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# Influence of Music Therapy on Spasticity, Functional Independence and Quality of Life in Subjects with Hemiplegia: A Randomized Controlled Trial

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## Abstract

**Background and purpose:** Spasticity is a common impairment in hemiplegia arising in about 90% of the patients, which leads to various direct or indirect secondary impairments. Various studies have shown the association between depression, spasticity and quality of life in hemiplegic patients. Music therapy yet not very popular in physical therapy practice but evidences suggest its influence on different determinants of health viz. depression, anxiety, blood pressure and heart rate. Hence this study was conducted in attempt to study the effects of music therapy on spasticity, functional independence and quality of life in hemiplegic subjects.

**Methods:** 20 subjects with hemiplegia were enrolled in a 3 days randomized controlled trial. They were randomly allocated into (1) Experimental group, receiving music therapy and conventional treatment or (2) Control group, receiving only conventional treatment. Both the groups received treatment for 3 days (a session per day). Outcome measures were primarily spasticity and secondarily functional independence and quality of life.

**Results:** Participants in both the groups showed significant ($P<0.05$) reduction in the level of spasticity in all the group of muscles. There was significant ($P<0.05$) improvement in Functional Independence Measure and Stroke Specific Quality Of Life scores in both the groups. None of the variables yielded significant ($P<0.05$) difference when compared between the groups.

**Discussion and conclusion:** Although not found statistically significant, but clinical impressions point to the mild complementary effects of music therapy on spasticity and subsequently on functional independence and quality of life.

**Keywords:** Spasticity; Music therapy; Hemiplegia; Functional independence; Quality of life

## Introduction

Stroke is the third leading cause of death after heart disease and cancer [1,2]. The estimated adjusted prevalence rate of stroke ranges 84-262/1,00,000 in rural and 334-424/1,00,000 in urban areas. The incidence rate is 119-145/1,00,000 based on the recent population based studies [3]. The incidence of stroke is age related; relatively uncommon before 50 but doubling each decade after the age of 55 [2]. Spasticity is a common symptom after stroke, arising in about 90 percent of patients, and usually occurs within the first few days or week [4,5]. Spasticity in UMN syndrome occurs predominately in anti-gravity muscles [6,7]. Hemiparetic patients with associated spasticity have shown four fold higher cost for health care and significantly impaired functioning and lower health related quality of life (HRQOL) compared to hemiparetic patients without spasticity [8,9]. Drugs that are usually prescribed to manage spasticity have potential side effects like weakness, drowsiness, gastric distress, nausea, sedation etc. If all of these measures fail, other treatment approaches like botulinum toxin injections, neurolysis, phenol blocks, intrathecal administration of baclofen are tried.

Anxiety, depression, aggression, and emotional liability are commonly seen in subjects with hemiplegia. Depression is common after stroke, developing in around 30%-40% of subjects with hemiplegia. Stress and depression has been found to be associated with spasticity and quality of life post stroke. Quality of life scores have shown to be reduced in stroke survivors [10-13] significant factors being spasticity [11,14] and depression [12,15] that follow the cerebrovascular accident.

Music therapy can be defined as the clinical and evidence based use of music interventions to accomplish individualized goals within a therapeutic relationship. Music therapy interventions include: improvisation, receptive music listening, song writing (composition), lyric discussion and music performance. Music is used as a tool to develop individuality, communication, and social skills, sense of confidence, motivation and self-expression; as well as to enhance well-being and quality of life for people of all ages with a range of needs and challenges. Classical music has been found to have various positive effects such as relaxation, mood elevation, reduction in fatigue, sadness and tension [16]. In patients awaiting various medical and surgical procedures, music therapy has shown to relieve anxiety and stress and reduce pain and muscle tension levels and significant change in physiological parameters (vascular constriction, heart rate and finger skin temperature) has been documented [17-19]. A study demonstrated increment in subject pain control, physical comfort and relaxation after single session of music therapy [20]. Music therapy has also been credited for improvements in motor function in stroke patients [21]; growth enhancement and reduction in heart rate in premature infants in NICU [22]; significant reduction in acute procedural pain, anxiety and muscle tension in subjects undergoing burn dressing change [23]; Music therapy is cost effective, easy to administer and does not require sophisticated equipments and skills. However there is paucity of literature relating to the effect of music therapy on spasticity, functional independence and quality of life in subjects with hemiplegia.

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Therefore, the purpose of this study was to examine the effects of music therapy on spasticity, functional independence and quality of life. The hypotheses were that subjects given music therapy additionally would exhibit significant improvement in spasticity, functional independence and quality of life.

## Methods

### Study design

This study used a randomized controlled design to study the influence of music therapy when administered additionally to the conventional treatment of spasticity. Approval of the project was obtained from the Ethical Committee of KLE Institute of Physiotherapy. Institutionally approved written consent was obtained prior to the study participation. Participants after their enrollment were randomly allocated into either (1) Experimental group, receiving music therapy and conventional treatment or (2) Control group, receiving only conventional treatment.

### Participants

Participants of either sex with hemiplegia were recruited from secondary and tertiary health care centers in Belagavi, Karnataka. Subjects were included if they were suitable according to following criteria (1) age group: 40-70 years, (2) diagnosis of first ever stroke, (3) MAS grade 1 or more than 1, (4) Mini Mental State Examination score more than 24 and (5) cooperative and willing to participate. Subjects were excluded if they had (1) unilateral or bilateral hearing impairment, (2) sensory or motor aphasia, (3) any other neurological involvement and (4) hemisection of spinal cord.

### Primary outcome

Spasticity was determined using Modified Ashworth Scale (MAS) grading. Six different groups of muscles (3 in upper limb namely shoulder adductors, elbow flexors and pronators and 3 in lower limb viz. hip adductors, knee extensors and ankle plantar flexors) were evaluated in order to assess the generalized effect of the intervention. The MAS has demonstrated high level of inter-rater reliability. One study showed that Kendall's tau correlation between the raters' grade was 0.847 ($p<0.001$) [24].

### Secondary outcome

Additionally, functional independence and quality of life was assessed to record any change in response to the treatment.

Functional independence was assessed using Functional Independence Measure (FIM). This scale includes physical and cognitive domains of function. 18 items are evaluated and rated from 1-7 on 7 point ordinal scale. The FIM has demonstrated high levels of intra-rater (0.95) and inter-rater (0.95) reliability [25].

Quality of life was measured quantitatively using Stroke Specific Quality of Life scale (SSQOL). SSQOL is a 49 item questionnaire covering 12 aspects of quality of life. Each item is rated from 1-5 on a 5 point Likert type scale.

### Procedure

First encountered 20 eligible patients were involved in the study. They were randomly allocated into any of the two groups either group A (10) or group B (10) using envelope method. All the participants underwent pre-intervention assessment for the level of spasticity, functional independence and quality of life. The same variables were evaluated again after the final treatment session. The protocol lasted for 3 days for both the groups (a session per day for 3 consecutive days). Subjects assigned to group A received music therapy additional to the conventional treatment; those assigned to group B received only conventional treatment. Music therapy included 30 minutes of receptive listening to the relaxing music composed by the fusion of Eastern classical instrumental pieces delivered via Philips SBCHL 140/98 over the ear headphone played on Sony Ericsson W8 android phone (in the range of 50-65 db) prior to the conventional treatment session. Conventional treatment included (1) Inhibitory techniques (slow stroking, prolonged icing, prolonged pressure) to the hypertonic group of muscles, (2) facilitatory techniques (quick icing, fast stroking) to the muscle groups opposite to the hypertonic group, (3) Weight bearing exercises for both upper and lower extremities (sitting with weight bearing through upper extremities, plantigrade position and weight shifts in plantigrade position, (4) Prolonged stretching (through positioning) and (5) Rhythmic rotation, slow rocking movements. The conventional treatment lasted for around 30-45 min.

### Data analysis

Data were analyzed using SPSS software. Descriptive statistics were calculated for all the variables and participant characteristics. Mean and standard deviations were calculated for the level of spasticity, functional independence and quality of life measured pre and post intervention for both the groups. Baseline value of each variable was measured and compared between the groups using Mann-Whitney U test. Post-intervention values of the variables were measured and within group comparison was made using Wilcoxon matched pairs test and between group comparison was made using Mann Whitney U test. P values were considered significant if $P<0.05$.

## Results

We screened 25 individuals with hemiplegia and enrolled 20 participants in our study. Of the 20 participants enrolled, 19 participants completed the trial and were considered for data analysis. One participant withdrew from the study without stating any reason. No significant harms or unintended effects were found during the study. The flow of participants through the trial is summarized in Figure 1. There was no significant difference between the groups in either demographic or baseline characteristics ($P>0.05$). The demographic characteristics of each group are summarized in Table 1.

### Primary outcome

Table 2 demonstrates the shift of patients from their baseline spasticity to their post interventional level of spasticity indicating the change induced by conventional therapy or conventional therapy combined with music therapy. All the muscle groups except shoulder adductors showed significant reduction in spasticity in experimental group whereas in control group, all the muscles except hip adductors and ankle plantar flexors exhibited significant change. However upon between the group comparison utilizing Mann Whitney U test, it failed to yield any significant results.

| Variable | Group | n | Mean | SD | t-value | p-value |
|---|---|---|---|---|---|---|
| Age | Group A | 10 | 53.30 | 9.18 | 0.2705 | 0.7900 |
| | Group B | 9 | 52.11 | 9.98 | | |
| BMI | Group A | 10 | 23.97 | 2.99 | 0.8783 | 0.3920 |
| | Group B | 9 | 22.86 | 2.44 | | |

**Table 1:** Participant demographics.

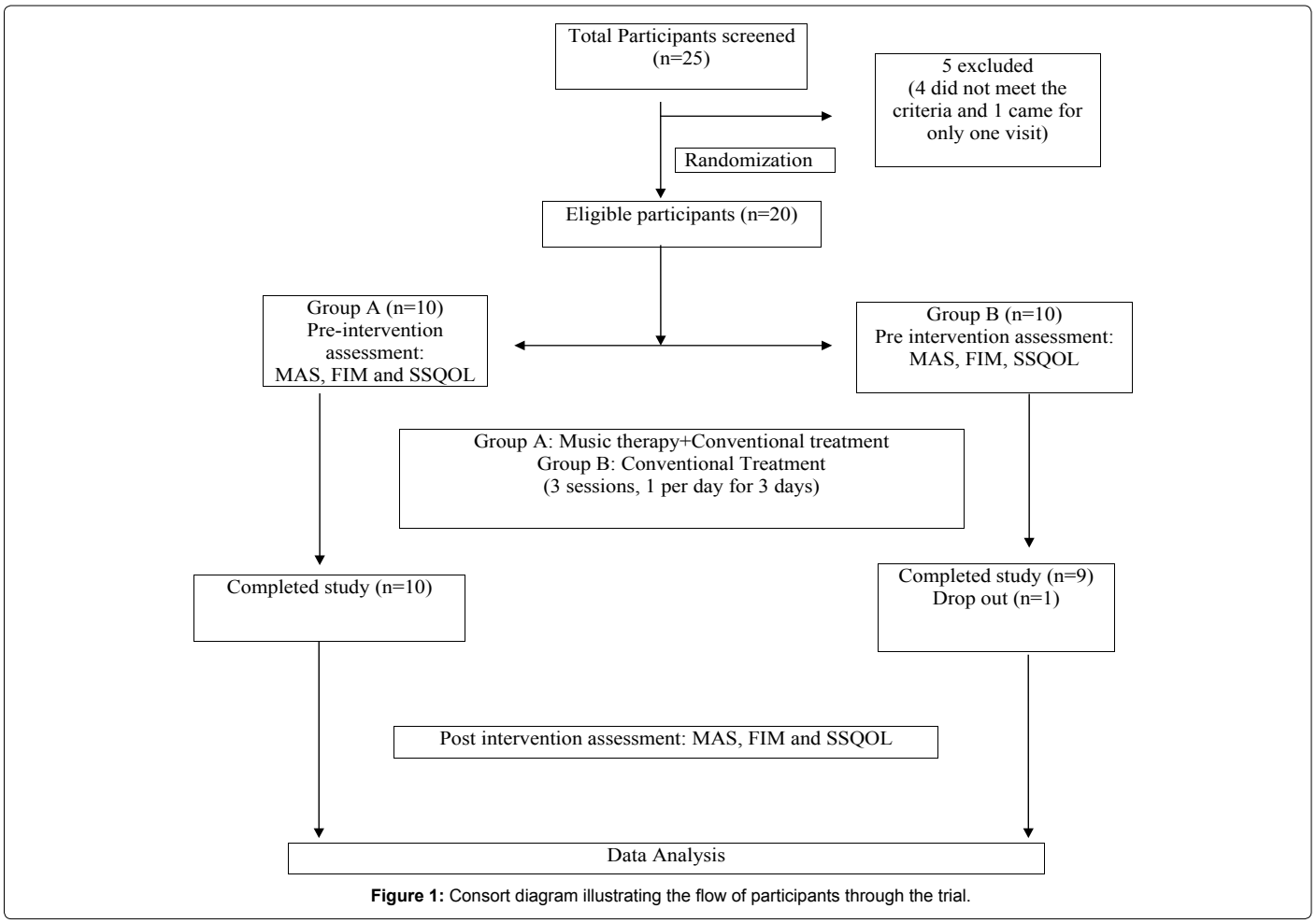


**Figure 1:** Consort diagram illustrating the flow of participants through the trial.

| Muscle Group | | Group A (Experimental) (n=10)# | | | | | | Group B (Control) (n=9)# | | | | | | $P_b$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 1+ | 2 | 3 | 4 | 0 | 1 | 1+ | 2 | 3 | 4 | |
| SA | Pre | | 2 | 7 | 1 | | | | 2 | 3 | 4 | | | 0.87 |
| | Post | | 6 | 2 | 2 | | | | 5 | 4 | | | | |
| | $P_a$ | 0.22 | | | | | | 0.02* | | | | | | |
| EF | Pre | | 4 | 2 | 3 | 1 | | | 3 | 4 | 2 | | | 0.39 |
| | Post | 1 | 5 | 3 | 1 | | | 1 | 7 | | 1 | | | |
| | $P_a$ | 0.02* | | | | | | 0.02* | | | | | | |
| FP | Pre | | 2 | 3 | 5 | | | | 3 | 1 | 4 | 1 | | 0.56 |
| | Post | 1 | 6 | 3 | | | | 1 | 4 | 3 | 1 | | | |
| | $P_a$ | 0.018* | | | | | | 0.04* | | | | | | |
| HA | Pre | 1 | 3 | 6 | | | | 1 | 3 | 1 | 3 | 1 | | 0.32 |
| | Post | 2 | 7 | 1 | | | | 2 | 3 | 3 | 1 | | | |
| | $P_a$ | 0.04* | | | | | | 0.05 | | | | | | |
| KE | Pre | 1 | 7 | 1 | | 1 | | 1 | 3 | 3 | 2 | | | 0.74 |
| | Post | 4 | 5 | | 1 | | | 5 | 2 | 2 | | | | |
| | $P_a$ | 0.04* | | | | | | 0.01* | | | | | | |
| AP | Pre | | 1 | | 1 | 6 | 2 | | | | 2 | 3 | 4 | 0.13 |
| | Post | | 2 | | 5 | 2 | 1 | | | 1 | 2 | 3 | 3 | |
| | $P_a$ | 0.01* | | | | | | 0.10 | | | | | | |

SA: Shoulder Adductors; EF: Elbow Flexors; FP: Forearm Pronators; HA: Hip Adductors; KE: Knee Extensors; AP: Ankle Plantarflexors
#distribution of patients according to the grade of spasticity on Modified Ashworth Scale
$P_a$: p value (*<0.05) for within the group comparison using Wilcoxon matched pairs test
$P_b$: p value (**<0.05) for between the group comparison using Mann Whitney U test

**Table 2:** Baseline and final grades of spasticity in both the groups.

| Outcome Measure | | Group A (Experimental) mean (SD) | Group B (Control) mean (SD) | $P_b$ |
|---|---|---|---|---|
| FIM score | Pre | 90.40 (21.42) | 80.78 (35.43) | 0.902 |
| | Post | 93.70 (19.44) | 83.67 (33.39) | |
| | $P_a$ | 0.007* | 0.007* | |
| SSQOL score | Pre | 129.10 (51.53) | 121.22 (34.46) | 0.653 |
| | Post | 146.10 (48.01) | 135.11 (33.82) | |
| | $P_a$ | 0.005* | 0.007* | |

FIM: Functional Independence Measure; SSQOL: Stroke Specific Quality of Life
$P_a$: p value (*<0.05) for within the group comparison using Wilcoxon matched pairs test
$P_b$: p value (**<0.05) for between the group comparison using Mann Whitney U test

**Table 3:** Baseline and final scores on FIM and SSQOL scales in both the groups.

### Secondary outcome

Table 3 plots the pre and post values of FIM and SSQOL scores. Like spasticity, both the groups revealed significant improvement in functional independence and quality of life scores ($p<0.05$). But between the groups comparison could not deduce the superiority of any of the treatment protocol.

## Discussion

This study was conducted with intent of studying the effect of music therapy on spasticity, functional independence and quality of life in hemiplegic subjects. The main findings of this study were: (1) significant improvement in spasticity, functional independence and quality of life in both the groups and (2) no significant difference in level of improvement upon between the groups comparison. Thus in our study, null hypothesis came to be true, i.e., there is no significant effect of music therapy on spasticity, functional independence and quality of life in subjects with hemiplegia.

Conventional treatment measures (prolonged stretching and icing, facilitation of opposite group of muscles and weight bearing exercises) that were administered to both the groups led to the reduction in spasticity as seen in both the groups. These already established measures to relieve spasticity might have acted via following mechanisms: (1) by changing the excitability of Moto neurons supplying the spastic muscles, (2) viscous deformation and (3) structural adaptations occurring in muscles and other soft tissues [26].

Supporting our use of classical music, a study examining the effect of different types of music found that classical music significantly reduces the negative scales of emotions (viz. fatigue, sadness and tension) [16] One study did not examine specifically study spasticity but showed that music-supported therapy leads to marked improvements of motor function after stroke and that these are accompanied by electrophysiological changes indicative of a better cortical connectivity and improved activation of the motor cortex [20].

A peculiar finding encountered at the end of our study is the disproportionate effect on spasticity among various group of muscles exhibited in both the groups. Shoulder adductors in experimental group and hip adductors and ankle plantar flexors in control group were the only muscle groups that did not show significant improvement upon within group (pre-post) comparison. Music therapy was hypothesized to have generalized effect and conventional measures were administered to all the above mentioned muscle groups. Despite all these, such unexplainable discrimination did occur.

We would like add a note upon the behaviour of ankle plantar flexors. This muscle group was most reluctant and showed least improvement both statistically and clinically. This stubbornness might be attributed to their higher grade of spasticity at baseline (compared to other group of muscles) as they were the only muscles having spasticity grade 4 on MAS (experimental group, n=2: control group, n=4).

Improvement in the functional performance and quality of life that was seen in both the groups might be the secondary effect of reduction in spasticity and depression level. Although the experimental group did not yield statistically significant results, we did observe the difference in few domains such as mood, personality, behavior and perspective of looking at self and the surrounding. These factors might have instilled motivation in the patients making them more compliant to the conventional treatment regimen, hence exhibiting clinically significant improvement in the experimental group.

There exist few limitations in this study viz. (1) the sample size seemed to be small enough to obtain the clear picture regarding the effects of music therapy, (2) the short period of intervention might have confounded the results (3) the musical piece administered to all the patients was common and no assessment of patient's preference was done and (4) the method of intervention utilized was only "passive receptive listening" which lacked active participation.

## Conclusion

Thus the conclusion can be derived that music therapy cannot be stated as a sole treatment but music therapy as an adjunct to the conventional therapy is quite beneficial in reducing the spasticity post stroke and in return enhancing the functional performance and quality of life. Future goals should be to determine the effectiveness of music therapy intervention, dose (duration of exposure to music) and frequency of dosage. Further researches in this field can be conducted utilizing more active participation during receptive listening or including live performance; by expanding the total intervention either by increasing the frequency or the duration of sessions; or by taking into account the preference of music.

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