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CASE REPORT

Functional Seating to Enhance Mobility and Activity in a Child with Spastic Quadriplegic Cerebral Palsy

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ABSTRACT

Introduction: Cerebral palsy is a permanent disorder of movement and posture caused by non-progressive disturbances in the developing brain. Spastic quadriplegia is the most severe subtype, affecting all four limbs and the trunk, and is often associated with significant limitations in mobility, posture, and functional independence. Children with this condition frequently require specialized postural support to enhance stability and improve participation in daily activities. This case report describes the use of functional seating to address postural instability in a 7-year-old girl with spastic quadriplegia following perinatal hypoxic–ischemic injury.

Case Presentation: A multidisciplinary rehabilitation program was implemented using a customized functional seating system equipped with lateral trunk supports and contoured cushions to stabilize the pelvis, trunk, and neck. The child presented with global developmental delay and difficulty sitting, walking, and speaking. The intervention focused on optimizing postural alignment, reducing abnormal movement patterns, and facilitating safer mobility and daily participation. Challenges during positioning included markedly increased muscle tone, strong extension patterns, and involuntary movement, which required continuous adjustment of the seating configuration.

Discussion: Despite these challenges, the functional seating provided improved postural stability, enabling the child to maintain sitting for longer periods with better alignment. Enhanced stability supported improved motor control and increased participation in daily routines. The intervention also reduced caregiver burden by facilitating easier and safer handling during daily activities.

Conclusion: Functional seating is an effective adjunct to rehabilitation for children with spastic quadriplegia. When integrated into a tailored, multidisciplinary program, it enhances posture, supports mobility, and improves participation in daily activities, contributing to better overall quality of life.

Keyword: *cerebral palsy, spastic quadriplegic, functional seating*

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INTRODUCTION

Cerebral palsy is a chronic condition that affects motor development and posture, limits activities, and is linked to a non- progressive problem of the growing brain. Cerebral palsy, the most prevalent pediatric disability, manifests in roughly 2–3.5 instances per 1000 live births, with a peak incidence of 65 cases per 1000 live births, especially among preterm infants.[3] The incidence of cerebral palsy in Indonesia ranges from 1 to 5 per 1,000 live births; nevertheless, there are around 5,000 to 25,000 diagnosed cases each year for every 5 billion live births in the nation.[4]

The clinical diagnosis of cerebral palsy can be determined by a combination of neurological and clinical indicators. The diagnosis generally takes place between 12 and 24 months of age. During the first two years of life, the subsequent four motor types may develop and progress: 1) Spasticity (85%–91%); 2) Dyskinesia (4%–7%), including athetosis and dystonia; 3) Ataxia (4%–6%); and 4) Hypotonia (2%), which is rarely categorized.[5] The primary risk factors for cerebral palsy are preterm birth and low birth weight; additional risk factors include multiple gestations, hypoxic-ischemic encephalopathy, and maternal infections.

The most reliable indicator of cerebral palsy is considered to be the existence and severity of hypoxic-ischemic encephalopathy in newborns.[6] Spastic quadriplegia Cerebral palsy is most frequently associated with a history of brain lesion known as periventricular leukomalacia (PVL), characterized by bilateral necrosis of the frontal and parietal periventricular white matter.[7] Children with cerebral palsy categorized at GMFCS levels IV and V are considered non-ambulant, representing 24.0 to 32.5% of the population, with elevated percentages noted in resource-constrained settings.[8]

Individuals with spastic quadriplegia often experience challenges related to muscular tone, posture, and ambulation, notwithstanding the stability of the underlying brain lesion. Ambulation and bipedalism are taught thereafter, with the ankles aligned in an equino-varus position due to the rigidity of the gastrocnemius muscles. The crouch gait in children may arise from heightened rigidity of the hamstrings and hip flexors with age, hindering extended ambulation and mimicking neurological decline.[7]

Children with non-ambulant cerebral palsy necessitate assistive equipment for upright positioning and mobility, as they do not develop proficient walking abilities. The aims of managing cerebral palsy are to augment functionality, enhance capacities, and maintain health related to mobility, cognitive development, social interaction, and independence, rather than to cure or restore normalcy.[9]

CASE PRESENTATION

A 7-year-old girl, with a 4/5 APGAR score and a history of perinatal hypoxic- ischemic syndrome, was presented at the outpatient clinic after a normal vaginal delivery. She is currently unable of ambulation. She displayed sialorrhea, strabismus, and a global developmental delay. She was born at full term and encountered no problems during delivery. She encountered challenges with self- feeding; nonetheless, no abnormalities were identified, and she was discharged with routine monitoring. This patient had a complete immunization record. The child possesses no prior history of seizures.

She weighed 16.0 kg, measured 110 cm in height, exhibited a cranial circumference of 44 cm (indicative of microcephaly), and was alert at entrance. Her vital signs were within normal ranges. The analysis of the standing participant's posture indicated a centrally aligned head, symmetrical shoulder elevation, lack of windswept hips, scissoring, and pelvic obliquity, as well as insufficient hip control and knee locking.

The patient displayed delayed fine motor skills, evidenced by her inability to grasp and use fundamental stationery objects such as books and rulers, as well as toys like dolls. She had not attained age-appropriate developmental milestones and

remained unable to walk or stand unaided. The patient was able to distinguish between family members and strangers, talked with incoherent single words, and could follow concise, precise instructions.

As narrated by the mother, the child was carried by her whenever she got to move. As her primary caregiver, the mother spent all her day taking care of the child. The mother noticed the child was unable to sit independently and was facing difficulty with movement transitions from the very first year.

The physical examination revealed stiffness, clonus, and hyperreflexia in the trunk and all limbs. The patient's inability to plantar flex her ankle joints and fully extend both knee joints may be attributed to spasticity, which also explains her capacity to attain full range of motion during passive movement

Figure 1. Body posture before using the functional seating

DISCUSSION

Cerebral palsy, a condition that often manifests in infancy or early childhood, affects movement and posture. It is the result of a non-progressive cerebral damage that transpires before, during, or immediately following delivery. Cerebral palsy encompasses a collection of static neuromotor dysfunction syndromes arising from injury to the developing brain, rather than being a unified disorder. The illness's consequences can be treated and alleviated through various surgeries, despite the brain damage being irreversible and incurable. [10]

Although children with cerebral palsy frequently spend significant time seated in different chairs, they are encouraged to participate fully in daily activities. We employ functional seating to improve their daily performance. To facilitate the child's optimal autonomous functioning, the chair must be adjusted to provide the most beneficial sitting position that enhances effective postural control. [11] Functional sitting includes an adjustable head support, a chest strap, lateral trunk support, armrests, a tray table, foot straps, a footrest, a sacrum pad, handles, and brakes.

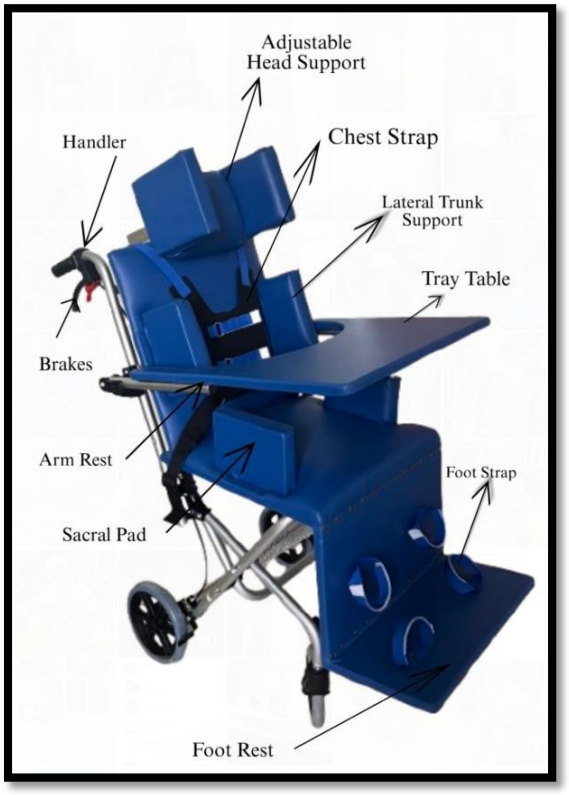

Figure 2. Functional seating detail

Observation indicated a notable improvement in the child's posture relative to its starting state. Her center of gravity is positioned anterior to the ischial tuberosities, enabling her to sustain an upright posture with a tilted pelvis while employing functional seating. Her stance allows her to maintain an upright posture by activating her posterior back muscles to offset gravitational forces on her torso. An abduction orthosis can improve her stability by facilitating symmetrical weight distribution on the ischial tuberosities. This inhibits the development of scoliosis, pelvic obliquity, and hip dislocation.

The angles of hip and knee flexion were deemed the most pivotal parameters in mitigating stiffness in children with cerebral palsy. Research

suggests that body orientation in relation to gravity considerably affects the modulation of muscle hyperactivity, possibly to a greater extent than hip flexion angles. Upright seating, as opposed to reclining, typically results in diminished aberrant tonic muscle activation in the back extensors and adductors.

In a seated position, lumbar lordosis decreases, and the ischial tuberosities, together with the surrounding soft tissue, bear the majority of the weight. [11] Conversely, the line of gravity is situated above the ischial tuberosities in an upright seated position.[12] The alignment of the line of gravity concerning the ischial tuberosities is crucial for evaluating the muscular effort necessary to sustain equilibrium. The ischial tuberosities serve as a fulcrum.[13]

A forward-tilted pelvis with an erect spine can enhance the stability of a hypotonic torso in a forward-leaning posture. Tilting the seat forward efficiently shifts the canter of gravity anterior to the fulcrum at the ischial tuberosities by facilitating anterior pelvic tilt and preventing posterior displacement.[14]

The upper limbs, comprising the head, trunk, and upper extremities, must be positioned next to the ischial tuberosities, anterior to the fulcrum. Postural control, the capacity to align the head and trunk against gravity while adjusting various body components relative to one another, requires this alignment. For seated to be successful, the weight must be evenly distributed on the ischial tuberosities. The pelvis commences its primary rotation solely once the buttocks have engaged with the chair.

Employing a sacral pad to sustain the pelvis in an anterior or neutral tilt can facilitate healthy pelvic posture. This enhances the infant's capacity to sit upright.[15] As the trunk progressed, the footrests in this functional seating inhibited the feet from moving backward, posterior to the knee joints. Additionally, it includes a foot strap that inhibits the infant from tilting their pelvis or leaning forward.

Figure 3. Body posture after using the functional seating

When seated with arms resting on the table and the line of gravity situated anterior to the fulcrum, the functional seating arrangement includes a table in front of the kid to promote weight distribution through the arms. This setup enables the youngster to navigate with one arm while being assisted by the other. This support may limit the utilization of the hands and arms for purposes outside stability maintenance.[13]

Evaluating pelvic positioning is crucial when utilizing functional seating to sustain postural control over time. To ensure this youngster maintains proper seating posture, the line of gravity must be positioned above the supporting surface and anterior to the fulcrum at the ischial tuberosities.

The kid attained notable milestones through specialized therapy aimed at improving muscle tone, coordination, and mobility, leading to enhanced engagement in play, social interactions, and self-care activities. These innovations improve family interactions, reduce caregiver strain, and empower the child. [16]

Considering that caregivers are essential to a child's development and well- being, family empowerment and engagement are crucial elements of pediatric rehabilitation. A cooperative alliance between families and rehabilitation specialists cultivates a nurturing atmosphere that promotes goal establishment, skill development, and thorough care planning. Furthermore, offering caregivers emotional support, education, and training improves their ability to effectively manage the problems of caregiving and advocate for their child's need.

CONCLUSSION

For children with severe cerebral palsy, especially those categorized at GMFCS levels IV and V, functional seating is an essential type of assistive equipment. Functional sitting is intended to enhance comfort and reduce the risk of secondary issues, including scoliosis, hip dislocation, and pressure injuries, while ensuring appropriate postural alignment. The tilt-in- space, reclining capabilities, contoured cushions, and lateral trunk support of these seating systems are vital components that collaboratively stabilize the pelvis and trunk. While children at GMFCS Level V depend mostly on caregivers for everyday duties, suitable sitting can facilitate a stable and effective posture that enhances meaningful participation in cognitive, feeding, and communication skills.

In conclussion The purpose of functional seating is to improve and facilitate the child's mobility and participation. These improvements boost the child's quality of life and functional independence, while also reducing the strain on caregivers and promoting harmonious family relationships. To achieve substantial enhancements in motor function and daily activities, a thorough and customized rehabilitation program incorporating interdisciplinary therapies may be utilized.

REFERENCES

1. Stark, Stacy M. Cerebral Palsy. In: Frontera WR, Silver JK, Rizzo TD E. Essential of Physical Medicine and Rehabilitation 2019. p. 689-96. Vol.Fourth edi. Elsevier; 2019. 689–96 p.
2. Makki D, Duodu J NM. Prevalence and pattern of upper limb involvement in cerebral palsy. J Child Orthop. 2014;8(215):9.
3. Himmelmann K, Hagberg G UP. The changing panorama of cerebral palsy in Sweden. X. Prevalence and origin in the birth-year period 1999-2002. Cereb palsy Epidemiol Sweden Acta Paediatr. 2010;99(9):1337–43.
4. Salfi QN, Saharso D AA. Profile of cerebral palsy patients in Dr. Soetomo General Hospital Surabaya, Indonesia. Biomol Heal Sci J. 2019;2(1):13–6.
5. Novak I, Morgan C, Adde L, Blackman J, Boyd RN, Brunstrom- Hernandez J et al. Early, accurate diagnosis and early intervention in cerebral palsy: advances in diagnosis and treatment. JAMA Pediatr. 2017;171(9):897–907.
6. Magdy AE. Evaluation of risk factors for cerebral palsy. Egypt J Neurol Psychiatry Neurosurg. 2021;57(13).
7. Huntsman R, Lemire E, Norton J, Dzus A, Blakley P HS. The differential diagnosis of spastic diplegia. Arch Dis Child. 2015;(100):500–4.

8. Paleg, G.S.; Williams SA., Livingstone R. Supported Standing and Supported Stepping Devices for Children with Non-Ambulant Cerebral Palsy: An Interdependence and F-Words Focus. Int J Environ Res Public Heal. 2024;21(669).
9. Hay WW, Levin MJ, Deterding RR AM. Current Diagnosis & Treatment: Pediatrics (22nd ed). New York: McGraw-Hill Education; 2014.
10. Sadowska M, Sarecka-Hujar B KI. Cerebral Palsy: current opinions on definition, epidemiology, risk factors, classification and treatment options. Neuropsychiatr Dis Treat. 2020;16:1505–18.
11. Myhr, Ulla L von W. IMPROVEMENT OF FUNCTIONAL SITTING POSITION FOR CHILDREN WITH CEREBRAL PALSY. Dev Med Child Neurol. 1991;33:241–56.
12. Akerblom B. Standing and Sitting Posture. Stockholm: AB Nordiska Bokhandeln.; 1948.
13. McClenaghan BA. Sitting stability of selected subjects with cerebral palsy. Clin Biomech. 1989;4:213–6.
14. Mandal AC. The seated man (homo sedens). The seated work position. Theory Pract Appl Ergon.1981;12:19–26.
15. Letts, M., Shapiro, K., Mulder, K., Klassen O. The yindblown hip syndrome in total body cerebral palsy. J Pediatr Orthop. 1984;4:55–62.
16. Jones MW, Morgan E, Shelton JE TC. Cerebral palsy: introduction and diagnosis (part I). J Pediatr Heal Care. 2007;21:146–52.