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Original article

THE ROLE AND IMPORTANCE OF EARLY PHYSICAL THERAPY INTERVENTION IN PREMATURE BABIES - CASE STUDY

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Abstract

Aim. This case study aims to highlight the role and importance of early intervention through the application of a personalized kinesiotherapy program on the physical, motor and cognitive development in a 28-week premature infant who presented complications associated with premature birth.

Methods. The observation and intervention in the study were carried out over a 14-month period, involving a multidisciplinary team and parental collaboration. Baseline assessment included medical history, neurological and behavioral status, physical and motor development, posture, reflexes and reactions to different stimuli, and personalized interventions. The physiotherapy program was initiated at 2 and a half months, immediately after discharge, performed 3 times a week. It combined specific physical methods/techniques and exercises to improve muscle tone, develop and correct posture, stimulate motor and cognitive skills. Regular re-evaluations were carried out to adapt the therapy, the family following all the recommendations of the medical staff.

Results. The early intervention program led to significant improvements in the child's development, observed at regular medical evaluations. Motor, cognitive and physical development was accelerated and supported by active parental involvement.

Conclusions. Individualized early physiotherapy combined with parental involvement and collaboration with the multidisciplinary team contributes significantly to favorable outcomes in the physical and motor development of the preterm infant. Our results emphasize the importance of including these programs in neonatal practice, supporting the findings of Tsigaras et al. (2024), who highlight the positive impact of sensory-motor physiotherapy on the quality of care and interventions in neonatal intensive care units (NICUs).

Keywords: Early intervention, physiotherapy, preterm infant, cognitive development, motor development, assessment.

Introduction

Preterm birth represents a major developmental challenge for children, requiring personalized medical and therapeutic interventions. Prematurity, defined as the birth of a baby before 37 weeks of gestation, carries increased risks to their health and development. According to the World Health Organization, there are three main categories of prematurity: late preterm (34-36 weeks gestation), moderate preterm (32-34 weeks gestation) and extreme preterm (less than 28 weeks gestation). Extreme preterm infants, such as the child in this study, have significant medical complications, including respiratory problems, neurological disorders, feeding difficulties and infections. In addition, "babies born prematurely, between 26 and 36 weeks, go through a series of developmental milestones that require specialized monitoring and ongoing support" (Raising Children Network, n.d.).

,,The differences between extreme preterm and term babies become apparent in the first two years of life highlighting the importance of continuous monitoring and personalized interventions" (Mostafavi, 2016)." These differences are caused by the immaturity of their organs and systems, such as incompletely developed lungs, which frequently require respiratory support, and immature nervous system, prone to complications such as intraventricular hemorrhage and periventricular leukomalacia (Als, 2009) .Thus, extreme preterm infants, such as the case analyzed in this study, require rigorous monitoring and tailored interventions to support their motor, cognitive and physical development in the first years of life.

From a motor point of view, premature infants often show significant motor delays, including hypotonia or spasticity, which justifies the need for early interventions. "Moderately to late-born preterm infants are at increased risk for neurologic delays, justifying the need for early interventions to support their optimal development" (Mitha et al., 2024). They also experience feeding difficulties, due to uncoordinated sucking and swallowing reflexes, and digestive problems, such as gastroesophageal reflux (Mitha et al., 2024).

Preterm birth can also affect social and emotional development, both through increased parental stress and disruption of early parent-child bonds. "Prematurity requires special interventions to overcome medical challenges and delayed development, with an emphasis on personalized care" (MedlinePlus, 2019). Studies have shown that early interventions, such as physiotherapy programs, can accelerate motor and cognitive progress in preterm infants, helping them to reach developmental milestones similar to full-term infants (Spittle et al., 2012). Early intervention is a key approach to support

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the development of children with disabilities, ensuring that each developmental stage is supported through personalized and integrated methods within the family and community context (Gherghescu & Timofte, 2020).

To assess the development of premature infants, corrected age, calculated as the difference between chronologic age and the number of weeks of prematurity, is used. This method is essential to understand and monitor their progress in relation to the developmental milestones of term-born children. Preterm infants may reach developmental milestones later than those born at term because their growth and progress is often calculated on the basis of corrected age rather than actual age at birth" (University of Nottingham, n.d.).

Through this case study we aim to highlight the importance of early assessment and intervention through physiotherapy in a preterm infant born at 28 weeks gestation, with a focus on the impact of medical complications and personalized interventions on motor and cognitive development. In the study by Ko and Lim (2023), entitled "Motor Development Comparison between Preterm and Full-Term Infants Using Alberta Infant Motor Scale", the authors found that "preterm infants scored significantly lower on the Alberta Infant Motor Scale compared to full-term infants, showing delays in motor development". These findings emphasize the importance of close monitoring of motor development in preterm infants and the need for early interventions to address any delays.

Objectives

The main objective is to emphasize the role of early interventions in supporting optimal development and reducing the gap with term infants. According to some landmark studies, motor delays in preterm infants are explained by neurological immaturity and other complications associated with prematurity (Ko & Lim, 2023; Spittle et al., 2012). The table below highlights these differences.

Table 1. Comparison of motor developmental stages in preterm and term newborns

Motor Development Stage	Children Born Premature (Chronological Age)	Term Children (Chronological Age)
Head maintenance (DV)	4-5 months	2-3 months
Forearm support (DV)	5-6 months	3-4 months
Rolling	6-7 months	4-5 months
Crawling	8-9 months	6 -7 months
Quadruped position	10-11 months	7-8 months
Standing	11-12 months	9-10 months
Walking free	15-18 months	12 months

Comments

1.Preterm infants typically achieve motor developmental milestones later than full-term infants relative to chronological age; however, recovery is achievable with appropriate interventions.

2.Full-term infants follow a predictable developmental trajectory and are considered the benchmark for motor milestone achievement.

According to the growth curves published by the World Health Organization (WHO, 2018), significant differences exist in the anthropometric parameters at birth between preterm and full-term infants. These differences are summarized in Table 2.

Table 2. Anthropometric parameters at birth in preterm and term newborns

Anthropometricn Parameters	Preterm Infants (under 37 Weeks of Gestation)	Term Babies (40 weeks of gestation)
Weight	1500-2000 g	2500-4000 g
Height	40-45 cm	50-55 cm
Head circumference	30-33 cm	34-35 cm

Remarks

1. Preterm infants have lower weight, height, and head circumference at birth, relative to their gestational age.
2. Full-term infants are born with anthropometric values that fall within the WHO standard ranges and are used as a reference for growth curves.

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Case Presentation

The patient, a male infant, was delivered prematurely by cesarean section on January 9, 2022, at a gestational age of 28 weeks. Anthropometric measurements at birth were: weight 1230 g, length 36 cm, and head circumference 26 cm.

The medical record at discharge included the following diagnoses: respiratory distress syndrome treated with surfactant, grade III-IV intracranial hemorrhage, perinatal hypoxia, plurietiologic anemia, and retinopathy of prematurity (under observation).

Figure1. Study subject_ Baby born at 28 weeks

Methods

Intervention protocol

The individualized therapeutic program included initial, ongoing and final assessments, along with motor stimulation exercises and corrective positioning, with the aim of involving parents in daily activities. Previous studies have demonstrated the effectiveness of these methods in accelerating the recovery of motor function (Einspieler & Prechtl, 2005).

Within personalized therapy programs, we have integrated strategies dedicated to pain management, considering its impact on early development and on the child's ability to cooperate during interventions. The role of the physiotherapist was crucial in preventing pain and reducing associated fears and distress, thus contributing to a safe, predictable and comfortable environment for the child. The holistic approach used resulted not only in improved wellbeing of the child, but also increased the child's willingness to actively participate in subsequent interventions, confirming the importance of this perspective as supported in the literature (National Center for Biotechnology Information, 2010).

The initial assessment included the child's complete medical history, neurological and behavioral monitoring, analysis of primitive reflexes and motor development. Initial observations revealed axial hypotonia, typical of preterm birth, Moro reflex present symmetrically at discharge, rapid fatigue during maneuvers due to a history of respiratory distress syndrome, left occipital plagiocephaly, and gastroesophageal reflux manifested during position changes.

The therapeutic program was tailored to the child's specific needs and focused on achieving the following main objectives:

1. Increasing muscle tone and enhancing joint mobility.
2. Preventing and correcting potential postural deformities.
3. Supporting the development of coordination and motor control.
4. Educating parents to continue the exercises at home.

To increase muscle tone and improve joint mobility we used passive and active exercises designed to stimulate muscle tone, especially in the trunk and extremities. Gentle massage and passive mobilization techniques were applied, such as gentle flexion and extension of the limbs, circular movements of the joints and stretching manoeuvres to prevent torticollis.

Another major objective was the prevention and correction of postural deformities through the use of specific positioning. The lateral decubitus position was used to reduce back pressure and stimulate spontaneous movements, and the ventral decubitus 'frog' position promoted symmetrical muscle development. The prone position, applied only when the child's breathing allowed, was used to stimulate the extensor muscles of the neck and trunk. For the management of gastro-oesophageal reflux, the child was positioned in a slightly reclined position.

Stimulation of natural reflexes, such as sucking, grasping or automatic gait, was an essential component of the therapy, with the aim of strengthening nerve and muscle connections. The exercises involved touching hands and feet and stimulating the support reflex. "Studies have highlighted the distinct characteristics of grasping movements in premature infants, particularly those with cerebral palsy, emphasizing the importance of early interventions (Van der Heide et al., 2005).

The development of motor skills was supported by a structured program tailored to growth stages. At 2-3 months of age, the focus was on forearm raising in the prone position to encourage head control and axial muscle strengthening.

At around 4-5 months of age, exercises focused on facilitating rolling, a key stage in the development of postural control.

At 6-7 months, the child began to sit up and exercises were aimed at improving trunk stability and dynamic balance.

Between 8 and 10 months of age, therapy focused on walking in patruped gait, and after the age of 10-12 months, exercises to support unsupported walking were integrated.

Sensory stimulation was a central pillar of the therapeutic program. Tactile, visual and auditory elements were integrated to support the development of sensory perception. Different textures were used for tactile stimulation, colorful toys for visual stimulation and rhythmic sounds for auditory orientation.

Parental involvement was crucial to the success of the therapy. After each physiotherapy session, parents were given clear instructions for simple and effective exercises, adapted to be done at home. The importance of correct positioning and gentle massage for stimulating the child's tone and development was explained to them. In addition, parents were emotionally supported and constantly informed about the stages of normal sensory-motor development and the child's progress.

The monitoring of the therapeutic program was carried out through regular reassessments by the pediatrician, neurologist and physiotherapist. These reassessments allowed the types and intensity of exercises to be adjusted according to the child's progress. The duration of the physiotherapy sessions varied between 20 and 40 minutes and the frequency of interventions was set at three sessions per week to maintain an optimal balance between stimulation and recovery. Collaboration with the multidisciplinary team ensured a holistic approach, integrating the child's motor, cognitive and social development.

Results

Results of the physiotherapy protocol

By using corrective positioning and specific exercises to support postural development, a significant improvement in cranial symmetry was observed. Axial muscle tone progressively increased, facilitating improved trunk control and a more stable posture in both dynamic and static positions. Primitive reflexes, such as the Moro reflex, were gradually integrated and the osteotendinous reflexes remained symmetrical and within normal limits.

The infant began to roll and move in a quadruped position, demonstrating significantly improved motor coordination. He also transitioned independently into a sitting position without support and acquired the ability to rise from a prone position. Subsequently, the child began to walk supported, achieving independence in walking and maintaining balance without difficulty.

Personalized exercises led to improved postural control with symmetrical alignment and more efficient movement coordination. The kinesiotherapy program, integrated with sensory stimulation and active parental involvement, supported age-appropriate language development and contributed to the child's improved interaction with the environment.

At the end of the intervention, the child had good balance, no particular attitudes and was able to move independently with stability. The early intervention through personalized physiotherapy had a positive impact on anthropometric parameters, contributing to a harmonious growth and the achievement of values close to the developmental standards for the corrected age (Bergman, 2014).

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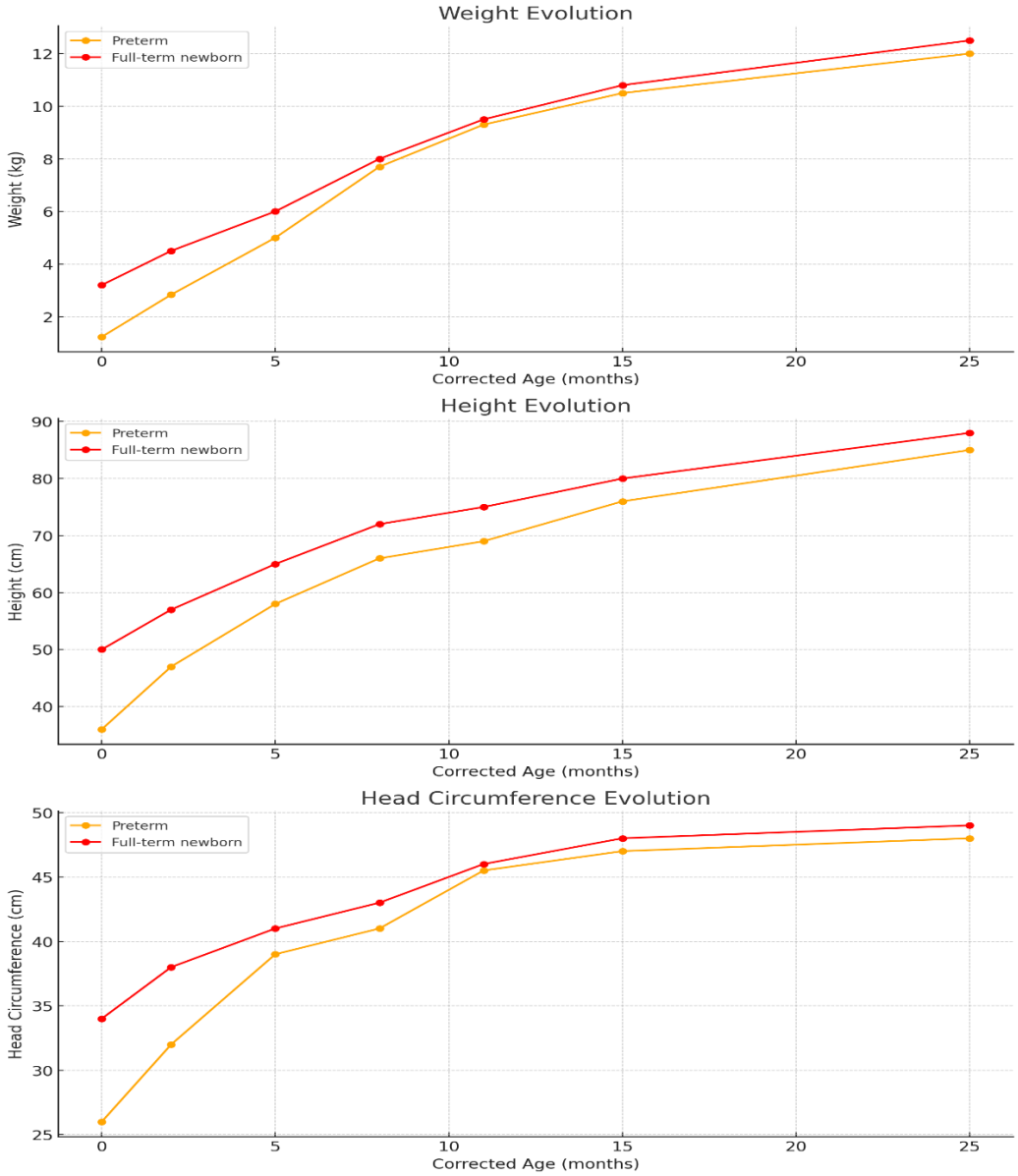

Figure 2. Changes in weight, height and head circumference over 25 months

Table 3. Child's physical development

Date of assessment	Gestational Age (weeks)	Chronologic Age	Age Adjusted	Weight (kg)	Heigh (cm)	Cranial Perimeter (cm)
09.01.2022	28	0 days	0 weeks	1.230	36	26
21.03.2022	28	2 months	0 weeks	2.835	47	32
04.07.2022	28	5 months	2 months	5.000	58	39
20.09.2022	28	8 months	2 months	7.700	66	41
09.03.2023	28	14 months	11 months	9.300	69	45.5
17.07.2023	28	18 months	15 months	10.500	76	47
20.05.2024	28	28 months	25 months	12.000	85	48

- The preterm infant was born with values significantly lower than the average term newborn in weight, height and head circumference.

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- Over 25 months, the preterm infant recovered almost completely, reaching average values for weight and head circumference, with a slight difference in height (-5 cm).
- The rate of recovery was steady and indicates a favorable response to the personalized interventions and care received.

Table 4. Neurological and motor development of premature infants

Chronologic Age	Age Corrected	Development Stage
2 months	0 months	The head was not upright and the tendency to rise from the ventral decubitus (DV) was absent.
5 months	2 months	Beginning to show a tendency to lift from the prone position, with slight elevation from the surface of the bed.
8 months	6 months	Began rolling independently.
10 months	8 months	Autonomous sitting without external support.
14 months	11 months	Positioned in a crouching stance, demonstrating improved motor coordination.
18 months	15 months	Walking short distances without support, demonstrating progressive improvement in motor coordination.
2 years	21 months	Moving independently while maintaining balance without support.

Key observations

1.The child presented a steady evolution, with gradual recovery of the delays specific to premature birth.

2.Axial hypotonia and plagiocephaly initially observed progressively improved and at 2 years of age the child has symmetric reflexes, normal tone and age-appropriate language.

3.Motor developmental milestones showed a favorable evolution.

- ❑ Rolling over occurred at 6 months of age corrected
- ❑ Autonomous sitting position at 8 months
- ❑ Moving around in a patruped at 11 months
- ❑ Unsupported walking at 15 months

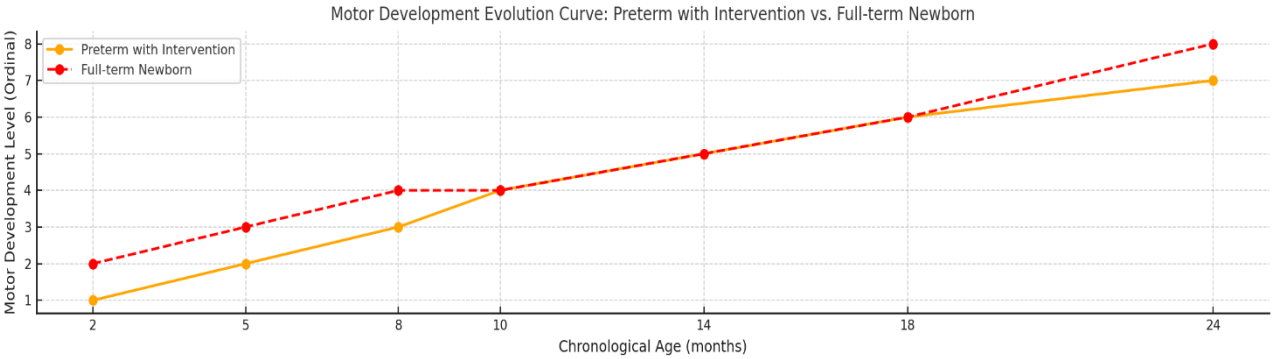

Figure 3. The evolution of motor development

The graphic shows the comparison between the motor development of a premature infant who received early intervention through physiotherapy and the motor development of a full-term newborn. The preterm infant showed accelerated recovery and reached motor levels similar to those of the full-term infant as he grew older, highlighting the effectiveness of early interventions.

Although the preterm infant showed an initial delay in motor acquisition, early intervention and age-corrected adaptation allowed a significant recovery, reaching close to the standards of term infants.

These results highlight the effectiveness of early intervention through personalized physiotherapy in supporting the child's physical, motor and cognitive development.

Figure 4. Images of the study subject

Discussions

Results confirm the effectiveness of early intervention in ameliorating motor and cognitive complications associated with extreme preterm birth. Similar studies highlight that parental involvement and a multidisciplinary approach optimize long-term outcomes. Preterm infants are also at increased risk of motor and cognitive developmental delays, highlighting the need for personalized interventions early in life (University of Nottingham, n.d.).

Conclusions

Individualized physical therapy programs initiated as early as possible are essential for optimizing preterm development. Involvement of the multidisciplinary team and parents contributes to favorable outcomes, supporting through continuous monitoring and intervention, the improvement of the child's development. (Spittle et al., 2012).

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Authors' Contributions

All authors have equally contributed to this study.

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