

## Full-Length Article

## The Effects of Functionally Oriented Music Therapy on Body Function and Quality of Life in Chronic Stroke Survivors and on Patients with Parkinson's Disease

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### Abstract

The objective of this pilot study was to estimate the effects of a 20 week Functional oriented Music Therapy (FMT) program on several body functions in patients with chronic stroke and in patients with Parkinson's disease (PD). 15 different body-functions were valued during session number 1, 20 and 21 with a 10-week follow-up. In addition, the quality of life was assessed based on self-rated questionnaires conducted before and after FMT. Both patient groups showed improvements in stability, trunk rotation, hand functions and whole body coordination but also in collaboration skills, logical thinking and in perception. Improvements were partly maintained at follow-up. In addition, both groups reported a better social life, increased concentration and improved self-esteem after FMT. These preliminary results indicate the feasibility of using FMT as a rehabilitation method for patients with a chronic stroke and in patients with PD.

**Keywords:** *Parkinson's Disease, Chronic Stroke, Music Therapy, Body Functions*

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### Introduction

Stroke is the third leading cause of death in Sweden after heart attack and cancer [1]. The Swedish Stroke Association also claims that stroke is one of the most common causes of disability in Sweden. Every year approximately 30 000 Swedes suffer from stroke [2]. The term stroke includes cerebral infarction and brain hemorrhage. The stroke causes inadequate supply of blood and thus oxygen to the brain tissue leading to brain damage [3].

Depending on where in the brain the damage and how much damage is made, the disease causes different symptoms and signs. Suffering from a stroke affects many of the individual's physical abilities and limits the everyday life of the victim [4], but also the social life [5] and the individual's self-confidence and self-esteem are negatively affected [6].

Parkinson's disease (PD) is a neurodegenerative disorder with a prevalence of approximately 20, 000 people in Sweden which mainly affects people over 50 years. The incidence of

PD in Sweden is approximately 2000 persons per year [7]. In PD cells in the central nervous system that produce the neurotransmitter dopamine are destroyed. Dopamine is used to control body movements, meaning that dopamine deficiency results in decreased control of movements [8]. PD is characterized clinically by the motor symptoms bradykinesia, tremor, rigidity and total loss of balance [8].

Stroke and PD are some of the most significant causes of long-term disability in developed countries. Therefore, it is necessary to explore new neurorehabilitation strategies to improve the recovery of physical functions and to promote functional cortical reorganization.

The purpose of this single case research study was to investigate the feasibility of an individually tailored *Functional oriented Music Therapy* (FMT) intervention on persons with chronic stroke and on persons with a diagnosed PD. The specific objective was to estimate the short-term and retention effects of a 20-week FMT program on bodily functions, emotional rehabilitation and quality of life for these both groups of participants.

The FMT method was designed between 1976-1989 by Swedish music educator Lasse Hjelm in collaboration with physicians, physiotherapists and occupational therapists at Uppsala University in Sweden [9]. Even though the FMT method is used today in many areas such as habilitation, rehabilitation, preschool, elementary school, in schools for children with learning disabilities, in elderly care and psychiatry [10], little research has been conducted about the effectiveness of the method.

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<i>Stroke</i>	1	2	3	4	5	6	7	8	9	10
Age (year)	79	24	59	53	48	44	71	63	4	67
Gender (M/F)	M	M	F	F	F	F	M	M	F	F
Time since stroke (year)	3	3	1	1	2	2	14	2	4	12
Side affected (left/right)	R	L	R	L	L	L	R	L	R	R
Symptoms (aphasia, paralysis, memory loss, postural instability, sensory input)	P/A	P	P/A	A/M	A/M	P	PI/S	P	P	M
<i>Parkinson's disease</i>										
Age (year)	75	74	71	67	57	74	78	71	61	75
Gender (F/M)	F	M	F	M	M	M	M	F	F	F
Time since onset (year)	10	9	12	20	6	5	5	10	8	5
Side affected (left/right)	R/L	R	R	R/L	L	R	R/L	R/L	L	L
Symptoms (tremor, hypokinesia, rigidity, and postural instability)	R/PI/H	PI/H	T	R/PI	T	H/T	PI/H	PI/H		R/H

Table 1. Initial participant characteristic.

In FMT the specially educated FMT therapist creates situations that provide opportunities for development in tune perception, emotion, cognition and motor skills - and can assist patients in finding the balance between these elements. Thus, the therapist works to support the development of physical, mental and social skill function in this realm through music [10].

The therapist plays the piano while patients are invited to play the drums, cymbals or various wind instruments. The music in FMT consists of especially composed melodies with chords [10]. For each melody/chord progression there is a definite instrument setup. Each instrument setup has an underlying purpose that addresses the practice of different functions.

In FMT the music is used as a tool and it fulfills a number of functions, such as catching the patient’s attention, enhancing learning by facilitating memory processes, increasing the auditory perception, as well as the emotional being and thereby increasing the motivation to play and interact [10,11]. In addition, the music often replaces spoken language. FMT is a non-verbal method, meaning that the therapist does not give any oral instructions. When the patient - after trying the musical solo alone, seemingly solves an important code (i.e. detects the instrument’s movement pattern) and as the therapist synchronizes the chords with the patient’s music and a musical interaction occurs. Through this musical interplay the patient’s participation is confirmed and s/he understands that the accompanied played chord was evoked through his/her played cue, in a way that it was supposed to be played, in collaboration with supported music and within a relationship.

Furthermore, through the use of music as a language, instead of a spoken language, FMT facilitates work with basic functions such as stability and balance, fine and gross motor skills by increasing focus on them, while it also encourages independent thinking as well through enhancing the patient’s ability to take initiative. In addition, a variety of perceptions are processed in FMT through the use of a number of drumsticks. Each therapy session is in progress for 20 minutes and starts and ends in the same way to provide security and

continuity. Every session is tailored to each individual’s ability and ambition where the therapist needs to design the session with the intention that the patient’s attempts should not fail [9,10].

**Methods**

*Subjects*

20 subjects were invited to participate in the study and subsequently informed about the study criteria (Table 1). 10 participants with a chronic stroke (6 women and 4 men; mean age, 51.2 years; median age, 56 years; mean duration of illness, 4.4 years; median duration of illness, 2.5 years) took part in the FMT study. 10 subjects with PD (5 women and 5 men; mean age, 70.3 years; median age, 72.5 years; mean duration of illness, 9 years; median duration of illness, 8.5 years) had weekly sessions of FMT. To meet our selection criteria, participants had to have an idiopathic Parkinson’s disease and stroke patients had to be discharged from rehabilitation. Patients were allowed to continue taking their medication, but the level had to remain constant throughout the study.

*Study design*

The study lasted for 30 weeks. The participants that participated in the study had one individual 20-minute FMT session per week for 20 weeks, followed by a 10 weeks intermission, tailed by a final FMT session, for a total of 21 FMT sessions. Overall, all of the participants that participated throughout the study remained enrolled, except for one patient with PD that did not attend the 21<sup>st</sup> session due to hospitalization that resulted from an infection and was excluded from the follow-up study.

The FMT therapist observed the participants capacity during session number 1, 20 and 21 from 15 different points of interest (Table 2). The ability was scored from 0 (full function) to 5 (non-existent function). The individual sessions were also video-recorded and observed by an examiner blind to the study and scored as above, as an internal control.

Observation point	Interpretation
Collaboration	Presence, interactions with the therapist, give and take, initiative
Logic thinking	Problem solving
Stability	Balance, body control
Side differences	Is there a significant difference between the two sides of the body?
Hand and wrist-function	Hand and finger coordination, grip and wrist-flexibility
Perceptions: auditory, visual, vestibular, proprioceptive	Do they notice the music, all drums, can they control the strength and length needed to hit a drum, and do the movements affect them?
Trunk rotation	Do the upper and lower parts of the body work together in synergy?
Respiratory coordination	Are breathing coordinated with body-movement?
Whole body control and coordination	Coordination, breathing, planning, preparation for a task

Table 2. Observation points in FMT and the interpretation of the observations.

The participant’s subjective emotional state and quality of life was assessed with a questionnaire (Table 3). The questionnaire was self-conducted before the FMT –study started and after the final FMT session (session number 20). All data were collected from August 2012 until March 2013.

Question:	Very well	Good	Fairly well	Bad	Very bad	Not at all
How does your..... work for you right now?						
Ability to sort noise	1	2	3	4	5	6
Reading	1	2	3	4	5	6
Power of initiative	1	2	3	4	5	6
Social life	1	2	3	4	5	6
Well-being	1	2	3	4	5	6
Sleep	1	2	3	4	5	6
Concentration	1	2	3	4	5	6
Memory	1	2	3	4	5	6
Endurance	1	2	3	4	5	6
Patience	1	2	3	4	5	6
Perception of time	1	2	3	4	5	6
Daily planning	1	2	3	4	5	6
General condition	1	2	3	4	5	6
Self-esteem	1	2	3	4	5	6

Table 3. Questionnaire for emotional rehabilitation and quality of life evaluation.

Statistical Analysis

All data was entered into a Microsoft Excel database and data were analyzed using Microsoft Excel 2011 (Microsoft Corp. Redmond, Washington). For baseline measurements, a paired

2-tailed Student t-test was performed for session 1, 20 and 21 for each distinct body functions and for session 1 and 20 for quality of life measurements. Statistical significance was considered when the value of P<0.05.

Results

The difference between the scores from the first FMT session and from the last session (20 week) as well as from the follow-up FMT-examination (30 week) demonstrated a significant improvement on many bodily functions in the subjects with a chronic stroke (Figure 1).

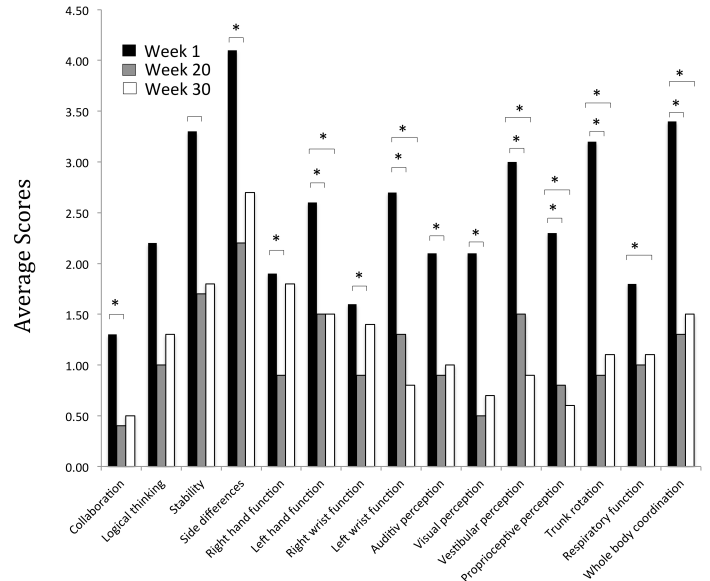


Figure 1. Patients with a chronic stroke after 1 session of FMT, after 20 sessions and after a 21st session followed after a 10 weeks interruption from FMT.

The 20 weeks of FMT therapy significantly improved (p<0.05) the participants collaboration skills, their stability, their hand-functions, all perceptions, their trunk rotations, as well as their complete body coordination that persisted with regard to stability, left hand functions, the vestibular and proprioceptive perceptions, trunk stability and whole body coordination after a 10 week of intermission. The respiratory coordination was significantly improved (p<0.05) after the 21<sup>st</sup> FMT-session as compared to the first session. The subjects with a chronic stroke self-reported an significant increase (p<0.05) in their ability to read, to sleep, to concentrate and had a better perception of time and a better memory, concentration and endurance, as compared to before the FMT therapy (Figure 2). Furthermore, they reported an improved social life, an increased feeling of well-being, self-esteem as well as being in a better general condition than before FMT, as reported in the self-conducted questionnaires. Participants with PD significantly (p<0.05) improved most of the measured skills (Figure 3). The collaboration skills, the stability, the hand-functions, the auditory and proprioceptive perceptions, the trunk rotations, the respiratory coordination, as well as their

complete body coordination had improved after 20 weeks of FMT therapy.

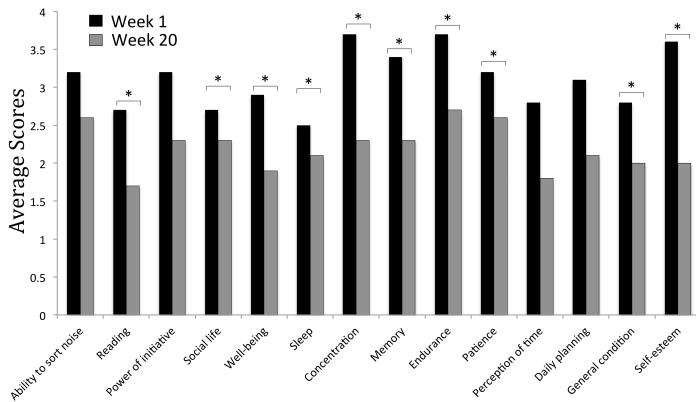


Figure 2. Patients with a chronic stroke self-reported quality of life and self-esteem before FMT therapy and after 20 weeks of FMT as answered in a questionnaire.

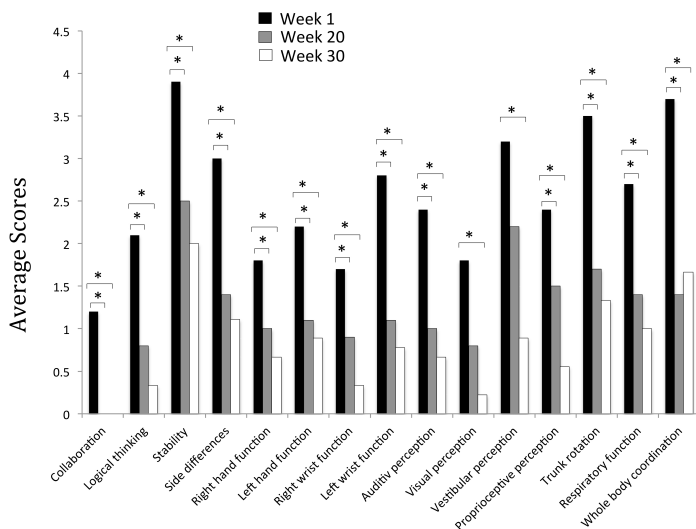


Figure 3. Patients with Parkinson's disease after 1 session of FMT, after 20 sessions and after a 21st session followed after a 10 weeks interruption from FMT.

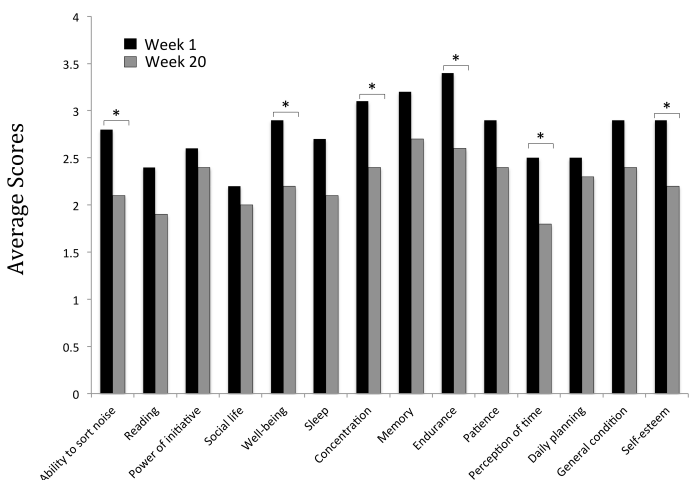


Figure 4. Patients with Parkinson's disease self-reported quality of life and self-esteem before FMT therapy and after 20 weeks of FMT as answered in a questionnaire.

These improvements persisted after a 10-week break and in addition, the visual and vestibular perceptions were improved during the interruption as compared to the results after one session of FMT.

According to the questionnaires assessing self-esteem and quality of life the FMT therapy improved significantly ( $p < 0.05$ ) on subjects abilities to sort noise, to concentrate, their endurance, their perception of time and their self-esteem (Figure 4).

### Discussion

This pilot study is, to our knowledge, the first to report the short-and long-term effects of 20 FMT sessions on body functions and on quality of life on subjects with a chronic stroke and on subjects with PD. Significant improvements in both subject groups were seen after 20 weekly sessions of FMT and some of these changes persisted after a 10-week follow-up. The physiological impact of FMT on both groups of patients may be explained to increased sensory input that is processed in precise organized neuronal circuits that allow us to sense, perceive and respond to environmental stimuli. Music itself activates motor circuits such as the basal ganglia, motor and premotor cortices, and even cerebellum, crucial for motor coordination and timing [12]. Music therapy and music making is further known to provoke structural and functional changes of the brain [13], modifying the release of stress hormones [14], cardiac function, respiratory pattern [15] as well as influencing the effects of several neurotransmitters, neuropeptides and other neuromodulators [16]. In addition, memory and emotion is affected through the engagement of prefrontal cortex and hippocampal regions by music [17]. Furthermore, exercise the release of endogenous neurotrophins associated with synaptic plasticity, increased cognitive ability, learning and memory [18,19]. FMT being a neuromuscular method combines movement and music which might potentiate the neuronal changes related to both music therapy and movement exercise. In accordance with such theories, it has previously been shown that programs that used physical exercise in conjunction with music exhibited positive responses in balance of body, muscle strength and flexibility, mood state and quality of life [20].

Most interestingly, the effects of FMT increased during the 10-week interruption for patients with PD, suggesting a continuing and sustained process of brain and body functions in this particular patient group. In accordance with previous studies, it may be argued that the motor facilitation seen in subjects with PD could be based on limbic reactions activating the cortical-basal ganglia motor loop, the circuit primarily affected in PD [21,22]. Furthermore, the sustained improvements could be due to enhanced memory sensitivity during positive mood and high arousal conditions as earlier demonstrated [23,24]. Although, the subjects with a chronic stroke also significantly sustained some of the body functions (stability, body coordination, left hand function, trunk rotation and vestibular and proprioceptive perceptions) with a

tendency to sustain the positive effects of the other examined functions, suggesting a more complex mechanism behind these changes.

In addition, participants participating in FMT therapy displayed improvements in their psychological state as indicated by the answers from the questionnaire scores. In both subject groups, the participants reported an increase in their well-being, concentration, endurance and self-esteem. This can directly be an effect of attending the study, projecting a feeling of being essential to the study. In addition, some of the participants disrupted their involuntary isolation, met other people in the same situation in combination with receiving full attention from the therapist during the sessions. Furthermore, the emotional impact of FMT may be explained to increased sensory input in the mesolimbic system, an area associated with reward-processing [25]. The mesolimbic reward system, including the ventral tegmentum and the nucleus accumbens is activated by music instantaneously but also when participants overcome the challenges presented in FMT, possibly enhancing the feeling of reward.

The quality of life of an individual who suffered from a stroke or with PD depends mainly upon the level of functional ability, making rehabilitation a critical component of the care of both groups of patients [20,26]. In the present study, FMT combines exercise with music making, possibly enhancing the individual effects of both rehabilitation forms as well as increasing the motivational impact on participating in the rehabilitation. However, a number of limitations of the current study should be considered. The small study sample size, in combination with the considerable variability in terms of homogeneity of group characteristics limits the interpretation of the study. This, in combination with the lack of a control group can limit how the results of this study's findings are interpreted and this should be taken into consideration. Nevertheless, the data of the present study indicates that FMT therapy might be useful as a method for inclusion in rehabilitation programs for patients suffered from a stroke as well as for patients with PD, but further investigations are needed to confirm our observations.

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