

Current research and discussion of combined treatment programs integrated sensory training for autism spectrum disorder

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Abstract. Autism spectrum disorder is a complex psychiatric developmental disorder that poses a significant threat to early childhood development. It is characterized by a wide range of symptoms, including impaired social interaction and communication, repetitive behavior, sleep disturbances, and gastrointestinal dysfunction. The debilitating nature of these symptoms can have a profound impact on the patient's social skills and quality of life, making it essential to explore effective rehabilitation therapies for ASD. Thankfully, there are numerous treatment options available for ASD patients, including pharmacological treatment, behavioral training, motor interventions, and alternative Chinese medicine. Among these options, sensory training in motor interventions has been widely accepted in clinical practice as an effective and safe intervention for ASD patients. This paper delves into the various rehabilitation treatment options available for patients with ASD, particularly in conjunction with sensorimotor training. It compares the advantages and disadvantages of different rehabilitation treatment methods and their clinical effectiveness, providing a valuable reference for choosing medical treatment options for patients with ASD. By exploring the most effective rehabilitation treatments available, we can ensure that ASD patients receive the best possible care and support to improve their quality of life.

Keywords: sensory integrated training, autism spectrum disorder, aripiprazole, alternative medicine.

1. Introduction

Autism spectrum disorder (ASD) is a heterogeneous disorder characterized by social difficulties, restricted, repetitive and stereotyped patterns of behavior and interests, which pose a serious impact on the physical and mental health of children. In addition to the typical speech and social difficulties, most children with ASD have intellectual, perceptual, and cognitive impairments. They are also often associated with physical symptoms such as gastrointestinal system incoordination and sleep disturbances. The causes and pathogenesis of the disease are still unclear, but some scholars believe that genetics and the family environment are risk factors for the development of children with ASD [1, 2]. The course of ASD and treatment period are long and the prognosis is poor. At present, the multi-modality approach based on medication, behavioral training, and health-related education are WHO-recommended treatments [3]. In this paper, we use a literature review approach to analyze the advantages and disadvantages of existing medication and treatment methods based on clinical practice

cases of sensory integration training and the combination of multiple therapies with it, providing patients with a variety of feasible rehabilitation treatment options. The motor interventions, such as sensory integration training, have been proven to be effective. For the pharmacological component, a variety of medications are available, such as aripiprazole and risperidone. There are also other treatment options such as behavioral training, alternative Chinese medicine, and social-physical training.

2. The definition and effectiveness of sensory training treatments

Sensory Integration, or SI, is a relatively effective form of play-motor training. It includes three concepts: sensory integration training, sensory integration games, and sensory integration activities. In a regular training procedure, Teachers use special equipment to enhance the integration of the brain through planned, guided, and targeted audio-visual, tactile, vestibular, and proprioceptive activities. Sensory integration training is not only sensory training but also brain function training. The training has a wide variety of programs and guided activities that can enhance the visual, tactile, vestibular, and proprioceptive senses of children, thus promoting their brain and physical development [4]. Surveys have shown that up to 95% of children with ASD have a sensory integration disorder (SID) [5]. Since sensory training can improve postural control, executive function, balance, and emotional behavior, this therapy is by far one of the most used motor interventions for ASD, and there is now some experimental data showing that the use of sensory integration training alone has a significant advantage over other monotherapies for patients with conventional ASD.

According to the experimental case of Deng Junchen, on the effect of sensory training on vestibular balance and executive function in children with ASD, the researchers initially selected 20 children with ASD aged 4-11 years as experimental subjects, and the screening instrument for the subjects in this study was the Sensory Integration Integrated Scale for Children (SIPT), which was introduced by the Institute of Beijing Medical University and has been further refined and modified [6]. The SIPT scale was introduced by the Institute of Beijing Medical University, and through further improvement, it has good reliability and validity in China. This scale is applicable to children with ASD from 6 to 12 years old and contains 5 factors with 58 questions. The 5 factors contain dimensions of vestibular sensation, tactile sensation, proprioception, learning ability, and special problems for older children over 10 years old. The last test factor was removed because the subjects of this experiment were mainly children under 10 years of age [7].

Before the experiment, 20 subject children passed the initial screening, and the results showed that 18 children had symptoms of sensory processing disorders (SPD) and 2 children were asymptomatic. This result was consistent with Professor Yi-Shin Chang's study that "more than 90% of children with ASD have symptoms of SPD", and therefore met the requirements of the experiment [8]. Subsequently, 18 children with SPD symptoms were screened twice, and the results showed that 10 had moderate SPD symptoms, 6 had mild SPD symptoms, and 2 were normal. During the experiment, the researchers randomly divided the 18 children into a control group and an experimental group of 9 children each for an 8-week intervention. The latter group was given sensory training and the former group was given regular physical education games. Executive function and vestibular balance were assessed before and after the intervention using the GO/NO-GO task assessment and the Footscan pressure distribution level and COP gait line assessment, respectively [9,10]. Medical Corporation, Tokyo, Japan) was used throughout the GO/NO-GO task to examine patients and to collect data on three blood oxygen signatures: oxy-Hb, deoxy-Hb, and total-Hb to record the degree of neural excitation in brain regions, the response time (RT) to GO/NO-GO effects and the positive response rate (AR). The COP gait line assessment was performed under the Strengthening Romberg's test, SR (strengthening Romberg's test), in combination with Visual Normal VN (Visual Normal) or Visual Deprivation VD (Visual Deprivation) task conditions, and data were collected were the distance from the center of pressure (COP) in the X- and Y-axis directions (Copx, Copy), the total length of the COP trajectory (TTW), and the ellipse area (EA) wrapped around 95% of the COP trajectory, all four metrics in millimeters (mm), when the subject stood bipedally at rest [11]. For Footscan and COP

measurement results, the data show that in the experimental group VD, VN task, COPx index decreased from 24.56 to 18.33, from 23.44±3.13 to 17.44; COPy decreased from 26.22 to 17.89, from 22.56 to 16.22; TTW decreased from 2717.33 to 2427.00, from 1846.33 to 1361.00; EA decreased from 1845.67 to 1691.33, from 1395.33 to 920.22, respectively. There was a significant decrease in the values of the four indicators before and after the VN experiment, but there was no significant change in the control group because the TTW and EA indicators were negatively correlated with the children's static balance ability. This indicates that sensory training improves the vestibular balance function of ASD children. For the results of GO/NO-GO measurement, the data collected before and after the experiment were analyzed by t-test, and the data results showed that the GO value in RT index decreased from 422.61 to 375.42 and the NO-GO value decreased from 438.47 to 382.19 in the experimental group before and after the intervention, and the difference between before and after was -47.19 and -56.28, respectively; the GO value in AR index values increased from 0.87 to 0.92 and NO-GO values increased from 0.84 to 0.89, with a difference of 0.05; in the control group, GO values decreased from 425.74 to 387.23 and NO-GO values decreased from 432.04 to 391.30, with a difference of -38.51 and -40.74; in AR indicators, GO values increased from 0.89 to 0.91 and NO-GO values increased from -38.51 to -40.74. The difference between the pre and post-treatment data of the experimental group was greater than that of the control group, thus indicating that the sensory training influences the improvement of the child's GO/NO-GO task performance positively and effectively enhanced the child's executive function.

After removing inaccuracies due to heart pulse, natural respiration, and head movement noise, the fNIRS data results showed that sensory training had a significant effect on the oxy-Hb oxygenation signal elicited by the GO/NO-GO task. The enhancement of oxy-Hb blood oxygen signal elicited by R-IFG and R-MFG brain regions was the most prominent. The enhancement of the hypoxic signal coincided with an increase in the child's behavioral cognitive performance during the task, thus suggesting that the fNIRS data in this study provide neurophysiological evidence for a positive effect of sensory training on the executive function of the subjects.

The data suggest that both sensory training and conventional interventions can improve balance and executive functioning in children with ASD of the conventional type with sensory integration disorder (SPD), but that sensory training is more effective and more targeted.

Moreover, sensory training also has a significant positive effect on multiple subtypes belonging to the autism spectrum, such as autism, ADHD, etc. As demonstrated experimentally by Pi Xiang, 58 cases of children with autism were selected for the study and randomly divided into a control group and an observation group, 29 in each group [12]. The children in the control group underwent conventional psychotherapy, while the observation group underwent combined sensory integration training, including vestibular balance training, bouncing training, tactile training, etc. To increase the children's interest in training and improve compliance, fun games such as slides, jumping beds, and skateboards were also performed with the children. A total of 57 items were recorded and evaluated using the Autism Behavior Scale, including sensory, interaction, somatic motor, language, and self-care, with scores ranging from 0 to 171, and the higher the score, the more severe the child's symptoms.

In this experiment, we mainly compared the changes in gross motor factor scores in the motor development ability of the children in the experimental group and the observation group, including three aspects of running and jumping, walking and throwing, with scores ranging from 0 to 25, and the higher the score, the better the children improved in the three aspects [13]. The experimental data showed that after the intervention, the children in the observation group scored higher than the control group and significantly higher than the pre-intervention scores of this group. The difference was statistically significant. Thus, it can be demonstrated that sensory integration training has a significant positive impact on the behavior and interaction, sensory, motor, language, basic self-care, and other motor development skills of children with autism, especially gross motor skills.

Besides, according to Chen Yanjuan, children who underwent 8 weeks of traditional sensory training showed significant improvements in vestibular, tactile, and proprioceptive senses [14]. The

above experiments show that sensory training has positive effects on a wide range of disorders under the ASD spectrum, thus proving its breadth and effectiveness. However, there are still some shortcomings in traditional sensory training, mainly because the type of research on sensory training for patients with ASD is limited to small clinical cases, the subjects used are from a single treatment facility, and the sample size of the experiments is small, mostly less than 200. Therefore, whether sensory training has generalized efficacy for ASD patients still needs to be proven by large data and large-scale studies. In addition, the potential risks and side effects of this therapy are not yet clear due to the small sample size and the single type of patients involved. Therefore, the safety of the treatment also needs to be improved.

3. Combined treatment programs integrated with sensory training

Because of its high effectiveness and wide recognition, motor interventions represented by sensory training are often combined with other types of therapies in clinical practice today to achieve more comprehensive and effective treatment results than single therapies.

Currently, the most commonly accepted combination therapy is the combination of pharmacotherapy and motor interventions. Aripiprazole is a novel antipsychotic drug that was approved by the US Food and Drug Administration (FDA) in 2009 for the treatment of irritable symptoms in patients with autism aged 6 to 17 years; the former was also approved shortly thereafter as a psychotropic drug for the treatment of co-occurring behavioral problems in children with ASD [15].

In a clinical treatment trial by Dandan Li, 97 children with ASD or ADHD were divided into an observation group and a control group according to a randomized number table method [16]. Children in both groups were given aripiprazole tablets, with the observation group receiving additional traditional sensory training on top of the control group. After 12 weeks of continuous treatment, the ADHD-RS, CGI-S, CARS, and ABC scores of children in both groups showed different extent of reduction and improvement of C-GAS scores, and the difference in scores before and after treatment in the observation group was greater than that in the control group, which indicated that aripiprazole had significant therapeutic effects on autistic symptoms, hyperactivity, and impulsivity of children, and the clinical efficacy of children after combined sensory training was significantly better than that of the control group. This indicates that aripiprazole has a significant therapeutic effect on autistic symptoms, hyperactivity, and impulsivity, and the clinical efficacy of children treated with combined sensory training is significantly better than that of the drug-alone group.

However, this therapy has a general defect, because the principle of action of aripiprazole is to regulate dopamine secretion, that is, the balance of the DA system, and the target point of action is located in the hypothalamic-pituitary node, according to Qiu Jihong [17]. Adverse events such as drowsiness and increased nocturia in children. According to the BOON-YASIDHIV study, after observational observation of 147 patients with ASD aged 3 to 19 years, its findings proved the effectiveness of risperidone, but also found that long-term use of risperidone may have an effect on endocrine, suggesting that pharmacotherapy should be part of the comprehensive treatment of ASD, and that a comprehensive evaluation of the advantages and disadvantages of drugs is needed before their use and careful. It is suggested that medication should be part of the comprehensive treatment of ASD, and the advantages and disadvantages of medication need to be evaluated comprehensively and carefully before using medication [18].

Therefore, although the combination of medication and sensory training has the advantage of significantly relieving symptoms of autism, hyperactivity, and irritability, unavoidable side effects of medication are often detected.

Another treatment option is sensory training combined with social sports games. According to Zhen Wang et al, progress in play skills can improve immediate responsiveness and adaptation to the natural environment, as well as active language expression in social interaction in children with autism [19]. In the experiment, the researchers designed a social motor model with combined sensory training, which was divided into three phases: baseline cycle, intervention period, and maintenance period. The

experiment consisted of 12 fun movement sessions with activities from a series of middle school physical education curriculum programs. The sessions were conducted by one teacher, assisted by three teaching assistants, and included interactive sessions between children with autism and their normal peers. The results of the study showed that action initiated, proper phrase initiation, and proper sentence initiation tended to increase during each training cycle, and incomplete or inappropriate language initiation indicators tended to decrease during each training cycle. The incidence of practice play behavior was significantly lower in the intervention period compared to the baseline period ($p < 0.01$), and the overlap rate of the same values between the two periods was 12.5%, indicating that the sensory training and social sports games improved the children's play level, which in turn promoted the children's language ability, environmental adaptation ability, and immediate response ability. In addition, the percentage of children with obese or overweight BMI before the experiment was 71.4% of the total sample, which decreased to 64.3% after 20 weeks of swimming training. This suggests that exercise training also has a positive effect on the obesity level and the maintenance of good body shape in children with autism.

However, this therapy has certain disadvantages, as professional training courses are expensive and the treatment period is long, the patient's family needs to pay extra training costs for the patient, resulting in an increased financial burden on the family. Patients with average financial conditions should consider carefully choosing this therapy and following it for a long time.

With the development and popularity of alternative medicine represented by Chinese acupuncture in recent years, the combination of alternative medicine and sensory training gradually occupies a greater proportion in the rehabilitation physiotherapy program for ASD, according to the clinical experiment of Lili Zhang et al, acupuncture therapy with sensory training can improve the children's language, sensory, and interaction abilities at the same time [20]. At the same time, it can effectively alleviate the symptoms of sleep disorders such as poor sleeping habits, sleep anxiety, and daytime sleepiness in children with ASD. Given that sleep disorders and behavioral disorders are the main clinical problems of ASD, and the incidence of sleep disorders is nearly 90%, Chinese acupuncture alternative therapy can play a unique role in improving the sleep quality of patients with ASD, thus enhancing their quality of life [21]. However, this therapy is not perfect, and one of the drawbacks is the limitation of the types of symptoms it can treat. In the study by Lili Zhang et al, it was shown in clinical trials that both interventions had no therapeutic effect on both sleep breathing disorder and allergic sleep. The second disadvantage is that the current research around alternative medicine for the treatment of patients with ASD is still shallow, lacking a large number of clinical trials to prove its effectiveness and potential risks, and the mechanism of action of Chinese acupuncture therapy for alleviating sleep disorders in ASD still needs further research.

4. Discussion

In summary, this paper introduces the concept of sensory integration training as a mainstream motor intervention for patients with ASD, demonstrates its effectiveness and generalizability with clinical practice and experiments, and compares and analyzes the advantages and disadvantages of three complex rehabilitation programs combining sensory integration training for patients with ASD. First, there are some disadvantages of the single sensory integration training therapy, because the research in the field is limited to small-scale clinical trials, thus the universality of the treatment for the general ASD population is still doubtful, and the potential side effects of sensory integration training are not clear due to the small sample size. Its strengths include its effectiveness in improving core physical functions such as social, sensory, language, and motor functions, and its proven effectiveness in a wide range of conditions across the ASD spectrum. The sensory training method is the most popular, recognized, and recommended of the monotherapies. Therefore, sensory training is often used as an integral part of the treatment plan in a combination of multiple therapies in parallel. Second, of the three combined therapies that incorporate sensory training, the combination of pharmacotherapy, social-physical training, and alternative medicine each has its own advantages and disadvantages. They have the main advantages of improving patients' irritability to a large extent, helping patients to

improve their interpersonal skills and thus stimulating their internal drive to integrate into social activities, helping patients to maintain good physical posture, and improving their sleep quality, respectively, but at the same time, they also have the main advantages of high side effects of medication, high limitation by local medical resources, high cost, unknown mechanism of action and side effects of the therapy, and no known effect on respiratory. The disadvantages of sleep disorders and sleep anomalies have not been found. Therefore, patients and their families should take into account their family's financial conditions, the severity of their mental disorders and other clinical reactions, and their ability to tolerate the risks of treatment, and then carefully select and flexibly apply the best rehabilitation idea that suits their individual conditions.

5. Conclusion

This study concludes that there are advantages and disadvantages of both single-sensory training and compliance therapy for the relief of physical symptoms such as speech and social impairment, intellectual, perceptual, and cognitive dysfunction, gastrointestinal system incoordination, and sleep disturbance in patients with ASD. For single-sensory training therapy, it has the advantages of a wide range of symptoms, effective for a variety of disorders under the ASD spectrum, significantly improving patients' static balance, and executive function, reducing patients' irritability and autistic and hyperactive symptoms. However, it has the disadvantage of questionable safety and generalizability. For the three combination therapies combined with sensory training, they have the main advantages of improving patients' irritability, helping patients to improve their interpersonal skills, thus stimulating their internal drive to integrate into social activities, maintaining their good posture to avoid obesity, and improving their sleep quality, but they also have the major advantages of drug side effects, high limitation by local medical resources, unknown mechanism of action and side effects for The main advantages of the study are that the patients can maintain good body condition to avoid obesity and improve the quality of sleep. On the basis of this study, the patient's family should choose the most suitable combination of effective therapies for the individual patient based on a comprehensive assessment of the severity of the patient's condition and the family's economic status.

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