

Effects of Medical Music-Care Therapy for Children With Neurodevelopmental Disorders

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Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) are categorized as neurodevelopmental disorders by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). ASD, which is frequently comorbid with ADHD, is characterized by difficulties with communication, behavior, and/or social interaction. Children with neurodevelopmental disorders often have a developmental coordination disorder owing to impaired cerebellar function, which has been shown to cause difficulties with physical balance. It is very difficult for such children to ride a tricycle or bicycle, turn a skipping rope, and go down a flight of stairs. Owing to the cerebellar dysfunction, some children with neurodevelopmental disorders exhibit poor physical balance, which may affect their behavior or social interactions in all situations. Specifically, children with ADHD tend to have a small cerebellar size. Therefore, we considered it necessary to train their cerebellar function as soon as possible, and hypothesized that their physical balance may gradually improve, leading to some positive effects on their behavior and/or social interaction. That suggested that music therapy is effective in improving cerebellar function. Therefore, we think that it may be useful for treating a developmental coordination disorder through the stimulation of the cerebellum. We have been using the “medical music-care therapy” method in our clinic since 2015. This new method is a group therapy conducted with mothers and infants. Further, it is also effective in identifying neurological deficits, particularly related to cerebellar function, which are evident from other assessments, such as the finger-nose test, standing on one-foot test, tandem gait test, and diadochokinesis test. This new method combines training and evaluation, and is useful to improve the self-esteem of children with neurodevelopmental disorders. We wish to draw attention to the benefits of medical music-care therapy, and thereby recommend its use for managing neurodevelopmental disorders.

Keywords: medical music-care therapy, children, neurodevelopmental disorders, autism spectrum disorder, attention deficit hyperactive disorder

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Introduction

“Music-care” is a type of music therapy in Japan, which began around 1997, just 20 years ago. We have been using “medical music-care therapy” in our clinic since 2015. This is a new form of group therapy that is conducted with mothers and infants. We began conducting it in Japan.

This form of therapy is effective for identifying neurological deficits, particularly related to cerebellar function, which can be determined using assessments, such as the finger-nose test, standing on one-foot test, tandem gait test, and diadochokinesis test. This new therapy combines training with evaluation, and is useful for improving the self-esteem of children with neurodevelopmental disorders.

Children with neurodevelopmental disorders often have a “Developmental Coordination Disorder” (DCD) owing to impaired cerebellar function, which has been shown to cause difficulties with physical balance (Miyachi et al., 2014). It is very difficult for such children to ride a tricycle or bicycle, skip-rope, or go down a flight of stairs. Furthermore, owing to their cerebellar dysfunction, some children with neurodevelopmental disorders exhibit poor physical balance, which can affect their behavior or social interactions in all situations. Specifically, children with ADHD tend to have a smaller cerebellum and tend to decline in “practice function” which is one of the theory of “Triple pathway” (Wyciskiewicz, Pawlak, & Krawiec, 2017; Coghill, Seth, & Matthews, 2014; Valera, Faraone, Murray, & Seidman, 2007). It is also mentioned that there is a relation between cerebellum and practice function (Coghill et al., 2014).

Therefore, it is necessary to train these children’s cerebellar function as soon as possible. We hypothesized that doing so would help gradually improve their physical balance, leading to some positive effects on their practice functioning, behavior, and social interactions. Thaut suggested that music therapy is effective for improving cerebellar function (Thaut, 2005). Therefore, we think that it might be useful for treating disorders of both practice function and developmental coordination through stimulation of the cerebellum.

Method

Children between the ages of 3-17 were selected for the study. Each group session was held for one hour a month with two music therapists and one psychologist. We took consent form from all patients and their parents in this study.

Results

Circadian Rhythms

“Circa” means “about”, “dian” means “day”. That is to say, 24 hours + α , a day. Human beings acquire a circadian rhythm at about three months old. This is because melatonin (sleep hormone) secretion begins at three months old. Melatonin secretion is controlled by light. In the present day, natural sleep is disturbed not only by neurodevelopmental disorders, but also the fact that many children stay up at night playing video games, which radiate light. We can reset the circadian clock only using morning sunshine. First, we must regulate the circadian rhythm of children with neurodevelopmental disorders. Children with irregular circadian rhythms more easily explode in anger, due to their low levels of serotonin.

Therefore, ensuring a regular circadian rhythm is very important to the daily life of children with neurodevelopmental disorders, and it must begin prior to starting music therapy.

Neurodevelopmental Disorders

“Autism Spectrum Disorder” (ASD) and “Attention Deficit Hyperactivity Disorder” (ADHD) are categorized as neurodevelopmental disorders by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). ASD, which is frequently comorbid with ADHD, is characterized by difficulties with communication, behavior, and social interaction.

The lighter the ASD is, the more likely the individual is to satisfy a diagnosis of ADHD and/or ASD and the more receptive they are to that diagnosis (ASD-like ADHD).

However, the darker the ASD is, the less likely the individual is to satisfy a diagnosis of ADHD and/or ASD and the less receptive they are to that diagnosis (ADHD-like ASD).

Comorbid disorders, such as Intellectual Developmental Disorder (IDD), specific learning disability, oppositional defiant disorder, conduct disorder, and depression and anxiety disorder also show a gradation from light to dark.

Changes of Stressor (Suzuki, 2011)

Figure 1 shows changes of stressor (urinary 17-OHCS) related to ASD comorbid with IDD. Stressors related to ASD comorbid with IDD significantly decrease after medical intervention such as music therapy without using drugs. Control average is 4.3.

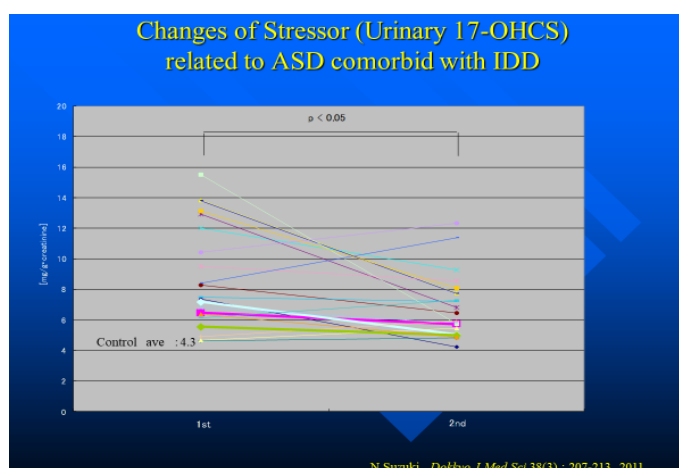


Figure 1. Changes of stressor (Urinary 17-OHCS) related to ASD comorbid with IDD.

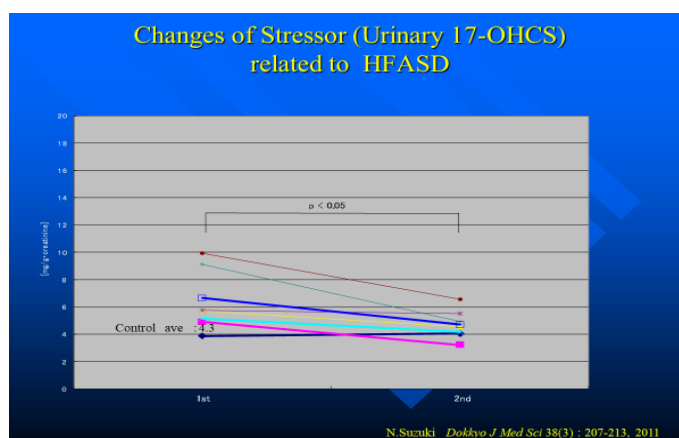


Figure 2. Changes of stressor (Urinary 17-OHCS) related to HFASD.

Figure 2 shows changes of stressor (urinary 17-OHCS) related to High Functioning ASD (HFASD, which is not comorbid with IDD). Stressors related to HFASD also significantly decrease after medical intervention, such as music therapy without using drugs. Control average is 4.3.

Clinical Effects of Medical Music-Care (Figure 3)

The Manual of the Medical Music Care Method (Autistic Factors)

Subject	○	△	×	unmarked	6/4	9/4
①Able to enter the room	○	△	×	unmarked	■	■
②Able to fulfill the therapist's instructions	○	△	×	unmarked	■	■
③Sing a song	○	△	×	unmarked	■	■
④Standing position (Romberg test)	○	△	×	unmarked	■	■
⑤Eye contact	○	△	×	unmarked	■	■
⑥Finger nose test	○	△	×	unmarked	■	■
⑦Diadochokinesis	○	△	×	unmarked	■	■
⑧Standing on one foot	○	△	×	unmarked	■	■
⑨Stepping	○	△	×	unmarked	■	■
⑩Crawling and creeping	○	△	×	unmarked	■	■
⑪Stand up	○	△	×	unmarked	■	■
⑫Balance beam walking	○	△	×	unmarked	■	■
⑬Blow soap bubbles	○	△	×	unmarked	■	■

Figure 3. The manual of the medical music-care method.

Clinical effects on language were increase in pre-speech, able to talk, able to listen, decrease in stammer, able to sing a song, and describe "love" via the gesture of drawing a circle with arms (nonverbal communication).

Clinical effects on ADHD were able to clean up the tools, able to be calm, able to wait one's turn, able to sit patiently in a restaurant, able to endure, and able to maintain control over oneself.

Clinical effects on ASD were able to hand over an object, able to bring something to the parent (understanding another people's mind), able to communicate, able to touch one's hand to the therapist's and express "good-bye" (human relations), able to adjust of power, able to blow soap bubbles by puckering the lips (imitation), and able to habituate to sound.

Clinical effects on DCD were able to stand on one foot, able to dance, able to ride a bicycle, able to get down the stairs, able to take off one's shoes while standing up and consequently the front of the shoe box area is not crowded (balance), able to draw a straight line with a ruler (clumsy).

Figure 3 shows the manual of the medical music-care method. Thirteen items are checked (No.1-No.13). A closed square mark is used to indicate that the child has accomplished the item. If the child does not accomplish the item, the item is not marked. If the child partially accomplished the item, a closed triangle is used to mark the item.

The 5-Year-Old Checkups (Figure 4)

In Japan, 5-year-old checkups are held in a few municipality. We performed 5-year-old checkups in Ibaraki prefecture, JAPAN.

The purpose of this checkups is to identify neurodevelopmental disorders. You can see a hyperactive child in left side. He exhibits the leg kicking that is characteristic of ASD.

We hold a staff conference before each medical music-care session in our clinic (Figure 5).



Figure 4. The 5-year-old checkups.



Figure 5. Staff conference.

Medical Music-Care

No.1 Able to enter the room (Figure 6). Figure 6 shows beginning of medical music-care in our clinic. Each child's name card is put on his or her back at the desk. Some children with ASD refused to come in. However, they were able to come in after their mothers had entered.

Some beginners do not join in the music-care, at first. However, we do not help them until they join the music-care. We just wait (Figure 7). After few minutes, this girl looked around and started to touch a clapper. It was important that nobody watched her while she was doing this (Figure 8). At last, the girl succeeded in joining in with her mother. The index finger takes the role of mental tempo for the piano (Figure 9).



Figure 6. Able to enter the room.



Figure 7. Beginners 1.



Figure 8. Beginners 2.



Figure 9. Beginners 3.

No.2 Able to fulfill the therapist's instructions. Figure 10 shows “he can wait”. He was able to stop the clapper during the interval. Such control training is important for children with ADHD.



Figure 10. He can wait.

The child with ASD is honest in a certain sense (Figure 11). He must beat the drum three times, but beats it only twice. Thus, the therapist instructs the child to determine how many times he should beat a drum by watching a second child beat the drum. The child with ASD would imitate what he just saw. Thus, he would beat the floor, which the therapist has done to instruct the child, rather than the drum. He is honest in a certain sense.



Figure 11. The child with ASD is honest in a certain sense.

No.3 Sing a song. The boy with taciturnity can sing a song. He was able to sing a song in a small voice.

No.4 Standing position. Figure 12 shows a Romberg test, a test used to examine neurological functions in relation to balance. In the Romberg test, a standing patient is asked to close his or her eyes. A loss of balance is interpreted as a positive Romberg test result.



Figure 12. Romberg test.

No.5 Eye contact. The child with Rett syndrome and the child with ASD + IDD played the drum without looking at it.

No.6 Finger nose test. She could wait and could rhythmically touch her own and her mother's noses. (Figure 13)



Figure 13. Finger nose test.

No.7 Diadochokinesis. This mother and child exhibited dysdiadochokinesis. Their elbows could be separated from their body. (Figure 14)



Figure 14. Dysdiadochokinesis.

No.8 Standing on one foot. The child is like his mother. ADHD has heritability (Figure 15).



Figure 15. The child is like his mother.

Leg kicking is frequently observed in ASD. The position of his knee is not in front of his body (Figure 16).



Figure 16. Leg kicking.

Figure 17 shows improvement of leg kicking whose boy with ASD + ADHD + IDD + obesity. He began medical music-care when he was five years old (left side). After one year, he could stand on one foot for a few seconds (middle side). After two years, he could stand on one foot very well (right side).

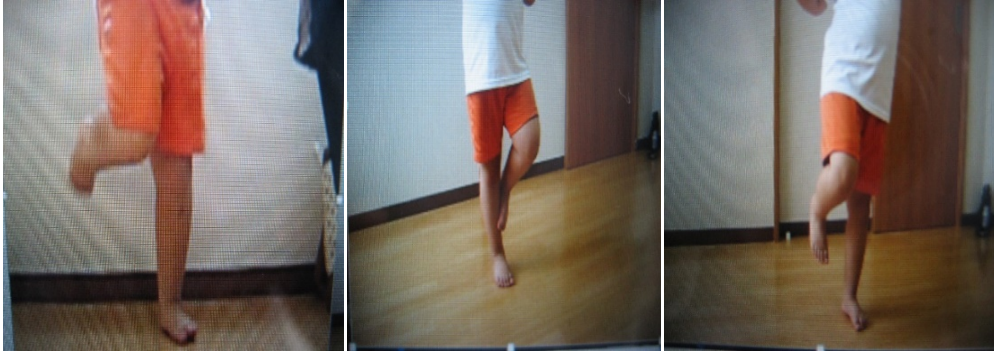


Figure 17. Improvement of leg kicking.

Leg kicking could be improved by medical music-care. The position of his knee gradually shifted to the front of his body. In the beginning, he could not stand on one foot and showed gravity anxiety (Figure 18).



Figure 18. Gravity anxiety.

No.9 Stepping. This boy is three years old, and he cannot swing both arms alternately. Alternating locomotion is very difficult for children with ASD. (Figure 19)



Figure 19. He cannot swing both arms alternately.

No.10 Crawling and creeping. Figure 20 & 21 show frontal signs of finger flexed and ankle flexed crawling. He flexes his fingers while crawling (Figure 20). He also flexes his ankles (Figure 21). These are frontal signs due to frontal lobe disorders.



Figure 20. Finger flexed creeping.



Figure 21. Ankle flexed creeping.

No.11 Stand up. We check children's ability to stand up from a sitting position. If his hands touch his knees, it is indicative of muscle weakness (Gowers' sign). Some children's sitting positions involve folding the legs to point away from themselves.

No.12 Balance beam walking. Figure 22 shows excellent tandem gait. Tandem gait refers to walking on a balance beam, putting the heel of one foot in front of the toes of the other.



Figure 22. Excellent tandem gait.

Figure 23 shows poor tandem gait. He could not be putting the heel of one foot in front of the toes of the other. But, they aim to the music therapist (Figure 24). They got a bodily sensation of achievement and pleasure.

The boy with hyperkinetics walks very quickly on the balance beam (Figure 25).

Involuntary plantar flexion of toes which continues for many seconds after withdrawal of evoking stimulus is occasionally observed in patients with diffuse brain lesions or focal lesions involving the frontal lobe (The tonic foot responses, Figure 26, Cohen & Iannone, 1967). Frontal lobe is one of the lesion of ADHD.



Figure 23. Poor tandem gait.



Figure 24. They aim to the music therapist.



Figure 25. The boy with hyperkinetics.



Figure 26. Tonic foot response.

This response has been designated as the “tonic foot response” or “grasp reflex of the foot”. If you observe carefully, you can identify tonic foot during a tandem gait examination.

No.13 Blow soap bubbles. He is just fooling (Figure 27). He blows bubbles happily, and he finally smiled (Figure 28).

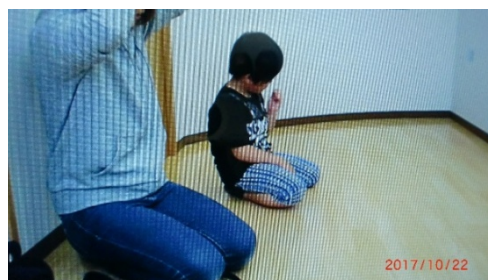


Figure 27. He is just fooling.

The girl with Rett syndrome also smiled (Figure 29). This situation includes both music therapy and art therapy.



Figure 28. He finally smiled.



Figure 29. The girl with Rett syndrome also smiled.

Taciturnity

Figure 30 & 31 show four years old of female with taciturnity. Figure 30 shows that she could not raise her arms by herself. However, Figure 31 shows that she could raise her arms easily when music is played and in a group.



Figure 30. Taciturnity 1.



Figure 31. Taciturnity 2.

The boy with taciturnity also smile (Figure 32). At first, he did not join in. However, later, he did (Figure 33).



Figure 32. The boy with taciturnity 1.



Figure 33. The boy with taciturnity 2.

Cases of Social Skills Training (SST)

When he enters the room, he put his slippers neatly side by side.

He prepared the balance beam for the tandem gait walking (Figure 34). He was able to clean up the tools voluntarily (Figure 35).



Figure 34. He prepared the balance beam.



Figure 35. He was able to clean up the tools voluntarily.

The children with ASD are sticklers for accuracy (Figure 36). The children with ASD get hung up on trifles and are sticklers for accuracy. They wanted to arrange the clappers closely in the basket.



Figure 36. The Children with ASD are sticklers for accuracy.

The boy with IDD could describe “clean up” via the gesture of drawing good by with hand.

The boy said, “Cheer up” or “Take it easy” to support the child walking on the balance beam. He gave a clap to the friend (Figure 37).



Figure 37. He gave a clap to the friend.

He swayed his body with rhythm and support the girl playing the piano. But, the boy with taciturnity did not.

Closing Ceremony

This closing ceremony is a traditional ceremony in Japan. Each person sits on his or her heels and bows. And say, “Thank you very much” (Figure 38).



Figure 38. The Japanese style of closing ceremony.

The girl with ADHD got out immediately (Figure 39).



Figure 39. The girl with ADHD got out immediately.

Finally, the farewell ceremony was held every time (Figure 40).



Figure 40. The Farewell ceremony.

Discussion

People with ASD have difficulties with communication, behavior, social interaction, and physical balance. Music therapy may help children with ASD to improve their communicative skills (Gold, Wigram, & Elephant, 2010). Our purpose is how to improve the communicative skills in ASD comorbid with ADHD children.

Music therapy (MT) was brought to Japan by Alvin from England about 50 years ago. But, music therapy is not infected to medicine in Japan even in the present day. Occupational therapy (OT), physical therapy (PT), and speech therapy (ST) belong to the rehabilitation center in most of the hospitals, but MT is not. MT is still out of style in Japan.

We keep “not unable, but able” in mind. First, we show music-care is performed. And lecture on how music-care is performed. Then we practice music-care. Children can act, because we always praise and never scold them.

Medical music-care is one of the music therapy. This is a new form of group therapy that is conducted with parents and infants. Parent-child interaction therapy is effective for families of children on the autism spectrum (Solomon, Ono, Timmer, & Goodlin-Jones, 2008).

This form of therapy is effective for identifying neurological deficits, particularly related to cerebellar function, which can be determined using neurological findings. This therapy is not only a music therapy, but also a music therapy including neurological findings and doctor’s check. There are many music therapies with PT or OT in the hospitals in the world, but only music therapy including neurological findings is rare.

Children with ADHD have worse dynamic balance performance due to developmental coordination disorder, and balance deficit could reflect a common cerebellar dysfunction in ADHD children (Goetz, Schwabova, Hlavka, Ptacek, & Surman, 2017). Children with ADHD tend to have a smaller cerebellum and tend to decline in practice function. Thaut mentioned that music therapy is effective for improving cerebellar function. Therefore, we think that it might be useful for treating disorders of both practice function and developmental coordination through stimulation of the cerebellum.

In our cases, some patients with taciturnity showed unexpected effects, such as raising her hands, participating to the music-care therapy with smile, and a little bit singing a song. These effects could not be seen on the scene of examining by a doctor in an examination room.

We used check lists of the manual of medical music-care therapy in this study. This check lists are original and easily to check about the effects in each session.

Many neurological findings were seen in this therapy. Tonic foot and flexed fingers are frontal (lobe) signs. Patients with ADHD shows low function about frontal lobe and tends to show those frontal signs in an

examination room. Finger-nose test, tandem gait, standing on one-foot test, running on the spot and diadochokinesis test are also checked in an examination room. Since most children with neurodevelopmental disorders did not cooperate with a doctor in an examination room, we used these tests in music-care therapy. Doctor checked these tests later by watching videotape recording. It could shorten a time of examining.

It was mentioned that music therapy and horseback riding are effective on social functioning in children with ASD (Bass, Duchowny, & Llabre, 2009; Kern & Humpal, 2013). So, we imported social skill training into medical music-care which is useful for social function.

Conclusions

Medical music-care is not only used for training or evaluating the functioning of the cerebellum, but also for social skills training.

We call for participants to smile and believe in the unlimited possibilities of medical music-care. Finally, I would like to thank the staff of my clinic and the music-care therapists.

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