

The Prototype Development of a Portable Sitting Support Orthoses for Children with Cerebral Palsy

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ABSTRACT

This study aimed at developing a prototype of a portable sitting support orthoses for children with cerebral palsy to allow independent sitting in a near normal sitting posture and enabling maximal functional independence. Sitting Postural Control was selected as the targeted skill because sitting is the earliest upright posture achieved in development process, but it is often delayed in children with CP. To overcome these problems, the developed prototype serves numerous accommodations, foremostly being lightweight and portable option that can be easily carried from one end to another providing an ease to the caretakers for transportation. Along with that, it's a cost-effective option.

Keywords: Cerebral palsy, prototype, portable sitting support orthoses

INTRODUCTION

Cerebral palsy (CP) is the most common disability of childhood that affects motor function as a result of injury to the developing brain.¹ CP is a group of neurological disorders that typically appear in infancy or early childhood and persist throughout life. It results from anomalies or injury to the developing brain that impairs the brain's capacity to regulate movement. The term "cerebral" refers to the brain, while "palsy" refers to the loss or impairment of motor function. The disorder may be brought on by aberrant brain development or injury to the brain's motor centers, which can happen prior to, during, or soon after birth. CP is characterized by a variety of symptoms, including as difficulty swallowing and speaking, weak arms or legs, stiffness or floppiness in the limbs, uncontrollable

movements, and delays in meeting developmental milestones.^{2,3}

About half of the patients with cerebral palsy suffers from musculoskeletal problems leading to various issues such as reduced muscle strength, coordination problems and limitations in functional tasks like standing, walking and sitting and performing daily activities.⁴ These issues may include muscle contractures, joint deformities, and muscle and joint instability, which can impact the child's posture, movement, and comfort. Additionally, complications like breathing, swallowing, eating difficulties, and learning challenges can arise due to musculoskeletal issues associated with CP.⁵ Additionally the use of Sitting Support Orthosis has shown to be beneficial in improving their sitting posture, comfort, overall quality of life. arise due to

musculoskeletal issues associated with CP. They are designed to provide stabilizing support necessary for a near-normal sitting posture, improve head control, reduced intensity of reflex patterns, abnormal muscle tone and enhance stability. For children with severe cerebral palsy who lack the balance or voluntary means to maintain a good sitting posture, sitting support orthosis plays a crucial role in preventing spinal deformities, improving spinal alignment, and enhancing overall comfort and function.⁶

The Present Sitting Support Orthosis available for children with cerebral palsy is specifically designed for non-ambulatory children with severe impairment providing stabilizing forces necessary for achieving a normal sitting posture but is difficult to carry from one place to another. Thus, this study focuses on creating a cost-effective, portable sitting support orthosis that makes it easy for parents and caregivers to carry the device from one place to another. Moreover, the orthosis is feasible and can effectively maximize functional independent sitting in children with CP.

MATERIALS & METHODS

The stages of prototype development have been followed in this study:

Gathering and Analysis of Requirements:

Before designing the prototype, thorough research is conducted to gather information about the orthoses, and existing similar orthoses. According to the reviewed articles, it has been proven that the current custom-made and adjustable sitting support orthoses are difficult to carry, time consuming to construct, and relatively expensive. After collecting all the requirements and analyzing them, this study intends to provide a portable and cost effective option for the population of children with cerebral palsy.

Designing the Prototype:

Designing a prototype involves creating a preliminary model of an orthoses to test its design and functionality. Initial concept sketches were designed to visualize and refine the design of the orthosis. For this study, A high-temperature thermoplastic sheet prototype is created based on the measurements taken. For folding from the edges, channel hinges are incorporated at the corners. Additionally, cut outs are given on the edges to hold it for transportation.

Creating the Prototype:

Creating a prototype involves transforming an idea into a tangible model to test its design, functionality, and feasibility. For this research study, A prototype of wood is created, replicating the thermoplastic model, which incorporates hinges, for folding it from edges, straps to stabilize the trunk part and head support, foam to provide cushion effect while sitting position and trunk part and many other modifications as shown in the image.

RESULT

In the present study, the author attempted to design a prototype on portable sitting support orthosis for children with cerebral palsy. The study supports the specific needs of children with cerebral palsy and has the potential to enhance their sitting support and overall quality of life. The orthosis will provide support and stability to help improve sitting posture and enhance the child's functional abilities. The designed prototype of portable sitting support orthosis is light weight and portable i.e., can be easily carried from one end to another, a well-designed option to provide the stabilizing support necessary for a near normal sitting posture, along with a cost effective option for child with cerebral palsy.



DISCUSSION

Children with CP can hold a normal posture temporarily, but they are unable to move their upper extremities and hold their positions over an extended period of time.

Adaptive seating systems for the treatment of children with CP have been utilized for the improvement of positioning and functioning and for the prevention of various secondary complications. With additional accessories, adaptive seating equipment is used to activate functionality.

Our primary motivation in this study was to enhance the seating adaptability of children with Cerebral Palsy. In order to help achieve various clinical goals, including accommodating moderate to severe postural deformities, preventing further progression of current postural deformities, inhibiting abnormal reflexes, controlling muscle tone, promoting function through proximal stability, facilitating skin protection through even distribution of pressure, and comfort or sitting tolerance, a portable sitting support orthosis is chosen. The Portable Sitting Orthosis can help with sitting posture and reaching for different activities, provided the orthosis must fit quite closely to be effective.

The primary goal in rehabilitation is to find a sitting position that gives the child an

opportunity to sit in a near normal sitting position and engage in activities of daily living such as eating, communication and dressing. Balancing sufficient trunk support with adequate trunk mobility has important functional and medical consequences. A functional requirement is that the sitting position is used in everyday life and does not impair balance, spasticity or respiration.

Through recent years, adaptive seating has been studied as an assistive postural device to help individuals with neuromotor impairments, who have difficulty making posture against gravity. Adaptive seating helps individual with mobility impairments to improve their postural control, which is the ability to control the body's position in space to secure stability and orientation while sitting. With its ability to increase independence, comfort, support adaptive seating is an essential tool for people with limited mobility. It is intended to meet a wide range of requirements and can be applied in a variety of circumstances including homes, public areas, and health-care settings.

According to the study, Gross Motor Functional Classification System Level IV children are benefited the most from such adaptive seating

systems. Specifically, before the age of 2, these children have head control but require trunk support to sit on the floor. They can roll and may roll to their stomach but have limited voluntary control of movement. Between ages 2-4, they can sit with upper body support and may be able to self-propel short distances by rolling or crawling on their stomach but require assistance for transition. There may be adaptive equipment for sitting and standing. From ages 4-6, they require adaptive equipment for trunk control to sit and stand and may walk short distances with assistance, but primarily use wheeled mobility. They require help with transfers.⁷ In Summary, our novel portable sitting support orthoses is feasible and can effectively maximize functional independence. It can be provided to children between the age of one to five years so as to assist them become functionally independent and to benefit from the physiological benefits of sitting support orthoses.

CONCLUSION

In conclusion, the study on prototype development of a portable Sitting Support Orthoses for children with CP has yielded valuable insights and outcomes that have significant impact on well-being of children with CP. The developed orthoses are specially designed for non-ambulatory children with severe impairments providing stabilizing forces necessary for achieving a normal sitting posture. It provides support and stability to help improve sitting.

While more research is needed to fully understand the benefits of adaptive seating, the available evidence suggests that it can have a significant impact on the quality of life for individual with mobility impairments.

Limitations

To analyze the efficacy of the sitting support orthoses through patient evaluation and further refinement of the

prototype to make it compact and lightweight.

Future Directions

The present study focused on developing a prototype of a Portable Sitting Support Orthoses by using the subsequent stages of the prototype development process which included initial evaluation by the user, Prototype Refinement and Implementation of the orthoses on patient can be accessed in future in further studies to validate the efficacy of the developed prototype.

Declaration by Authors

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