; it lasts between ten and fifteen minutes, according to the personality of the patient and his immediate state of mind. The values of blood pressure, pulse and respiratory rhythm taken before the session give an approximate indication about the presenting state, and determine the duration of this phase. When the respiratory rhythm (the most evident immediate sign) becomes regular the second phase could start.

2. The second phase contains three parts: the first addresses the class of disease (for example Anxiety); the second addresses the sub-class of disease (Anxiety, G.A.D.); the third is the therapeutic music composed for each patient. This phase lasts between twenty-five and thirty minutes, according to the type of disease and the medical condition of the patient.

3. The third phase is aimed to stabilizing the new levels of patient’s homeostasis, evident in both his behavior and in the values of the tests run after the session. It last between five to seven minutes.

Details: After the initial assessment session, the therapy sessions are grouped in cycles of ten. During the first three sessions the duration of time need for the first phase is longer than the duration of time used for the other two phases. Normally after three sessions, the first phase became shorter, allowing the extension of the second phase. During the session the therapist applies various methods of observation, noting the duration, frequency or the interval of patient’s reactions. Also, different associate techniques (extra musical) are implied if necessary, case by case.

At the end of each session the therapist writes a preliminary report about it; after a cycle of ten sessions a conclusive report is issued and presented to the referent. This report presents the details of therapy used, the reactions of the patient towards it and the termination plan.

Results

1. The loudness of tinnitus diminished;
2. The sleep activity improved: during the sessions (third part of the session, starting with the fourth session) the patient slept for about 20 minutes while in therapy and beyond
3. Tinnitus is still present, at a softer level; but it is not perceived anymore as fastidious.
4. The patient can cope with by herself without external aids; (that shown that the new information was stored in the long term memory and used as a reference).
5. Improved: personal and social life of the patient (changes in behavior);
6. Insomnia it is not diminished by itself in time, except +/- 30 minutes after the patient finished to listen to the Music Integrative Neurotherapy™ personalized Audio CD I gave her at the end of the sessions of therapy (the patient doesn't took all the cycle of ten sessions, for economic reasons; this information arrived to me a couple of month after, from the patient’s husband). The personalized CD contained mainly Music Integrative Neurotherapy™ material for Sleep Disorders- Insomnia (NEC)

Discussion

Once find out the central frequency of the tinnitus and working around it, I took in consideration the hypothesis of selective and permanent damages of Corti’s organ as a radiation therapy’s side effect. There was a similarity between the general aspect of tinnitus and the wave shape and frequency range of some radio waves recorded from space and presented in the University of Iowa website (http://www-pw.physics.uiowa.edu/space-audio/)

I let her listen to some samples of the Earth (planet) radio waves, recorded by NASA and JPL at different altitudes and distances in the deep space, in the eventuality that the damages of the Corti’s organ could have destroyed in some way her natural barrier against the perception of these and other similar sounds (see Note 4).

Conclusion

1. The mind can be piloted, by a music composed based on the medical data of the patient, to create by itself specific patterns and use them to recognize, classified and react to information precedent considered as unpleasant and damaging;
2. At least one of the possible treatment of tinnitus can be done by using the mechanics of memory stimulated via specially composed music, to elicit the creation of a process of pattern recognition changing the unpleasant reality of tinnitus in an understandable, known image/concept; and to store the final pattern of information in the long term memory as reference for future decisions;

Musics science-based Music Integrative Neurotherapy™ can be used directly for the treatment of the disease, not only as an entertainment background, using a play list of music not composed for therapy, as often is used the music in therapy at present time.

Notes

1. The audio files of the examples are presented in an audio compressed format (mp3). That means the lowest and highest frequencies are not audible; in the real therapy they are audible, for the effectiveness of the therapy itself, delivered via special 3D sound headphones, and via computer. This audio compressed format is due to the limited space allowed for the examples because of the length and weight of the original audio files (raw .wav format); however, it could give a general idea about the therapy. In some cases, an image of the original raw wave (uncompressed) file is shown.
2. In order to listen to the Audio examples the reader must be connected to the Internet. All the computer based media players (PC and MAC) are enabled to reproduce these examples. Note 2: to follow, M.I.N.T.= Music Integrative Neurotherapy™
3. This clinical case was briefly mentioned, without the detailed procedure, in my presentation (“Music Integrative Neurotherapy™ and its Applications in Mood, Personality and Sleep Disorders”) at the 2007 Conference of the American Music Therapist’s Association, Louisville, KY, USA. (see the handout of this presentation at: http://medicamu.ipower.com/lvil1.pdf) Also, it was extensivly presented at the “Toward a Science of Consciousness” International Conference 2012, organized by Center for Consciousness Studies, University of Arizona, Tucson, AZ, USA (consciousness.arizona.edu/2012ArtTech.htm)
4. We are permanently immersed in these natural and other man-made radio waves frequencies; it seems to me that the Corti’s organ and some other parts of the auditory system act additionally as selective audio-filters, muting the background sound in order to keep the brain functions working normally. If these
filters are damaged, the probability of an increased vulnerability to the action of the all-present radio waves also increases.

My hypothesis was that the tinnitus was in some way produced by something else different than the blood circulation sound, the frequencies at which usually the latter is perceived being way higher that the ones this patient heard permanently as tinnitus.

To my excitement she recognized FIVE of these sounds as being very similar to her tinnitus (and indeed, they were in the range of tinnitus and have quite similar wave shapes).

Establishing that, I composed various pieces addressing both separate ears and the binaural sound effect, using each pack of waves as a melody line itself.

Then I organized this waves in a string heterophony first and in a field heterophony further, building a general AB (A’B’ A”B”) C musical form and processing the sounds in layers of different amplitudes.

I calculated to obtain a binaural sound at determined intervals in time (every 20 seconds), aiming to temporary muting the background (tinnitus) sound’s frequencies by annulling them via the subtraction of its general frequency from a slight superior wave packs frequency; that created in the brain a low frequency wave corresponding to heart wave sinus sound and brain wave delta frequency.

Each piece lasts for about six minutes and was employed in the third part of the session, starting with the fourth session.

Listen to ex. 8: simplex A http://medicamus.com/tinnitus/07%20sr%20simplex%20A.mp3

The reaction of the patient was quite immediate: she felt asleep for some 20 minutes (I had to change the therapy room for that).

Listen to ex. 9: Complex C http://medicamus.com/tinnitus/08%20sr%20complex%20C.mp3

This introduce two interesting questions: is it possible that some forms of tinnitus are the result of Corti’s organ damages with consequential exposition to the environmental electronic sounds, usually not perceived by the brain and interpreted by the mind at a conscious level?

Second question: the most frequently present pack of waves is produced by the auroras phenomenon; in today’s world, through the ionosphere and reflected back to the Earth surface are passing most of the communication waves, at all ranges of frequency and types of waves. Sometimes one could perceive into these waves a distinct human voice with an unintelligible speech.

Could it be that the “voices” heard by the usual schizophrenic type patient, if affected by an undetected dysfunction of the Corti’s organ, are really real and produced by the environmental electronic sounds; with an explanation/personification give to the patient by his/her own mind?

Interpreting each “voice” and the speech as belonging to known, to the patients, really characters; involving tries of the patient’s mind to give a recognition pattern to unknown sounds and classifying them as messages from known persons; giving to these unintelligible sounds a meaning accordingly to the patient’s self personality and desires.

This hypothesis does not contrast the usual evaluation and definition of a schizophrenic type; it could complete it, though.

A treatment for schizophrenia could start from this hypothesis and try to bettering the patient’s condition by using in therapy the music as a science.

5. The patient’s written consent for the anonymous use of the data is on file in therapist’s archive.

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Competing interests

There are no competing interests.

Authors' contributions

I hereby state that I am the sole author of this paper and enclosed figures, tables, audio and video files.

References
