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Assessing the effects of newly designed pressure vest on children with autism spectrum disorders

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ABSTRACT

Introduction: Pressure vest is usually used as a training intervention for the treatment of autistic children by medical experts. This article assessed the effect of pressure vest on attention and involuntary behaviors of children with autism.

Aim
The aim of this study is to expand the pressure vest therapy as a new non-invasive method to treat the autism spectrum disorder.

Material and methods: Pressure vest have cells dilated to apply pressure to the body and an air compressor manually adjustable for proper functioning. It is needed to apply pressure in a different way to enter some dynamic pressure that has a characteristic rhythmic massage. In this study, we used an alternative treatment plan for five children with autism within seven days of seven weeks. At first, the vest was worn to the baby and then a series of tasks and common games were performed. The Micro had three different programs to control valves of pressure vest.

Results and discussion: Children in most cases did the exercises and assignments with interest and had more patience. Assessing four main parameters including the focus, anger, learning and speaking in children indicates that at the end of the seven-weak course, the behavior of children has improved in the form of a reduction in the anger level and the improvement of speaking, learning and focus. The device had an acceptable performance in the prevention of sudden behaviors. The major advantage of these vests were increasing focus and concentration, enhancing comprehension and learning and reducing hyperactivity.

Conclusions: Further work with a larger database of subjects and different psychological evaluation methods is required to confirm our findings. The Micro three different programs to control valves of pressure vest had no significant effects.

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1. INTRODUCTION

Autism spectrum disorder as a psychological disorder emerges as the poor communication and social interaction in children, anger, anxiety, lack of focus and etc. It also makes them experience unwanted actions such as hand or finger flapping, body rocking and indiscoverable vocals. There is a need to expand global examinations to diagnose and treat the autism in children.[1,2]

The main reason for the autism is still unknown but the early diagnosis and intervention can be highly effective in reducing the long-term consequences of the disease such as verbal damages.[3] Many treatments have already been tried to find ways to improve the behavior of children with autism such as using embryonic stem cells and adult sensory intervention, behavior therapy, massage therapy and drug treatments.[4]

Another method of treatment is the use of therapeutic behavior with low and high intensity.[5] In the study performed by Lovaas et al.,[6] the intensive therapeutic behavior was tested on 19 four-year-old children for a period of 40 hours during a week. The results showed that after 6 years, 47% of the children had reached a normal behavior, in comparison with a control group of 19 children, who had undergone non-severe therapeutic behavior. Beyond the practices, some principles can be applied in areas such as child health, stress management, and behavioral therapies to treat the autism spectrum disorders as behavior therapies.[7–11]

Also, sensory treatments as the effective methods in treating autism are widely being used in autistic children for reducing stress and increasing the health level. Sensory interventions are applied in different types of intervention, sensory methods and practices, with the goal of self-regulation.[12]

Sensory based interventions are widely being used to help children with autism. They aims to alter the underlying neurological processing of sensory information in order to improve functional outcomes.[9,13] Interventions have been developed that apply specific sensory input to modulate behavioral responses to sensory stimuli. Examples of sensory-based interventions include: brushing or deep pressure applied to the body, manual compression of the joints, weighted vests, and hammocks.[14]

The design of therapeutic pressure vest in the previous research is based on the vest that makes constant pressure (static) to the body or there are a number of weights hanging from the body in the vest to enforce the pressure to the trunk. Weighted options used for more than 10% of the child's body weight are evenly distributed throughout the vest, providing joint compression in the shoulders and spine. Therapists use weighted vets to increase trunk stability and reduce activity levels (thereby increasing calm behavior). Using dynamic pressure instead of static pressure has potential benefits.[15,16] The overall goals of pressure therapy are relaxation, muscle tension relief, pain reduction, mobility of soft tissues and blood circulation improvement. There is considerable scientific evidence regarding the positive effects of massage therapy in the treatment of anxiety and stress, pain in joints and tendons and even sleep.[17]

In this study, a pressure vest adjustable cell with dynamic pressure pattern was presented to massage the body according to the programmable logic method. Filling and emptying of different cells inside the vest caused the rhythmic massage loss, thereby helping the patient to feel better. In this study, the effects of dynamic pressure vest were tested on children with autism on series of tasks and common games within seven weeks. Also the effect of inflated pressure vest, on autistic children psychological manner has been evaluated and the advantage of this system was evaluated in comparison to the former methods of pressure therapy.

2. AIM

The aim of this study is to expand the pressure vest therapy as a new non-invasive method to treat the autism spectrum disorder.

3. MATERIAL AND METHODS

In this study a device including a controller was used to fill specific arrays, empty cells and therefore exerting a dynamic pressure to the trunk. The design and manufacturing methods include: design and construction of wearable vest, air compressor mechanism, electroneumatic valve, pressure regulator design, controller design and electrical circuits.

3.1. Design and construction of the wearable vest

The vest had six separated cells (calf) opening in the front and back. These cells were embedded in the vest. Cuffs were placed symmetrically on the front and back of the vest and a faced pair was filled and emptied simultaneously. This phenomenon created more pressure. Pocket was built inside the jacket where the cuffs were placed and there was some access for the pocket outside the vest. Inside the jacket, the cuffs using hose connectors were connected two by two, providing the possibility of inflating two cuffs at the same time. The vest was completely open and free from both sides and anyone could easily wear it (free size). Then we put together the back and forth of our jackets by some tags sewn on the dress (Figure 1).

3.2. Mechanism of air compressor and electroneumatic pressure regulator valve design

The electromagnetic air pump was used for feeding air and suitable air pressure inside the vest. The compressor could create pressure up to 260 mmHg and discharge up to 60 L/min, making it very suitable for our work. The body of the pump was made of an aluminum alloy reducing the air flow resistance and the heat loss from the body was handled more effectively. Other characteristics important in the study were the low noise pump, high efficiency, low pressure and lack of pollution on the environment. Low noise working of the pump was very important. It prevented the stress

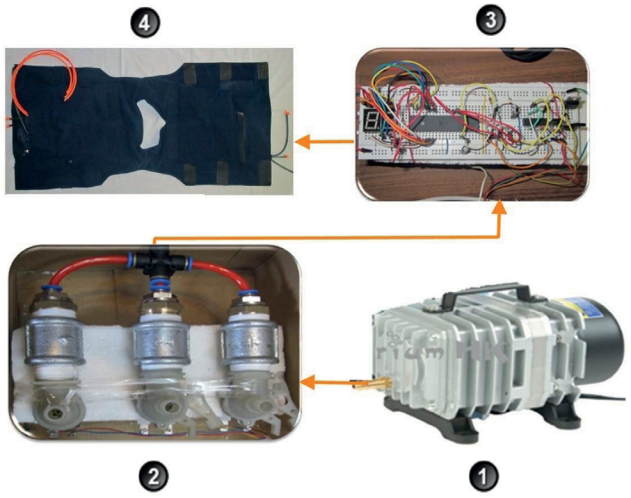

Figure 1. The overview of the therapeutic pressure vest: (1) compressor, (2) electromechanical valve, (3) control circuit, (4) pressure vest.

on the patient and helped the patient to feel comfortable. To control the entry and exit of air in cells, an electroneumatic valve was required for each pair of cells with a high response rate since these valves were controlled by the inner core and a coil. In this system, three valves were placed in parallel, open or close, by the command control circuit. Pressure regulator was placed immediately after the compressor and before the electroneumatic valve. By rotating that, the input air pressure to any cell could be adjusted. So the unique feature of this device was applied for rhythmic massage (not static), which was done by the pressure regulator. Some of the features of the pressure regulator are as follows: manufacturer – Jacob Aerodynamic, type – NAR-200-RNKG, structure – diaphragm, material – zinc and techno polymer, ports – 4/1 and 8/1, working temperature – from –20°C to 50°C, maximum inlet pressure – PSI 250, and discharge pressure – up to 135 PSI 5.0.

This valve could set output pressure from 0.5 PSI to 135 PSI. By connecting a pressure gauge to the pressure regulator, pressure applied to the patient's body was measured in every moment.

3.3. Design and construction of the electrical circuit controller

To use different methods of applying pressure, valves in various forms had to be opened or closed. In the proposed system, AVR was used to control the valve. The circuit was simulated using the Proteus software and then implemented on board. The Micro had three different programs to control valves. These programs are described below.

3.4. The first program

In the first program (P1), valves did not act together and each valve was opened separately for a specified period of time by a micro-relay command. For example, if the duration were determined by the micro in 5 s, by running the program, the first valve would be opened for 5 s, and the other two valves would be closed. In the second 5 s, the second valve was opened and the other two valves were closed and the cycle was continued until the machine power was cut off.

3.5. The second program

In this program (P2), the valve was opened and closed at the same time and then the third valve was opened when the other valve was closed. It was as if there were only two valves in the machine.

3.6. The third program

In the third program (P3), each phallus was opened and closed simultaneously. So, in this case, only one valve was in orbit. Due to these different programs, different massage techniques could be used. For example, in the state number two, two cells could be wound in the upper trunk simultaneously and then under cell as another cell. The importance of this is the ability of massaging the upper and lower body separately, one after another. We could set the number and duration of each valve (s) as an input control circuit.

4. RESULTS AND DISCUSSION

To test the system, a seven-day course of treatment was considered. Five boys and girls, who were willing to attend the tests, participated in the test, according to teachers and the parents present in this period. Children wore a vest in the Child Support Autism and the device started the first program on schedule. Also, the instructor asked them to do some work such as writing, reading, playing and painting. This program was performed almost every day for 20 minutes. The lecturer took note at the same time to get information regarding children's reactions at the end of a detailed report. We classify the level of speaking ability, learning ability, focus and anger and score them from 1 to 5. Score 5 and 1 respectively means good and poor learning/speaking/focus ability. Score 5 and 1 respectively means very angry and not angry manner. The results of test subjects have been shown in Figure 2.

Among the deficiencies observed, the device was importable, so the children had to sit in their place. Another disadvantage of the device was the sound produced by air compressor, causing children's distraction. To overcome this drawback, it is possible to replace the compressor with compressed air lines used in hospitals and clinics. A suggested by teachers, the use of the device for a few months is required to view more details. By a dynamic vest, the amount, location, and timing of the pressure can be varied, potentially stimulating the mechanoreceptors more frequently, and the vest could be effective for a longer period of time. Second, since the amount, location, and timing of the pressure can be varied, a dynamic vest can be more child-specific than a static vest, as the

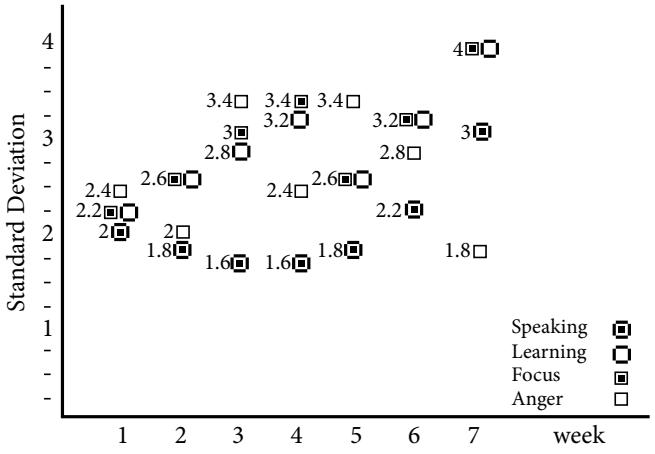

Figure 2. Standard deviation of test subjects in the 7th week follow-up.

parameters of the vest are adapted to each child's sensory needs. In this research the effect of pressure vest, on autistic children has been evaluated based on coaches and experts experience it could be replaced by psychological test like questioner or analyzing the EEG signals.

5. CONCLUSIONS

According to the experts of the Autism Center, the devices had a positive effect on children's behavior, such that they liked to do things and showed less angry behavior. The device had an acceptable performance in the prevention of sudden behaviors because, except a special case, children followed the tasks and demands of the instructor very well. The benefits of these vests were: increasing body awareness, improving balance and coordination, increasing focus and concentration, enhancing comprehension and learning, dramatically reducing hyperactivity, maximizing the benefits of therapy sessions, and increasing therapy carry over.

Conflict of interest

None declared

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