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Low-Cost Indigenous Modified Dynamic Hip Abduction Orthosis for Cerebral Palsy - A Case Report

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ABSTRACT

Background: Hip dislocation and subluxation are frequent issues in children with cerebral palsy (CP), particularly those with spastic forms of the condition. One of the strategies for managing these problems is the use of hip abduction orthoses, which help to prevent or treat hip deformities. The focus of this study is to examine the effects of a modified dynamic hip abduction orthosis in addressing hip adductor tightness in a patient with CP.
Case Description and Methods: The case involved a 6-year-old boy with spastic paraplegic CP who presented to the National Institute for Locomotor Disabilities (NILD), Kolkata. Upon a thorough assessment, the child was diagnosed with hip adduction deformity, and a dynamic hip abduction orthosis was prescribed to address this issue. The orthosis was designed to gradually reduce the hip adduction tightness while providing support for functional movement.
Findings and Outcomes: After three months of consistent use of the orthosis, there was a marked improvement in the hip adduction tightness. The child was able to walk while wearing the orthosis without experiencing any limitations in hip movement, demonstrating the effectiveness of the device in improving range of motion and reducing deformity.
Conclusion: The combined approach of physiotherapy and orthotic intervention is critical in treating hip adduction tightness in children with CP. In this case, the dynamic hip abduction orthosis proved to be an effective tool for improving hip function and reducing the deformity. Such interventions can enhance the quality of life and mobility in children with similar conditions.

Keywords: Cerebral Palsy, Dynamic Hip Abduction Orthosis.

INTRODUCTION

Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fatal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and

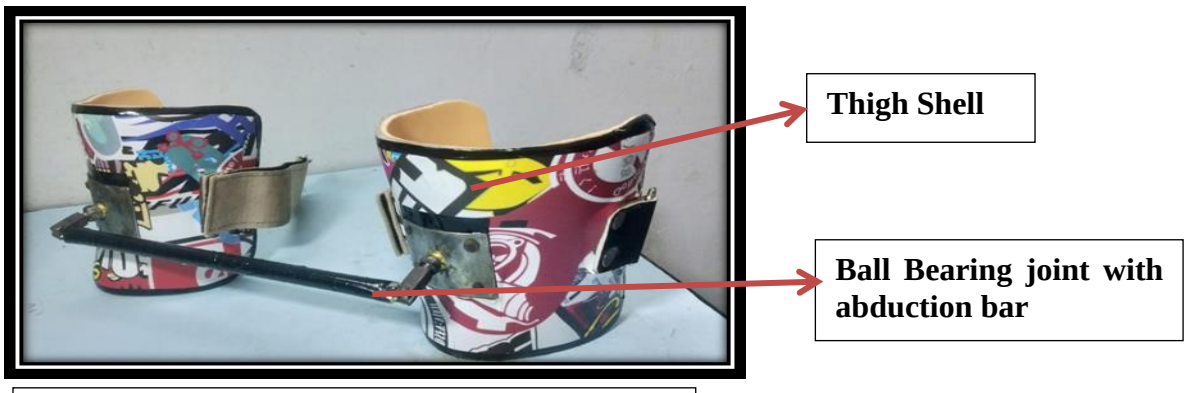
behaviour, by epilepsy, and by secondary musculoskeletal problems.[1] Hip dislocation and subluxation are frequent issues in children with cerebral palsy (CP), particularly those with spastic forms of the condition. One of the strategies for managing these problems is the use of hip abduction orthoses, which help to prevent or treat hip deformities. Meanwhile, several studies regarding nonsurgical treatment for hip displacement, including various types of hip abduction braces, postural alignment seating systems, and botulin toxin injection, have reported inconsistent results.[2-5] In previous research, it has observed that a seating system with medial knee support could act as a fulcrum, thereby accelerating progressive hip displacement in patients with non-ambulatory spastic cerebral palsy.[6,7]Hip abduction orthoses (HAO) are used for the prevention and treatment of these problems. Conventional HAO limits hip adduction through a proper on the side of the thigh. For children with CP who have hypertonic hip adduction muscles, it is difficult to maintain hip abduction with conventional HAO because the prop of the HAO bends during movement [8-9]. The focus of this study is to examine the effects of a modified dynamic hip abduction orthosis in addressing hip adductor tightness in a patient with CP.

MATERIALS & METHODS

The case involved a 6-year-old boy with spastic paraplegic CP who presented to the National Institute for Locomotor Disabilities (NILD), Kolkata. After a comprehensive assessment, the child was diagnosed with hip adduction deformity, and a dynamic hip abduction orthosis was prescribed to address the issue. The orthosis was designed based on biomechanical principles to counteract the level of hip adduction tightness the child experienced.

The fabrication of the orthosis involved the use of a polypropylene (PP) sheet for the thigh shell, with evathane padding incorporated for enhanced comfort. The orthosis was equipped with an abduction bar and a ball bearing joint that allowed for controlled movement. The abduction bar helped to maintain the thigh in an abducted position, directly reducing the adduction tightness. Additionally, the ball bearing joint permitted some movement at the hip, allowing the child to walk without restriction while wearing the device.

This design facilitated the gradual reduction of hip adduction tightness while still providing functional support for walking, making it an effective intervention for improving hip function and mobility.



Modified Dynamic Hip Abduction Orthosis

RESULT

After three months of consistent use of the modified dynamic hip abduction orthosis, the child showed significant improvement in hip adduction tightness. Prior to using the orthosis, the child experienced restricted hip movement due to tightness in the hip adductors, which can limit functional

activities like walking and contribute to progressive deformities.

The orthosis, designed to maintain the hip in an abducted position, gradually stretched and relaxed the adductor muscles. This mechanical correction, combined with the comfort and support provided by the device, led to a reduction in hip adduction tightness over time.

As a result, the child experienced an increase in the range of motion at the hip, allowing for more natural movement during walking. The ball bearing joint of the orthosis also allowed for some movement at the hip, ensuring that walking could still occur without being hindered by the orthosis itself.

Ultimately, the child was able to walk without any limitations in hip movement, indicating that the orthosis successfully addressed the hip adduction deformity and improved functional mobility. This outcome highlights the device's effectiveness in reducing hip deformities, enhancing the range of motion, and allowing the child to engage in walking with improved mobility.

DISCUSSION

Cerebral palsy (CP) is a complex condition characterized by permanent motor impairments, often accompanied by secondary musculoskeletal complications. Among the various musculoskeletal issues in CP, hip dislocation and subluxation are common, particularly in children with spastic forms of the disorder. These problems can lead to significant functional limitations and discomfort, necessitating interventions to prevent or manage them. Hip abduction orthoses (HAOs) are one such intervention, designed to prevent hip deformities and maintain hip stability by controlling hip adduction, a common problem in children with CP.

Previous research has explored the role of different types of hip abduction braces and other nonsurgical treatments for managing hip displacement. While some studies have shown promise with approaches such as postural alignment seating systems and botulinum toxin injections, results remain inconsistent, particularly for children with more severe forms of CP or spasticity. Some studies have noted that conventional HAO designs, although beneficial for controlling hip adduction in less severe cases, may not be effective in children with hypertonic or spastic adductor muscles. This is due to the difficulty in maintaining hip abduction when the orthosis bends during movement, limiting its functionality for children with more rigid muscle tone. [5-7,10, 11]

The current study sought to address these limitations by exploring a modified dynamic hip abduction orthosis. The design of this orthosis took into account the biomechanical principles required to counteract severe hip adduction tightness while still allowing for natural movement during walking. The inclusion of an abduction bar and a ball bearing joint in the design enabled the orthosis to maintain the thigh in an abducted position while permitting some movement at the hip, ensuring that walking could still occur without interference from the device. Results from this case study demonstrate the effectiveness of the modified dynamic hip abduction orthosis in reducing hip adduction tightness. After three months of consistent use, the child showed significant improvement in the range of motion at the hip. The device facilitated gradual stretching and relaxation of the adductor muscles, addressing the tightness that had previously restricted movement. This mechanical correction allowed the child to walk without limitations caused by hip adduction tightness, highlighting the success of the orthosis in improving functional mobility.

The findings are consistent with other studies that have shown positive outcomes with modified or dynamic orthotic devices, though they also underline the importance of tailoring interventions to the specific needs of each child. In this case, the combination of biomechanical design and comfort features like evathane padding played a key role in ensuring compliance and comfort while the orthosis was worn.

Moreover, the inclusion of the ball bearing joint was crucial in ensuring that the orthosis allowed for some hip movement, which is essential for functional activities like walking. This dynamic feature differentiates the modified orthosis from conventional HAOs, which can be restrictive and uncomfortable for children with more severe spasticity.

CONCLUSION

The use of the modified dynamic hip abduction orthosis for three months resulted in a significant improvement in the child's hip adduction tightness. The orthosis effectively addressed the restricted hip movement caused by tight hip adductors, a condition that typically limits functional activities like walking and can lead to progressive deformities. By maintaining the hip in an abducted position, the orthosis gradually stretched and relaxed the adductor muscles, reducing tightness over time. As a result, the child experienced a notable increase in hip range of motion, allowing for more natural and unrestricted walking. The design of the orthosis, particularly the ball bearing joint, allowed for functional movement at the hip, enabling the child to walk without limitations. This case demonstrates the effectiveness of the modified dynamic hip abduction orthosis in reducing hip deformities, improving the range of motion, and enhancing functional mobility, highlighting its potential as a valuable intervention for children with cerebral palsy experiencing hip adduction tightness.

Declaration by Authors

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Conflict of Interest: The authors declare no conflict of interest.

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