

# The Value of Exercise Rehabilitation Program Accompanied by Experiential Music for Recovery of Cognitive and Motor Skills in Stroke Patients

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**Background:** The aim of this study was to systematically assess the effects of exercise rehabilitation program accompanied by experiential music for clinical recovery. **Methods:** This was a prospective randomized study with 65 stroke survivor patients. All cases underwent a neuropsychological assessment first as a prescreening test, during the admission at the Rehabilitation center (baseline), and 6 months post-stroke. All patients received standard treatment for stroke in terms of medical care and rehabilitation. Additionally, all patients were separated into 2 Groups: a music Group (daily listening to experiential/traditional music), and a control Group (CG) with no experiential/traditional music therapy (standard care only). Computed tomography perfusion and full neurological examination including GCS were assessment. As Recovery was defined the improvement of cognitive and motor skills of the limb in the affected site, with an increase of muscle strength at least by 1/5 and with emotional progress. **Results:** Statistically significant differences were found between the Group CG and the rest of the patients in respect of Lesion size ( $P = .001$ ) and CBF in affected area ( $P = .001$ ). Multivariate analysis revealed that only Group and Lesion size were independent predictors for Recovery (odd ratio [OR][95%confidence interval]) .11(.001-.133) and .798(.668-.954) respectively. **Conclusion:** The findings of this study suggest that the music-based exercise program has a positive effect on mood profile in stroke patients and Recovery rate is higher when exercise rehabilitation program was accompanied by an enriched sound environment with experiential music.

**Key Words:** Experiential music—traditional music—alternatives stroke therapies  
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## Introduction

Stroke is one of the most important cause of disability in developed countries.<sup>1</sup> According to the World Health Organization, approximately 15 million people worldwide experience their first-ever stroke each year, 1/3 of these died and another 1/3 have difficulty in performing activities of daily living.<sup>2</sup> Usually at the rehabilitation

centers for stroke are used the Physical therapy and other device-assisted rehabilitation methods such as robot-assisted therapy or virtual reality, but they are expensive and time-consuming.<sup>3,4</sup> Exercise training for stroke rehabilitation, is an alternative method with very encouraging effects in patients outcome.<sup>5,6</sup> Most exercise programs for stroke survivors are physically-based training planned to improve musculoskeletal functions<sup>7,8</sup> without any progress in physical and mental status<sup>9</sup> which is associated with increased morbidity and mortality.<sup>10</sup>

Computer Tomography (CT) provides useful information in stroke evens but it is limited to identifies the extent of irreversibly damaged tissue (ischemic core)<sup>11-13</sup>, and to demonstrate that reperfusion therapy may be insignificant or even potentially harmful when the ischemic core is large, or the perfusion lesion is particularly severe.<sup>14,15</sup> On the other hand computed tomography perfusion (CTP) can show abnormalities not detectable by other techniques and may be advantageous for the evaluation and early detection recovery in patients with cerebral ischemia.<sup>16</sup>

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Recent research has established that music while exercise, helps to achieve goals within therapeutic environments that lead to reorganize and integrate information processing with executive control and emotion,<sup>17,18</sup> divert attention from the sensation of fatigue and enhance acquisition of motor skills.<sup>19</sup> Music therapy was also found to have a positive effect on psychological and cognitive states of elderly populations.<sup>20</sup> However, these positive effects are very questionable as little is known about the wider potential effects of the recovery environment on structural brain plasticity after stroke in humans and clinical improvement of music therapy most times is difficult to verified and precisely predicted.<sup>21</sup>

The aim of this study, therefore, was to systematically assess the effects of exercise rehabilitation program accompanied by experiential music for clinical recovery, using the mini mental test (mMt) and Barthel Index (BI) compared with CTP findings in stroke survivor patients.

## Methods

This was a prospective randomized study with 65 stroke survivor patients. All patients had an acute ischemic/hemorrhagic stroke. Additional inclusion criteria were: no prior neurological/psychiatric disease, drug/alcohol abuse, or hearing deficit; right-handed;  $\leq 75$  years old; Greek-speaking; and able to co-operate. Patients had to have residual function of the affected extremity; that is, the ability to move the affected arm without help from the healthy side, and to move the index finger without help from the healthy hand. Moreover, patients had to score over 50 overall on the BI (possible score 100).<sup>22</sup> All cases with stroke underwent a neuropsychological assessment (including cognitive tests and questionnaires) (mMt for the investigation of cognitive deficits; first as a prescreening test, during the admission at the Rehabilitation center (baseline), and 6 months post-stroke (Table 2). BI used to measure performance in activities of daily living (Table 3). CT Perfusion was performed 3-6 days (control) and at 6-months of admission. All cases were assessed and had been tested previously with the Aachener Aphasia Test to determine speech capabilities. None of the patients were diagnosed with depression or other psychiatric or neurological diseases. They were all native speakers of Greek. Central Nervous System pathology was evaluated using patients medical history. Additionally, through flipping a coin, all patients were randomly separated into 2 Groups: a music Group (MG) (daily listening to experiential/traditional music), and a control Group (CG) with no experiential/traditional music therapy (standard care only). The study was approved by the HUCH Ethics Committee, and all patients signed an informed consent. All patients received standard treatment for stroke in terms of medical care and rehabilitation.

CTP (performed by 2 radiologists) and full neurological examination including GCS were assessment (performed

by 2 physicians other than the treating physicians). Clinical outcome was classified as normal, when no new neurological sequelae or radiologic evidence of ischemic abnormalities were detected or, as adverse, when neurologic or radiologic abnormalities were diagnosed or, death. As Recovery was defined the improvement of cognitive and motor skills of the limb in the affected site, with an increase of muscle strength at least by 1/5 and with emotional progress.

CTP parameters -Cerebral blood flow (CBF) and cerebral blood volume (CBV) values in CTP-, were recorded and evaluated using 2 adjacent 10 mm slices positioned at the level of the basal ganglia with the same angulation as for native CT. A bolus of 50 mL of nonionic contrast medium (Imeron 400, Bracco, Konstanz, Germany) was administered by a power injector into a central venous catheter at a flow rate of 4 mL/s followed by 30 mL of saline. Four seconds after beginning of the bolus, 40 images were collected at each slice level at a rate of 2 images per second (120 kV, 110 mAs, matrix 512  $\times$  512). These values were calculated by commercially available postprocessing software platform (Perfusion CT, Siemens) and CTP color maps were qualitatively assessed using a visual grading scale. A positive visual assessment was noted for side-to-side asymmetries or clear bilateral defects suggesting a decrease in CBF, CBV, mean transit time (MTT) which were related by the central volume principle:  $CBF = CBV / MTT$ .<sup>23</sup> CBV was measured in units of milliliters of blood per 100 g of brain and was defined as the volume of flowing blood for a given volume of brain.<sup>24</sup>

## Procedure

The duration of the pilot study program for the exercise Group was 6 months at a frequency of 4 training sessions per week, of 45 minute each session. As regards to control Group individuals, their task was solely to complete mMt questionnaire prior and after exercise intervention, without being present during the application of the program. Patients in the exercise Group followed a 6 months music-based exercise program, at a frequency of 4 training sessions per week, for 45 minute each session. In each session, the residents sat in a circle, facing the main instructor, so they could follow the exercises through imitation. Simple and specific verbal instructions combined with continuous visual demonstration were used by the main instructor, whereas undergraduate adapted medical students equal to the number of patients, served as assistants throughout each session to provide kinesthetic guidance on a one-to-one basis, whenever necessary. Individualized supervision was used to promote motivation and adherence to the exercise program that can be challenging for individuals with stroke.<sup>25</sup> To enhance interest and participation, the music chosen with consideration of their age was experiential/traditional music

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