*International Journal of Humanities and Social Science Invention*
*ISSN (Online): 2319 – 7722, ISSN (Print): 2319 – 7714*
*www.ijhssi.org ||Volume 5 Issue 9||September. 2016 || PP.24-29*

# The Effectiveness of Music Therapy on Cerebral Palsy Patients Receiving Rehabilitation Treatment

Lee Jang-won, M.D.[1], Kim Yong Kyun, M.D. [1], Choi Jung Hwa, M.D.[2], Lee Soyoung, PhD.[3]

[1]*Physical Medicine and Rehabilitation Myungji Hospital, Seonam University College of Medicine, 14-55 Hwasu-ro, Deokyang-gu, Goyang city, Gyeongi Province, Republic of Korea*
[2]*Department of Rehabilitation SRC Rehabilitation Hospital, Seoul, Republic of Korea*
[3]*Lee Soyoung, The Center of Arts and Healing Myungji Hospital, Seonam University College of Medicine, Goyang City, Gyeongi Province, Republic of Korea*

Correspondence : Lee Soyoung, PhD.
The Center of Arts and Healing Myungji Hospital, Seonam University College of Medicine,
14-55 Hwasu-ro, Deokyang-gu, Goyang City, Gyeongi Province, Republic of Korea
e-mail: leesoyoung26@naver.com
phone: 82-31-810-5446

Co-Correspondence : Choi Jung Hwa, M.D
Department of Rehabilitation SRC Rehabilitation Hospital, 25, Gyeonsu-gil, Chowoleup, Gwangju City, Gyeongi Province, Republic of Korea
e-mail:rubato235@naver.com
phone 82-10-9062-4802

***ABSTRACT:***
***Objective:*** *To find out the effect of music therapy in cerebral palsy (CP) patients between who received conventional rehabilitation treatments and who additionally received music therapy*
***Methods:*** *In this retrospective study, 50 CP patients who received rehabilitation treatments on a day-ward basis for at least six months, between March 2013 and February 2015, were selected as subjects. Of the 50 patients, 25 received only conventional rehabilitation treatment (rehabilitation group), and the remaining 25 received both the conventional rehabilitation treatment and music therapy (music therapy group).*
*In this study, the results of the Korean-version Denver Developmental Screening Test 2 (DDST-2) and the social quotient (SQ) were confirmed, before and after the treatments.*
***Results:*** *At baseline, no statistically significant differences were confirmed between the rehabilitation group and the music therapy group in terms of gender, age, and diagnosis. Korean-version DDST-2 scores and the SQ score also did not show statistically significant differences between the groups.*
*With the intervention, the music therapy group showed more statistically significant improvements in the gross motor, fine motor, language, and personal-social parts than the rehabilitation group. The music therapy group also showed greater improvement in SQ score than the rehabilitation group, but the difference was statistically insignificant.*
***Conclusion:*** *This study was conducted to prove the effectiveness of the current music therapy program and to investigate the area in which the therapy produces the greatest effect. It is hoped that the therapy would find wider application among children in the future as it showed significant functional improvements in the gross motor, fine motor, language, and personal-social parts in this study.*
***Keywords:*** *Cerebral palsy, Music therapy, Denver developmental screening test, Social maturation*

## I. INTRODUCTION

Disabled children, including cerebral palsy (CP) patients, usually have gross and fine motor disorders, speech disorders, and difficulty in carrying out the activities of daily living (ADL). Moreover, they have a low level of participation in social activities and experience difficulty in establishing an identity. Rehabilitation treatment is required for impaired individuals to help them express and recover their physical, mental, and socioeconomic capabilities [1, 2].

Conventional rehabilitation treatments for disabled children include exercise therapy, which helps children adjust during the developmental stage, improvement of cardiopulmonary functions, and increase of muscular strength and endurance. Exercise therapy includes neural development therapy, sensory exercise therapy, proprioceptive neuromuscular facilitation, and sensory integration treatments. It also includes

occupational therapy, which helps development of the fine motor muscles and provides ADL training, and speech therapy, which helps language development.

In rehabilitation treatments, sensory stimuli are so important [1,2] that various trials of sensory stimulation have been conducted. In Thaut et al., the effects of neurological music therapy based on the roles of auditory motor entrainment were confirmed to have helped patients with Parkinson's disease, traumatic brain injury, poliomyelitis, or developmental disorders [3].

Thus, the effects of music therapy have been verified, marking it as a new additional treatment [4-9].

Music therapy is good enough to be utilized in terms of its therapeutic effects. However, when taking into account the fact that providing treatment is not easy for children who are not motivated and do not have good concentration, the advantages of music therapy are more emphasized. Music therapy improves treatment efficacy and maximizes the effects by arousing the interest of children and inducing their participation in the treatment [1, 2].

Music therapy, consisting of singing and playing musical instruments, helps improvement of an impaired infant's gross and fine motor skills and promotes language and cognitive development by using various sensory stimuli including auditory, visual, and touch stimuli. [6, 8-14].

Music therapy is a type of creative art treatment that can improve the communication and expression abilities and can recover the physical, emotional, cognitive, and social integration [4,5].

Currently, music therapy is being used in special schools and some rehabilitation hospitals, but few studies on its treatment effects have been conducted. Mohamed conducted the study of music therapy for CP patients to evaluate its effects using GMFM(Gross Motor Function Measure). He confirmed gross motor improvements like walking, jumping, and running [6]. However, in Korea, there are only few studies that assessed overall music therapy including gross motor, fine motor, language, ADL and sociality.

In this study, the effects of music therapy on the gross and fine motor skill and on language were investigated in CP patients. The patients were assigned into the conventional rehabilitation treatment group (rehabilitation group) and the group that additionally received music therapy (music therapy group). It was hypothesized that the study subjects who additionally received music therapy would show improvements in the gross motor, fine motor, language, personal-social parts and sociality. All subjects underwent the Korean-version Denver Developmental Screening Test 2 (DDST-2) and social maturity test, and the changes in the gross motor, fine motor, language, personal-social parts and sociality were compared.

## II. METHODS

### *1) Subjects*

In this retrospective study, 50 CP patients who received rehabilitation treatments from the Department of Rehabilitation Medicine, Myongji Hospital on an inpatient basis for at least six months, between March 2013 and February 2015, were selected as subjects. Of the 50 patients, 25 received only conventional rehabilitation treatment (rehabilitation group), and the remaining 25 received both the conventional rehabilitation treatment and music therapy (music therapy group).

**Inclusion criteria:** (1) CP patients diagnosed based on their MRI results and clinical manifestations; (2) CP patients who underwent development evaluations within one month before and after the treatment; and (3) CP patients who underwent the conventional rehabilitation treatment and music therapy for at least six months.

**Exclusion criteria:** (1) CP patients with additional diseases, such as autistic spectrum disorder and Attention-Deficit Hyperactivity Disorder (ADHD); and (2) visual- and hearing-impairment patients. The Ethics Committee of Myongji Hospital approved this study (MJH-15-095).

### *2) Intervention*

As the conventional rehabilitation treatments in this study, daily exercise therapy and occupational therapy were conducted twice daily, for 30 minutes each time, five days a week for eight weeks. The music therapy group received music therapy in addition to the conventional rehabilitation treatment. The music therapy was conducted for 30 minutes each time, twice a week for 8 weeks (16 times or more). The subject patients who were readmitted within 40 days after their hospital discharge and who were then retreated were included in this study.

The music therapy was conducted after the initial conduct of the Korean-version DDST-2 evaluation on each patient. In each session, therapeutic singing and therapeutic instrumental playing were conducted. The therapeutic singing consisted of singing the children's songs chosen by the subjects and singing the songs chosen by the therapist. The therapeutic instrumental playing included the activities of playing the keyboard and various percussion instruments, which required the use of the gross and fine motor muscles, in addition to activities inducing rhythmic body movements and motions. The rhythm activities were designed to include playing specific musical patterns set by the music therapist to enhance the subjects' concentration skill. When necessary, walking exercises using rhythmic auditory stimuli were added. Within the given structure, the

patients and the therapist played in an ensemble to enhance the interaction between them, to induce the subjects' language and non-language expressions, and to eventually promote the subjects' articulation and communication performances.

***3) Measurements***

The differences in the subjects' Korean-version DDST-2 scores in the four parts (gross motor, fine motor, language, personal-social) and in the SQ from the social maturity test between the baseline and follow-up were evaluated.

The Korean-version DDST-2 test is a modified version of the Denver Developmental Screening Test-2 for Korean children aged between two weeks and six years and four months, The developmental ages are standardized in this test for the early screening of developmental delay.

The Korean-version social maturity test is a modified and supplemented version of the U.S. Vineland Social Maturity Scale (1965 version). To score the 117 preliminary test items, the social age was calculated using the Social Age Conversion Table, and was then divided by the life age and multiplied by 100 to obtain the social index.

***4) Statistical Analysis***

To determine the difference in the function changes between the rehabilitation and music therapy groups, the subjects' Korean-version DDST-2 scores in the four aforementioned parts at the baseline and follow-ups were investigated. At each time of investigation, the fraction of each functional age(months) against the biological age(months) was calculated and defined as the achievement rate, and the difference in the achievement rate at the baseline and follow-ups was defined as the change amount (percentile). In SQ, the social and life ages are already considered; as such, the score difference between the baseline and follow-ups was defined as the change amount. The chi-squared test was used to compare the groups' gender and CP type, while the t-test was used to compare the change amounts in the Korean-version DDST-2 scores and SQ. Multiple regression analyses were used to investigate the changes in the variables, such as the duration of treatment and the age, which could affect the music therapy effects and the changes in the parts of the Korean-version DDST-2 and in SQ, and to confirm the correlations between the independent and dependent variables. All the statistical analyses were conducted using SPSS v18.0 (SPSS Inc., Chicago, IL, USA). Statistical significance was accepted when $p<0.05$.

## III. RESULTS

A total of 50 CP patients received rehabilitation treatments. The rehabilitation group included 16 males (64.0%) and 9 females (36.0%) while the music therapy group included 13 males (52.0%) and 12 females (48.0%). The treatment duration of the rehabilitation group was 401.04±132.16 days, and that of the music therapy group was 390.39±156.21 days. The age of the rehabilitation group subjects was 38.8±22.28 months, and that of the music therapy group was 41.36±21.28 months. In terms of the diagnosis, spastic hemiplegic cerebral palsy was confirmed in 10 subjects (20.6%) in the rehabilitation group and in 10 subjects (20.6%) in the music therapy group; spastic diplegic cerebral palsy was confirmed in 9 subjects (55.9%) in the rehabilitation group and in 7 subjects (40.0%) in the music therapy group; and spastic quadriplegic cerebral palsy was confirmed in 6 subjects (23.5%) in the rehabilitation group and in 8 subjects (34.0%) in the music therapy group. No statistically significant difference in gender, duration of treatment, age, and CP diagnosis was confirmed between the groups [Table 1].

At baseline, the Korean-version DDST-2 values of the rehabilitation group were 15.81±16.53 months in the gross motor part, 25.52±24.00 months in the fine motor part, 24.66±23.61 months in the language part, and 19.52±15.86 months in the personal-social part. In the music therapy group, the values were, 17.08±12.40 months in the gross motor part, 21.23±13.90 months in the fine motor part, 18.19±12.34 months in the language part, and 17.12±11.02 months in the personal-social part. The SQ values of the rehabilitation group were 52.4±25.3, and those of the music therapy group were 48.6±23.9. In terms of the baseline data, no statistically significant difference was observed between the groups [Table 2].

In the rehabilitation group, the change amount of achievements rate(the fraction of each functional age(month) against the biological age(month)) before and after the intervention was -5.21±17.0% in the gross motor part, -5.60±24.0% in the fine motor part, -5.12±18.6% in the language part, and -6.16±17.4% in the personal-social part. In the music therapy group, the difference was 1.24±8.41% in the gross motor part, 2.30±11.4% in the fine motor part, 1.27±9.59% in the language part, and -2.96±6.19% in the personal-social part In the gross motor, fine motor, language, and personal-social parts, the music therapy group showed statistically significant greater improvement than the rehabilitation group.

The SQ difference in the rehabilitation group was -0.39±9.05, and in the music therapy group,

4.35±7.91, confirming that there was greater improvement in the music therapy group than in the rehabilitation group, but the difference was statistically insignificant [Table 3].

Multiple regression analyses were conducted to investigate the association between the treatment duration and the age, which could affect the change amounts of the Korean-version DDST-2 scores in the four parts and the SQ test scores, but no statistically significant results were obtained.

## IV. DISCUSSION

Music therapy includes listening to music, which is effective in relaxation and anxiety relief; singing, which includes singing with others, memorized lyrics, and imagining the next lyrics; and playing piano and percussion, which improves gross and fine motor muscles using auditory and visual stimuli [3,4].

In children with CP, rehabilitation treatments using sensory integrative stimuli through visual, auditory, and touch sensations, have been reported to show good effects [1, 2]. As music therapy provides with not only auditory but also visual and touch stimuli, it may produce good effects as a rehabilitation treatment. Music therapy involves not only language communications but also non-language communications. Thus, patients with communication problems and those who avoid communication, such as autistic children, can benefit from the therapy, and their language development can be induced [8]. Moreover, music therapy can be used for patients with a high level of anxiety, through emotional ventilation [4]. Music therapy itself arouses interest and can be applied to cognitively challenged pediatric patients [8]. Furthermore, it does not have any known side effect [4-5].Emotional ventilation through music therapy has been used for treating depression and anxiety, and its effects have been intensively investigated.

According to Eum et al., the stroke patients in their study who underwent music therapy two times a week for six weeks experienced a decrease in anxiety, depression, and abnormal behavior, and showed significant improvements in the quality of their lives [4]. Infant cancer patients were given music therapy to investigate the changes in their quality of life [15]. The CP patients who received the conventional rehabilitation treatments experienced a decrease in anxiety after music therapy, which was confirmed through the hospital anxiety and depression (HAD) scales [7].

Most recently, in addition to the emotional effect of music therapy through ventilation, many studies have been conducted to determine the effects of music therapy at various activity parts such as movement, language, ADL.

In the study by Mohamed. published in 2010, the CP patients who underwent movement treatments and music therapy showed significant improvement over time on the GMFM of walking, jumping, and running. [6]. The favorable effects of music therapy on the gait patterns of the CP patients were confirmed [16], and its favorable effects on gross motor exercises such as sitting and standing were reported [13]. Music therapy was confirmed to have been effective for fine motor muscle exercise due to the finger movements while playing musical instruments [11]. Also, when children with language retardation underwent music therapy, favorable effects on language were reported [12].

As mentioned earlier, music therapy includes various activity parts, such as the gross motor, fine motor, and language parts, and the interactions between the therapist and the patient.

If it is utilized, improvement of various parts can be promoted at the same time, so it is being used for pediatric rehabilitation treatment. Only a few studies regarding the effects of music therapy on various activity parts, however, have been conducted. In this study, the effects of music therapy were investigated using the gross motor, fine motor, language, and personal-social parts of the Korean-version DDST-2, through cross-sectional evaluations.

DDST-2 consists of 104 items for evaluating the gross motor, fine motor, language, and personal-social parts. For the gross motor part, there are 31 items for evaluating gross motor exercises like head lifting, sitting, standing, walking, and running; for the fine motor part, there are 28 items for evaluating fine motor exercises like grasping, hand manipulation, and drawing; for the language part, there are 29 items for evaluating articulation, expression language, and receptive language; and for the personal-social part, there are 25 items for evaluating the ADL and sociality for maintaining relations with others and for self-management. The tester evaluated the items for each part to calculate the implementation age (months). This test is useful for confirming the development in each part and the differences among the parts.

In this study, improvements in all the parts (personal-social, gross motor, fine motor, and language) of the Korean-version DDST-2 were observed after music therapy was conducted. These results may be explained by rhythmic auditory stimulation (RAS) [16]. RAS is a neurologic music therapy method using rhythmic sensory stimuli that contribute to the improvement of movements such as hand reaching, hand manipulation, sitting, standing, and gait. The improvements are attributed to the sound stimuli that pass through the brain sound system and function as timing cues of the motor control system [17-19]. According to a previous study, the CP patients' reticulospinal tract did not function appropriately, and their pyramidal and extrapyramidal systems were not systematically cooperative, showing non-rhythmic movements or asymmetric patterns. RAS stimulates the spinal motor neuron of the reticulospinal tract through auditory-motor synchronization. As a result, CP patients whose motor control system pathway has been damaged can experience counterbalance effects through the regular external temporal cue [20].

Music therapy using RAS reinforced the patients' trunk and proximal limb and peripheral muscles and improved their performances, resulting in the development of gross motor, fine motor, and personal-social parts of the patients brought about by improved ADL.

Before describing the improved language it will be referred to the language characteristics of cerebral palsy. According to Michalowicz R, he suggested two sets of language impairment factors in cerebral palsy. First, physical factors such as respiratory system dysfunction can affect the impairment and phonation of the articulatory organ, including the lip and tongue. The second set consists of psychosocial factors, including the pathological home environment, such as depression, cognitive disorders, and child neglect [10].

The physical factors of language problems include the following. Lip and tone hypertonicity causes the articular organ movements, articulation speed, and pronunciation to deteriorate, and the irregular short breathing cycle decreases the

phonation quality. The deteriorated coordination between breathing and the articular organ makes it difficult to regulate the strength of articulation, resulting in a pattern of interrupted, choppy speech [10]. Music therapy including rhythmic singing, sounding out long, and singing repeated phrases can stimulate the physical factors to strengthen the articular organ and respiratory system.

The effects of music therapy on the psychosocial factors are language ability improvement through the increased opportunity of language use. The language ability of children improves through repeated communications, and their cognitive ability develops accordingly.

When an infant has depression with a decreased language use motivation, or when an infant is deprived of opportunities to use language, such as in the case of a neglected child, language development is discouraged [21]. Music therapy provided CP patients who had voluntarily or involuntarily limited opportunities of using language with motivations, offering emotional ventilation through music. The activities of song discussion and song writing provided the CP patients with a motivation for using language, and their increased opportunities of language use improved their language ability.

In this study, the social maturity test was used to examine the sociality changes. The social maturity test, a modified version of the U.S. Vineland Social Maturity Scale (1965 version), has 117 preliminary test items in six categories: self-help (general, diet, and grooming), movement, working, communication, self-management, and socialization. This test is conducted through interviews of the testees' parents. If the testees' parents are not available, their brothers/sisters can take the place of the parents. In this study, the patients' mothers were the testees. Even though the subjects were mature enough to provide their personal information, they were not the ones who were interviewed because they could provide incorrect information due to their modesty, self-emotion, excessive optimism, or lack of self-judgment.

In this study, the SQ score of the music therapy group improved more than those of the rehabilitation group did, but the difference was statistically insignificant. The reasons for this are as follows. First, the subjects whose language and cognitive abilities were so poor that they could not sufficiently interact with the therapist were not excluded from the study.

According to Hay et al., children become capable of recognizing babies nearby as friends, and responding to them with language and gestures, only at around 21 months old and up.

In addition, music therapy is significantly effective for improving sociality in the 24-month-old or older patients. At such age, the interaction is usually one-to-one and not one-to-many [14]. Thus, the sociality index change in 24-month-old or older patients who have significant social interactions can be investigated and compared by assigning them to the individual music therapy group or the group music therapy group. Second, this study was conducted employing individual music therapy consisting of one-to-one interaction between the therapist and each subject.

In this study, the relation between the patient's treatment duration and age, which could affect the Korean-version DDST-2 part and SQ cores, was investigated through multiple regression analysis, but no statistically significant outcomes were obtained. This may be due to the small sample size. Further studies with a larger sample size may be necessary.

Below are the limitations of this study. First, the evaluation tool used by the testers was subjective rather than objective. To overcome this limitation, image changes according to the electronic response of each part of the brain based on the brain fMRI and changes in the autonomic nervous system were observed in the most recent studies to confirm the effects of music therapy [22-23]. In future studies, objective evaluation tools can be used in addition to the Korean-version DDST 2. Second, the treatment durations of the two groups were different. The effects of the longer treatment duration in the music therapy group compared to the rehabilitation group may not be overlooked. In addition, the time and sequence of the music therapy were not consistently designed in this retrospective study. In future studies, the experimental and control groups should have identical protocols. Third, the music therapy provided to each subject was custom-designed for unique individuals in various developmental stages. In future studies, patients in the same age range and developmental stages can be selected to investigate the effects of music therapy using consistent protocols.

## V. CONCLUSION

In this study, the effects of music therapy were verified, and its applicability to children with cerebral palsy was confirmed. Music therapy improved the functional levels of the patients in the gross motor fine motor, language personal-social parts of Korean-version-DDST 2

## REFERENCES

[1]. Braddom RL. Physical medicine and rehabilitation. 4th ed. Philadelphia: Saunders;2011. p. 1253-74.
[2]. Kwon BS, Lee JI. Theraputic exercise and physical modalities. In: Sung IY, editor. Pediatric rehabilitation. 2nd ed. Seoul: Koonja; 2013. p.171-206
[3]. Thaut MH. The discovery of human auditory–motor entrainment and its role in the
[4]. development of neurologic music therapy. Prog Brain Res. 2015;217:253-66.
[5]. Eum Y, Yim J. Literature and Art Therapy in Post-Stroke Psychological Disorders. Tohoku J Exp Med. 2015;235:17-23
[6]. Goodill SW. The creative arts therapies: making health care whole. Minn Med. 2010;93:46-9.
[7]. Mohamed GN. The Confluence Between Arts and Medical Science — Music and movement therapy for children with Cerebral Palsy. Malays J Med Sci. 2010;17:1–4.
[8]. Ali K, Gammidge T, Waller D. Fight like a ferret: a novel approach of using art therapy to reduce anxiety in stroke patients undergoing hospital rehabilitation. Med Humanities 2014;40:56-60
[9]. Rainey Perry MM. Relating Improvisational Music Therapy with Severely and
[10]. Multiply Disabled Children to Communication Development. J Music Ther. 2003 ;40:227-46.
[11]. Wang TH, Peng YC, Chen YL, Lu TW, Liao HF, Tang PF, et al. A Home-Based Program Using Patterned Sensory Enhancement Improves Resistance Exercise Effects for Children With Cerebral Palsy: A Randomized Controlled Trial. Neurorehabil Neural Repair. 2013;27:684-94
[12]. Wilk M, Pachalska M, Lipowska M, Herman-Sucharska I, Makarowski R, Mirski A, el al. Speech intelligibility in cerebral palsy children attending an art therapy program. Med Sci Monit. 2010;16:222-31.
[13]. Chong HJ, Cho SR, Jeong E, Kim SJ. Finger exercise with keyboard playing in adults with cerebral palsy: A preliminary study. J

Exerc Rehabil. 2013;9:420-5.
[14]. Dastgheib SS, Riyassi M, Anvari M, Tayarani Niknejad H, Hoseini M, Rajati M, et al. Music Training Program: A Method Based on Language Development and Principles of Neuroscience to Optimize Speech and Language Skills in Hearing-Impaired Children. Iran J Otorhinolaryngol. 2013;25:91-5.
[15]. Peng YC, Lu TW, Wang TH, Chen YL, Liao HF, Lin KH, et al. Immediate effects of therapeutic music on loaded sit-to-stand movement in children with spastic diplegia. Gait Posture. 2011;33:274-8.
[16]. Hay DM. Cooperative interactions and sharing among very young children and their parents. Developmental Psychology. 1979;15:647-53
[17]. Madden JR, Mowry P, Gao D, Cullen PM, Foreman NK. Creative Arts Therapy Improves Quality of Life for Pediatric Brain Tumor Patients Receiving Outpatient Chemotherapy. J Pediatr Oncol Nurs. 2010;27:133-45
[18]. Kim SJ, Kwak EE, Park ES, Lee DS, Kim KJ, Song JE, et al. Changes in gait patterns with rhythmic auditory stimulation in adults with cerebral palsy. NeuroRehabilitation. 2011;29:233-4
[19]. Mattern-Baxter K. Effects of partial body weight supported treadmill training on children with cerebral palsy. Pediatr Phys Ther. 2009;21:12-22.
[20]. Cha Y, Kim Y, Chung Y. Immediate Effects of Rhythmic Auditory Stimulation with Tempo Changes on Gait in Stroke Patients. J Phys Ther Sci. 2014;26:479-82
[21]. Fedrizzi E, Pagliano E, Andreucci E, Oleari G. Hand function in children with hemiplegic cerebral palsy: prospective follow-up and functional outcome in adolescence. Dev Med Child Neurol. 2003;45:85-91.
[22]. K.H. Mauritz. Gait training in hemiplegia. Eur J Neurol. 2002;9:23-9
[23]. Umphred DA. Neurological rehabilitation. 3rd ed. St. Louis: Mosby;1995 p. 263–86
[24]. Koelsch S. Investigating Emotion with Music Neuroscientific Approaches. Ann N Y Acad Sci. 2005;1060:412-8.
[25]. Orita M, Hayashida N, Shinkawa T, Kudo T, Koga M, Togo M, el al. Monitoring the Autonomic Nervous Activity as the Objective Evaluation of Music Therapy for Severely and Multiply Disabled Children. Tohoku J. Exp. Med. 2012;227:185-9

**Table 1.** Demographic characteristics of the study subjects

| Classification | | Conventional rehabilitation (n=25) | Conventional rehabilitation plus music therapy (n=25) | P value |
|---|---|---|---|---|
| Gender | Male | 16 (64.0%) | 13 (52.0%) | 0.284 |
| | Female | 9 (36.0%) | 12 (48.0%) | |
| Treatment (days) | | 401.04 ±132.16 | 390.39 ±156.21 | 0.793 |
| Age (months) | | 38.8 ±22.28 | 41.36 ±21.28 | 0.670 |
| Cerebral palsy type | Spastic hemiplegia | 10 (20.6%) | 10 (26.0%) | 0.728 |
| | Spastic diplegia | 9 (55.9%) | 7 (40.0%) | |
| | Spastic quadriplegia | 6 (23.5%) | 8 (34.0%) | |

Values are expressed as mean ± standard error.

**Table 2.** Baseline values of Korean-version Denver Developmental Screening Test 2 and Social quotient

| Classification | Conventional rehabilitation (n=25) | Conventional rehabilitation plus music therapy (n=25) | P value |
|---|---|---|---|
| K-DDST-2 | | | |
| Gross motor (months) | 15.81±16.53 | 17.08±12.40 | 0.760 |
| Fine motor (months) | 25.52±24.00 | 21.23±13.90 | 0.444 |
| Language (months) | 24.66±23.61 | 18.19±12.34 | 0.233 |
| Personal-social (months) | 19.52±15.86 | 17.12±11.02 | 0.538 |
| Social quotient | 52.4±25.3 | 48.6±23.9 | 0.593 |

Values are expressed as mean ± standard error.
K-DDST-2, Korean-version Denver Developmental Screening Test 2

**Table 3.** The change amount of Achievements rate(the fraction of each functional age(months) against the biological age(months)) in the Korean-version Denver Developmental Screening Test 2 and Social quotient difference between before and after the treatment

| Classification | Conventional rehabilitation (n=25) | Conventional rehabilitation plus music therapy (n=25) | P value |
|---|---|---|---|
| K-DDST-2 | | | |
| Gross motor (percentile) | -5.21±17.0% | 1.24±8.41% | 0.032* |
| Fine motor (percentile) | -5.60±24.0% | 2.30±11.4% | 0.029* |
| Language (percentile) | -5.12±18.6% | 1.27±9.59% | 0.026* |
| Personal-social (percentile) | -6.16±17.4% | 2.96±6.19% | 0.019* |
| Social quotient | -0.39±9.05 | 4.35±7.91 | 0.893 |

Values are expressed as mean ± standard error.
*$p<0.05$ by paired t-test
K-DDST-2, Korean-version Denver Developmental Screening Test 2