

## 5. MUSIC THERAPY AND BACKGROUND MUSIC IN THE PHYSIOTHERAPY OF A PATIENT WITH NORMAL PRESSURE HYDROCEPHALUS

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**Abstract:** *Cognitive deterioration and gait balance disturbances are the core symptoms of idiopathic normal pressure patients with normal pressure hydrocephalus – NPH (J. Larson et al, 2021). The manifestations caused by NPH directly foul the patient’s autonomy. Rehabilitation in NPH and supervised physical exercise are important factors to improve patient’s functions (J. Rydja et al, 2021). Music therapy and background music have cognitive, psychosocial, behavioural, and motor benefits for people with neurological disorders. Various forms and genres of music can be engaging, emotional, physical, personal, social, persuasive, and music also promotes synchronization of movement (O. Brancatisano et al., 2020). The process of music therapy intervention was structured and designed according to American Music Therapy Association (2005) in a 3-step process of preparation, implementation, and evaluation. Background music and instrumental and movement music activities were aimed at relaxation and cognitive stimulation in a patient with NPH during physiotherapy. In instrumental activities three music instruments were used, two Orff instruments a tambourine, a rattle, and a plastic string resembling an accordion (made from recycled material) – to improve the range of movements, strength, endurance, and coordination of the upper limb bilaterally and to improve walking motor skills.*

*Furthermore, we selected background music according to the patient’s taste and choice. The music genres in our sessions were electronic music, pop, and relaxing jazz. The music styles were Synth-pop, Ambient, Disco, Eurodance, Dance-pop and Relaxing jazz. A total of 5 music therapy sessions were held within two months. Each session lasted for 60 min. We observed the following changes in the patient: The mechanism of regulation of fine motor movements was affected in his upper arm bilaterally, and communication skills were also improved. The gross motor skills in upper arm improved bilaterally. The walking speed was more pronounced, and his submaximal performance distance was extended. During background music the patient myofascially relaxed – the spasticity began to subside, and music induced psychological and physical well-being on his emotional level.*

**Key words:** *cognitive skills, communication, dancing, emotions, music therapy, neurological disorder, normal pressure hydrocephalus (NPH)*

### 1. Introduction

**Normal pressure hydrocephalus (NPH)** is a neurological disorder, characterized by gait and balance disturbance, ataxia, cognitive deterioration, and urinary incontinence, combined with ventricular enlargement. It means that gait-balance disturbances are the core symptoms of idiopathic normal pressure hydrocephalus (Y. Nikaido, H. Urakami & Y. Okada et al., 2023; C. Hallqvist, H. Grönstedt & L. Arvidsson, 2022; S. Ghosh & C. Lippa, 2014; P. C. Modesto & F. C. G. Pinto, 2019).

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The manifestations caused by NPH directly foul the quality of life, especially the patient's autonomy, but it is important to state that, in most cases, it is reversible with the appropriate treatment, and with a combination of surgical and multidisciplinary rehabilitation. Physiotherapy, as an integral part of this multidisciplinary work, aims to monitor the gait pattern of patients with NPH, as this manifests as the inability to perform a sequence of movements, and the absence of motor and sensory symptoms. The difficulties with activities of daily living, such as personal hygiene, dressing, feeding, or even walking, usually appear slowly at the beginning of the illness, when movement slow down and the balance is impaired. The patient loses the stimuli to perform these activities, becomes discouraged, and generally avoids social activities (P. C. Modesto & F. C. G. Pinto 2019).

Rehabilitation in NPH is suggested to be an important factor to improve patients' functions. The long-term effect on balance and higher goal achievement indicates beneficial influences of supervised physical exercise (J. Rydja, L. Kollén & Hellström, 2021). It is generally accepted that music-based interventions fall into two main categories, more specifically, music therapy and music in therapy. Music in therapy is also known as background music, and music medicine.

**Music therapy and background music** have cognitive, psychosocial, behavioural, and motor benefits for people with neurological disorders. O. Brancatisano, A. Baird & W. F. Thompson (2020) found seven properties – 'capacities' of music that interact with brain function and contribute to its therapeutic value. Music – in its various forms and genres – can be engaging, emotional, physical, personal, social, and persuasive, and it also promotes synchronization of movement.

Well-designed music activities and music with the properties beneficial to patients can afford human health, well-being and provide a framework for the development of non-pharmaceutical treatments for neurological disorders. Z. Fábry Lucká & M. Habalová (2022) claim that music can affect people with its rhythm, timbre, pitch, melody, harmony, and dynamics as we respond to them. Our response evoked by music can manifest itself on a somatic, cognitive, emotional, communicative, and social level, with music acting as:

a) Stimulating – faster tempo, strong rhythm, higher volume, more pronounced dynamic changes and contrasts, gradation, staccato, variations of tones, sounds, melodies.

b) Calming – slower tempo, small dynamic changes, lower volume, legato.

Sláviková (2022) claims that there has been a turn in psychological research in relation to personality through imagination, which she considers to be easily grasped through movement, graphic expression, and other expression. She believes that the receptive, creative, and intellectual level of musical experience can mobilize deep psychological contents in a person and penetrate hitherto suppressed areas of consciousness and unconsciousness. She says that this opens wider self-knowledge, but also cognition of "otherness". Similarly, Medňanská & Strenáčiková (2021) consider expressive music making and music improvisation to be an important medium when we want to connect with other people and oneself.

Music instruments can be beneficial in physiotherapy because they can act as motor stimulators. In the area of gross motor skills, it is possible to practice

coordination and accuracy in movement performance. Patients learn and practice the ability to coordinate their movements through sight, and they also receive auditory and kinaesthetic feedback during movement and direct contact with the instrument (C. P. Hurt-Thaut & S. B. Johnson, 2017).

We talk about music therapy within physiotherapy when expressive means of musical speech are essential for physiotherapy. Without it, the therapy would not make sense. For a better understanding of the terminology, it is important to distinguish the term **background music** from the term music therapy, which is music selected for training as a background music or music in medicine (E. Králová & J. Kantor, 2020). The British Association for Music Therapy (BAMT, 2019) defines music therapy as “work with patients of all ages who may have emotional, physical, mental, psychological, and neurological disorders”. A relationship based on trust between a therapist and a patient allows change to occur in patients and the healing process to begin.

Within physiotherapy, all music activities can be applied – vocal-intonational, music and movement, perceptual, instrumental, and music and drama. A physiotherapist can guide them in such a way that they motivate the patient, increase his or her self-esteem, self-confidence, and bring him or her joy (E. Králová & J. Kantor, 2020). The participation in music activities is dependent on the ability to focus on what is happening. Different variations in music as well as properly designed activities, can help patients sustain attention by (Z. Fábry Lucká & M. Habalová, 2022):

- The changes in dynamics, tempo, volume – to excite, arouse expectations, surprise.
- New inputs and variations in ongoing activities that involve different sensory modalities. One of the most enjoyable media for conveying different sensory information is movement.

## **2. Preparation of Music Therapy Process**

Music therapy (MT) can be applied in every phase of normal pressure hydrocephalus if the patient reflects on music. The patient from our case study inclines towards relaxing, soothing music, and stimulating instrumental music – pop, disco, and jazz. He does not like drawing and classical music. During individual physiotherapy sessions with MT intervention, we were using an individual receptive and expressive form of MT with the following music genres: electronic music, pop, and relaxing jazz; and the selected musical genres were Synth-pop, Ambient, Disco, Eurodance, Dance-pop, Relaxing jazz. For our sessions we prepared musical samples according to the patient’s taste and according to his or her emotional and physical condition during a particular session. We obtained informed consent from the legal representative for photographic documentation and video recording with the patient.

### **Anamnesis**

Name: J. M.

Age: 23

Sex: male

Diagnosis: normal pressure hydrocephalus

Personal anamnesis: delayed mental development, hydrocephalus diagnosed at 18 months. In 2012, re-operation with normal pressure hydrocephalus. In 2013, the condition improved. Recurrent epileptic seizures from 5 years to 20 years. The last two years without a seizure. Confirmed intellectual disability (at the level of a 12-year-old child), he is a patient with impaired communication, and rare urinary incontinence. The patient attends a special school for children with special needs.

He regularly sees the professionals at rehabilitation centres and exercises with assistive technology for communication (Alternative and Augmentative Communication – further AAC). He likes music and dancing. The legal representative describes the deterioration of the patient's health after the end of the last rehabilitation stay as follows: He shows no interest in regular exercise, is often moody and unwilling to cooperate. So that movement stagnation does not occur in the patient, she sought professional physiotherapy intervention.

**Objective structured clinical patient examination:** A patient with AAC can walk a short distance with the help of a wheelchair. The gait is spastic, the movement dynamics are slow, unstable with a slight supination position of the foot on the right leg. In a passive position (sitting) there is spastic posture of the upper limbs and acral spastic deformities, more pronounced on the left. Active elevation of the right upper limb to 2/3 and the left upper limb to 1/2 of the physiological range. Mild muscle hypotrophy. Muscle strength of right upper limb 2+ and left upper limb 2. He answers questions in a simple way with the unique form of expression. Confirmed intellectual disability. When he was asked to grasp a pen from the table, he responded with the activity of his right hand (the left upper limb remained in a spastic posture). His preferred side is right.

### **Music Therapy Session Planning**

MT intervention took place in a private physiotherapy clinic, in an **individual form**. The schedule of meetings for a specific day was agreed with the legal representative of the patient according to how he responded to the MT. We used an individual receptive form of MT, where the music interpretation was directed towards the listener to improve communication and cognitive skills. An **expressive form of MT** was used to rhythmize fine motor movements during creative activity (creating according to subjective fantasy with coloured sticks and cymbals) and music-movement activities for the development of gross motor skills (Orff musical instruments and an instrument from recycled material, pantomimic banging on the knees of his body, exercise with AAC with the patient without tools and with a fit-ball).

The music genres used were electronic music, pop, and relaxing jazz; music styles were Synth-pop, Ambient, Disco, Eurodance, Dance-pop and Relaxing jazz. We selected specific pieces of music with the patient. The choice of level was not categorized in advance, because it depended a lot on the mood in which the patient came to the MT session. A total of five sessions were held within two months. Each session (physiotherapy, and MT) lasted for 60 min. MT intervention within one session lasted from 15 to 30 min. The music intervention was in the very beginning of each session. Two MT sessions took place in a receptive form and three sessions were in an expressive form of MT.

### **3. Music Therapy Programme Implementation**

**The main objective** is to specify the selection of music genres and rhythms with a calming effect, to induce subjective well-being in our patient. The prerequisite is to improve the patient's gross and fine motor skills. **Sub-objectives** are to improve the coordination of movements, reduce spasticity, improve muscle strength and elasticity of soft tissues, improve communication and cognitive skills, revitalize fine and gross motor skills, improve the mechanics of walking for longer distances with an assistant or with the help of French crutches, and get the patient interested in exercising at home.

**Long-term plan:** to improve the rhythm and stability of bipedal walking without the help of an assistant for longer distances, depending on the timeliness of the results (if music therapy is beneficial), to recommend MT as the form of therapy for him in the future.

#### **Music Therapy Session Management**

**Expressive component** was implemented 3 times a month, using rhythm, moderate tempo, and the melody of music to rhythmize fine motor movements during the patient's creative activity with coloured sticks and cymbals. We also used this component of MT during movement activities without equipment by practicing movement activities for the development of gross motor skills. During the exercise, we adapted to the music so that we and the patient formed a unified pattern. We applied exercise according to the spatial dimension of musical speech: melody, pitch, intensity, colour, tonality, dynamics of tectonics and harmony. The following Orff musical instruments were used: a tambourine, a rattle, and a musical instrument made from trash, recycled material – a plastic string resembling an accordion, and to enhance coordination with a small fit-ball to improve upper and lower body coordination.

We used the **receptive component** 2 times for specific emotional condition of the patient to relieve his inner tension by listening to relaxing, soft, and melodious music. There was also applied this component of MT to improve communication and cognitive skills, where the intensity, colour of the melody and tempo of the music induced subjective well-being in the patient. Since the individual components of MT could not be planned due to the diverse emotional condition of the patient, we guided the selection of music activities that had benefits for physical, mental, and psychosocial health of the patient. This was an important part of our intervention because mental health is the keystone for emotions, thinking, communication, learning, hope, resilience, and self-esteem.

#### **The Structure of a Music Therapy Session**

We adjusted the length of the MT intervention according to the condition of the patient, approximately from 15 to 30 minutes of exercise. The individual meetings were planned irregularly to see how the patient would react to MT when he does not expect it. We implemented an expressive form of MT during the day, as it suited the patient. We designed MT intervention during physiotherapy based on current psychological condition of the patient. When he arrived at MT session nervous, with tension, emotionally imbalanced, tired, stressed out and frustrated, we selected relaxation with calm and peaceful music. Within physical rehabilitation we focused on releasing muscle tension. When he arrived at MT session calm and

emotionally well balanced, we selected stimulation with faster and dynamic music. Within physical rehabilitation we focused on stimulation of gross motor skills.

### **Expressive form of Music Therapy (music therapy)**

#### **Music and movement intervention – session 1**

Process: MT session took place the afternoon, after school, the patient was tired. During both activities, the music activity was purposefully directed towards the perceiver in a way to influence the mechanism of regulation of fine motor movements in creative activities, when he was playing with coloured sticks and with so-called “C-letters” while he was connecting and disconnecting them.

**Music sample no. 1:** Modern Talking *Alone* (1999, slow romantic songs *Just Close your eyes*, 4:17 min, and the second one *How you mend a broken heart*, 4:14 min, slow tempo, legato, small dynamic changes, lower volume).

- We selected an expressive form of music therapy during, the patient was listening to slow tempo, lower volume, legato and small dynamic changes in two romantic pop songs. We selected compositions that did not induce our patient a feeling of anxiety during the physical therapy exercise as a primary intervention.

- In this activity we used coloured sticks. He was sitting near the window to have enough light for the training of fine motor skills. As the part of tuning the patient to the MT, he was listening to two pieces of music *Just close your eyes* and *How you mend a broken heart*, while he was creating abstract work from the coloured sticks.

- The objective of the activity was to relax the patient and to influence the mechanism of regulation of fine motor movements, by creative playing with coloured sticks.

- During this activity, the patient worked with the right upper limb, where in certain parts of the activity he answered the physiotherapist’s questions in a simple form of communication. During listening to music approx. in the middle of the first composition he started working with the hand of the left upper limb (fig. 1). The total time of the patient’s creative activity with coloured sticks was 8:31.

**Music sample no. 2:** A. van Beek *Earth Dream Music* (2013, *Rainbows on Earth*, 5:26 min, instrumental demo with a moderate tempo)

- The patient was listening to slightly faster tempo of electronic, instrumental, Synth-pop music, that was selected to relieve the spasticity in his left arm.

- In this activity we used a game so called “letter Cs”. He was sitting near the window to have enough light for the training of fine motor skills.

- The objective of the activity to relax the patient and to influence the mechanism of regulation of fine motor movements in creative activity with so-called “C-letters” while he was connecting and disconnecting them (fig. 2).

- This was followed by a creative purposeful C-s game, where we played music at a moderate tempo with a regular beat and a melody that activates the limbic system.

A moderate tempo is assumed to be like a natural walking pace (76 to 80 paces per minute) or a heartbeat (72 per minute). In the end of these two MT activities with coloured sticks and C-letters, patient’s motor skills on the upper limb bilaterally improved together with hand mechanics during music therapy, as well as the patient’s communication improved, he articulated words clearly.



Figure 1. A patient uses coloured sticks in finger work with his right upper limb

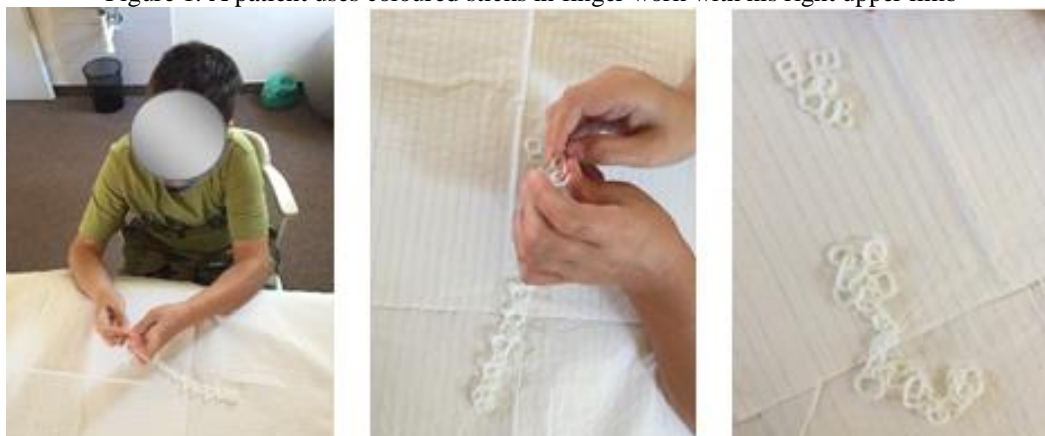


Figure 2. Connecting the letter “C” toy – the detail of upper limb & the result “connected Cs”

### **Music and movement intervention – session 2**

Process: MT session took place in the afternoon, after school. The patient was calm and communicative, he wanted to exercise. Because this is a patient with alternative and augmentative communication (AAC), during music and movement activities we focused on the development of gross motor skills, on upper limb bilaterally together with coordination elements in lower limbs.

**Music sample no. 3:** Jean Michael Jarre *Oxygène* (1976, *Oxygène part IV*, extended 7:28 min, electronic music genre, style: Synth-pop and Ambient, with a moderately fast tempo).

- We selected the music-movement activity at the 2<sup>nd</sup> session because the patient was motivated to exercise. The tempo of composition is moderately fast as it is assumed to be like a natural walking pace. There is alternated intensity in dynamics and rhythm.
- The objective was to stimulate the development of gross motor skills in the upper limb and the rhythmic movements of his whole body during the exercise.
- The patient was listening to music and while he was standing, he rhythimized gross motor movements on his upper limb bilaterally together with coordination elements in his lower limb. The patient tuned in the music during the MT. He verbalised and demonstrated that he had a good time exercising.
- At first, physical activity was led by a physiotherapist. After two minutes, the patient took the initiative in the motor expression by himself (relief of spasticity was noticed), and physiotherapist’s movement copied the patient’s creative movement expression. After a small break, the patient and a physiotherapist started the last activity: With the help of an assistant, the patient and the physiotherapist were throwing a small fit ball to each other (fig. 3).



- During the music was playing, the patient relaxed myofascially and the spasticity began to subside. The patient verbalized a feeling of happiness.



Figure 3. Music and movement activities with a small fit ball

### **Music instrumental and dancing intervention – session 3**

Process: MT session took place in the morning, prior to school. The patient was emotionally balanced and communicative, he wanted to exercise.

**Music sample no. 4:** A. van Beek *Earth Dream Music* (2013, *Swimming with Dolphins*, with vocals 4:04 min, genre: electronic music, style: Synth-pop, with a moderately fast tempo)

- We rehearsed and stimulated functional movement patterns with the patient using the technique of expressive MT with Orff musical instruments.
- The patient is sitting on the chair of a physiotherapy room.
- In the first part of the session, we implemented the activity by playing musical instruments a tambourine and a rattle. The patient selected two Orff musical instruments (tambourine and rattle) and a plastic string music instrument made from trash resembling an accordion.
- The objective of the activity was to train and stimulate functional movements in the upper limb bilaterally while sitting to improve the range of movements, strength, endurance and coordination of the limb and hand bilaterally.
- During the exercise, the physiotherapist held the tambourine and the patient responded by moving the hand (left and right upper limb) in which he held the rattle, while trying to hit the tambourine in the position and height the physiotherapist set (fig. 4).



Figure 4. Elevation in the shoulder joint of the right upper limb – Flexion in the shoulder joint and elbow joint in the left upper limb – Abduction in his shoulder joint bilaterally

**Music sample no. 5:** Modern Talking *Alone* (1999, *Don't let me go*, 3:20 min, genre: electronic music – pop, music style: Disco, Synth-pop, Eurodance, moderately fast pop).



- In the beginning we used rhythmic warm-up from sitting, to create dance steps.
- The patient was in a sitting position, while he lifted and alternated independently the lower limb from the ground to a musical composition (the patient said in a simple way that it reminded him of an elephant that was stomping) to the given rhythm and tempo of the piece of music (fig. 5).



Figure 5. Active development of upper and lower limb, gross motor skills and coordination in the patient's dancing activity

- After an active warm-up – stomping like an elephant – the physiotherapist proceeded to the patient's dance activity, while the patient was copying the steps up, and down, to the left, right, to the side. All the steps were created in a simple communication between the physiotherapist and the patient.

#### **Receptive form of music therapy**

Process: MT session took place in the afternoon, after school, the patient was emotionally imbalanced and did not to exercise.

#### **Background music – session 4**

**Music sample no. 6:** Modern Talking *Alone* (2013, *How you mend a broken heart*, 4:14 min; *All I have*, 4:20 min; *Just close your eyes*, 4:17 min, *Keep love alive*, 3:26 min, slow tempo, legato, small dynamic changes, lower volume)

- We selected the piece of music for the patient to listen in the background purposefully. The patient selected a relaxing song at a slow tempo. Music genre is electronic pop music; music style is Disco, Ambient, and Synth-pop.
- The objective is to calm the patient emotionally during a relaxing massage to relieve muscle system. The musical activity lasted approx. 15 minutes.
- It induced subjective well-being in the patient, the result of which was a myorelaxation effect in the form of the release of soft tissues and it ended in the harmonization of the patient's physical and psychological condition.

#### **Background music – session 5**

Process: MT session took place in the afternoon, after school, the patient was emotionally imbalanced and did not to exercise. The physiotherapist selected to listen to soothing music for the patient to calm down.

**Music sample no. 7:** Coffee Relaxing Jazz *Late night jazz Longue* (2022, instrumental relaxing jazz, first 15 min, slow tempo, legato, small dynamic changes, low volume)

- We selected the background music purposefully. The patient likes listening to relaxing jazz at a slow tempo and calm rhythm.

- The objective was to strengthen limbic alertness at the cortical level through a dialogue to calm the patient through listening to jazz music through the pitch of tones and acoustic stimuli at a slower pace.
- Simple communication lasted 15 minutes, the patient told what was bothering him while background music was playing during communication. It had a very good effect on the patient's communication skills, he articulated properly, was communicative.
- His emotional condition after the dialogue changed too. He also calmed down mentally and was quiet and calm on a physical level.

## 6. Conclusions - Evaluation of Music Therapy

**Reviewing the effectiveness of MT intervention:** By MT, we aimed to improve the coordination of movements, reduce spasticity, restore muscle strength and elasticity of soft tissues, improve communication and cognitive abilities, revitalize fine and gross motor skills, improve walking motor skills, and get the patient motivated in exercising at home.

The physiotherapy took place within the framework of MT in 3 expressive forms and in 2 receptive forms with the objective to affect the movement regulation mechanism and harmonize the patient's emotional condition during the physiotherapy exercise or relaxation. We conclude that MT in an expressive form affected the mechanism of regulation of fine motor movements in creative activity on upper limb bilaterally together with the patient's communication skills.

Furthermore, the gross motor skills in upper limb improved bilaterally as the part of the improvement of range of motion, strength, endurance, and coordination. When music was playing in this movement activity, the patient myofascially relaxed to such an extent that the spasticity began to subside, and the patient demonstrated a feeling of happiness on an emotional level. His gait coordination was slightly enhanced, as well as the physiotherapist and the patient had a simple, well-articulated communication. The walking speed was more pronounced, and the patient's submaximal performance distance was also extended.

After therapy, spasticity was significantly affected for about 20 min, and gradually increased in intensity. The positive thing is that MT has a fundamental effect on spasticity in the NPH patient, thus surpassing all other forms of physical therapy exercises. In the receptive form, it induced a feeling of physical and psychological well-being in the patient on an emotional level, which was reflected in the muscle tone of the soft tissues and in the better well-articulated communication during music therapy. The patient is motivated to exercise at home after the MT sessions and looks forward to the next MT.

**Closing time of MT intervention:** MT successfully fulfilled the main objective of physiotherapy. During MT sessions the patient had trust toward physiotherapist, which positively influenced the patient's psychological mood and stimulated him to the suggested exercises. The patient is still recommended to continue with the designed methodology of exercises.

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