

Age of independent sitting posture acquisition of children with myelomeningocele

Idade para aquisição da postura sentada em crianças com mielomeningocele

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ABSTRACT

Objective: To study the acquisition of independent sitting posture in patients with high lumbar and thoracic myelomeningocele (MMC). **Method:** Cross-sectional study in children aged between 6 months and 4 years with MMC. A research was done in medical records and report cards from children being followed in the physical therapy sector at Fernandes Figueira Institute (IFF), Rio de Janeiro, RJ, Brazil. **Results:** The sample comprised 16 children with MMC, 9 (56%) female and 7 (43%) male, 13 (81.2%) children with high lumbar level, and 3 (18.8%) with thoracic level. In relation to independent sitting posture, 13 (81.2%) achieved this objective. The average time to reach this posture was 16 months (9-31). The average time of physiotherapeutic following was 3 months (1-8). Among the 13 children who sat, 2 (15.4%) were thoracic and 11 (84.6%) high lumbar level cases. Most (15 – 93.8%) performed regular physical therapy. The average age to start treatment was 3 months (1-8). **Conclusion:** It was observed that the largest part of the sample acquired independent sitting posture, including the thoracic level cases that reached this goal in a younger age than the found in the literature. The results can be considered positive, reinforcing the early physiotherapeutic intervention for the acquisition of motor development, promotion of functionality, and improvement of quality of life of children with MMC.

Keywords: myelomeningocele, spina bifida, child development, rehabilitation.

RESUMO

Objetivo: Estudar a aquisição da postura sentada independente em pacientes com mielomeningocele (MMC) nos segmentos torácicos e lombares altos. **Método:** Estudo transversal em crianças com idade entre 6 meses e 4 anos diagnosticadas com MMC. A pesquisa foi realizada em prontuários de crianças acompanhadas no setor de fisioterapia do Instituto Fernandes Figueira (IFF), Rio de Janeiro, RJ, Brasil. **Resultados:** A amostra foi composta por 16 crianças com MMC, 9 (56%) do sexo feminino e 7 (43%) do sexo masculino, sendo 13 (81,2%) com nível lombar alto e 3 (18,8%) com nível torácico. Em relação à postura sentada independente, 13 (81,2%) alcançaram esse objetivo. A média para chegar a essa postura foi de 16 meses (9-31). O tempo médio de acompanhamento fisioterápico foi de três meses (1-8 meses). Entre as 13 crianças que sentaram, 2 (15,4%) tinham nível torácico e 11 (84,6%), nível lombar alto. A maior parte da amostra (15 – 93,8%) realizou fisioterapia regular. A idade média para iniciar a fisioterapia foi de 3 meses (1-8). **Conclusão:** A maior parte da amostra adquiriu postura sentada independente, incluindo o nível torácico, que atingiu esse objetivo com a idade menor do que a encontrada na literatura. Os resultados podem ser considerados positivos, reforçando a intervenção fisioterápica precoce para aquisição do desenvolvimento motor, promoção de funcionalidade e melhora da qualidade de vida de crianças com MMC.

Palavras-chave: mielomeningocele, espinha bifida, desenvolvimento infantil e reabilitação.

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INTRODUCTION

Myelomeningocele (MMC) is the most frequent malformation caused by defective neural tube closure. It is characterized by protrusion of the meninges, spinal cord, and nerve roots through the defective vertebral arches, causing a series of orthopedic, neurological, and genitourinary deficits. The incidence varies in the literature. The available data shows rates ranging from 0.83/1,000 to 1.87/1,000 births^{1,2}.

Literature suggests several classifications that can be used, such as those based on the level of neurological injury. In 1964, was created a classification that highlights three spinal levels: thoracic, lumbar and sacral. Later, Hoffer *et al.*³ classified spinal cord injury in four levels: thoracic, high back, low back, and sacral⁴. The clinical presentation of children with MMC has many manifestations and degrees of severity, ranging from mild distal sensory deficit, including sphincter dysfunction, up to a complete paralysis below the injury level⁵.

Given the individual variation of the neurological deficit, it is difficult to determine the typical development of children with MMC, until gait is reached. However, it is known that the functional performance, and motor development of the lower limbs is inversely proportional to the location of the malformation^{4,6}. The motor development in children with MMC is directly related to the level of injury, to the involvement of the spinal cord, and to the associated comorbidities. The inability to sustain the head can be the first abnormal motor milestone, following the difficulty of shoulder girdle stability^{7,8}. It is also observed in these individuals deficit in the activation of flexor and extensor muscles, which can be worse with the increase of the head circumference (hydrocephalus), delaying the acquisition of trunk control. The delay of this acquisition is more evident in children with thoracic level MMC, where the innervation of the trunk musculature is affected and consequently the muscle activation is deficient, postponing the reach of the sitting posture^{7,9,10}.

The infant's ability to perform different activities, including anti-gravity posture, represents a milestone in motor development. The acquisition of independent sitting posture is an important milestone in the motor evolution and it is a pre-requisite in achieving the standing position. The different variation of sitting positions contributes to the development of

the correct biomechanical alignment of the musculoskeletal structures, and provides an efficient motor performance¹¹. The sitting posture is the main anti-gravity control experienced by the child in the second trimester. The acquisition and maintenance of this posture is a complex task, because the head must be kept aligned on a mobile base that is the trunk that should be kept in line with a relatively stable support base, the pelvis and lower limbs (LL). This requires an integrated muscle activation from proprioceptive sensory information^{12,13}. This posture benefits the child in several ways: it expands the visual field, generating greater interaction with the environment, promotes more autonomy in recreational activities and in self-care, and also allows the child with MMC to touch the wheelchair by him/herself, easing his/her movement¹². However, it is known that the preservation of the abdominal and trunk extensor muscles in children with partial paralysis of the trunk is essential for achieving independent sitting posture. In children with MMC, postural displacements, as for instance, crawling, can be disturbed or even not be present. Considering the prognosis for orthostatic posture and gait, several factors must be evaluated, such as: the level of lesion, orthopedic factors, presence of spasticity or neurological changes and/or other associated comorbidities^{3,4,9,14}.

Literature suggests that to achieve a sitting posture it is necessary that the child possesses some prerequisites, such as neck and scapular control and support, front and back synergism of the upper and lower trunk, synergic control of the abdominal muscles, thoracolumbar and hip flexibility, and protective reactions¹⁵⁻¹⁷. The independent sitting, without upper limb support, allows the child to experience a lateral transfer of weight, once the pelvis, hip, and lower limbs promote stability and mobility. This experience can significantly contribute to the achievement of crawling and then the gait⁹. Therefore, one can make an inverse correlation between the level of spinal cord injury and the achievement of functional independence. In this case, children with MMC with higher levels of injury (thoracic and high lumbar) tend to have a worse functional performance. For these children, the range of independent sitting posture becomes a real challenge⁴. However, this achievement provides greater independence by allowing the child to remain seated in the wheelchair and perform functional activities, determining a more productive lifestyle¹³.

The child with MMC on higher spinal levels (thoracic and high lumbar) has a shortage of sensory-motor and postural coordination, difficulty in maintaining symmetrical postures, weakness in the neck muscles and upper trunk. For that reason, the scope of the sitting position can be considered a great achievement. This achievement promotes a better interaction of the child with the environment and enhances the cognitive development¹⁸.

The objective of this research was to identify the age of sitting posture acquisition in children with thoracic and high lumbar MMC, emphasizing the importance of this posture, and its influence on the physiotherapeutic treatment offered to these children.

MATERIAL AND METHODS

The study was cross-sectional and descriptive. The sample comprised children from 6 months to 4 years diagnosed with MMC in the thoracic and high lumbar levels, under regular monitoring of their motor development in the physical therapy sector at IFF (Fernandes Figueira National Institute of Women, Children and Adolescent Health). Children with genetic syndromes or encephalopathies, and those who abandoned the physical therapy monitoring, were excluded. The study sample was evaluated every 2 months in the physical therapy sector, where children and their families were oriented and referred to the regular physical therapy treatment in specialized institutions. A descriptive evaluation of the motor development performance has been used since January 2010. Likewise, the Alberta Infant Motor Scale (AIMS) was introduced in the evaluation of children with MMC. Thus, the achievement of the sitting position has been obtained from the AIMS scale or physical therapy reports described in the medical records.

The data were collected between March and May 2011 through a form developed by the researcher, which contained information such as child's age, MMC type, comorbidities, age the child started the treatment monitoring in the physical therapy sector of IFF, regular physical therapy treatment performance, age the child started the physical therapy treatment, and age of the sitting position acquisition. For data analysis the EPIINFO 2000 program was chosen with version 3.5.1 and descriptive analysis with frequency charts and tables. The project was approved

by the Ethics Committee of IFF on 12/03/2010 under number 0087/10, in compliance with Resolution 196/196 of the National Board of Health.

RESULTS

Among the 16 children included in the study, 9 (56%) were female and 7 (43%) were male. The average age of the sample was 29.5 months (9-45). Regarding the MMC type, 13 (81.2%) were high lumbar level, and 3 (18.8%) were thoracic level. The most common comorbidities found were (Figure 1): Arnold Chiari II malformation (100%), hydrocephalus (93.8%) and neurogenic bladder (81.3%). The presence of congenital clubfoot and hip dysplasia, both with (25%), cardiac malformations (12.5%), and other changes (33.3%), such as dysgenesis of the callosum corpus and hydrosyringomyelia, were also observed. In relation to independent sitting posture, 13 (81.2%) acquired this posture in contrast with 3 (18.8%) that did not. The average time to reach this milestone was 16 months (9-31). Among the 13 children who sat, 11 were of high lumbar level, and 2 were thoracic level cases (Figure 2).

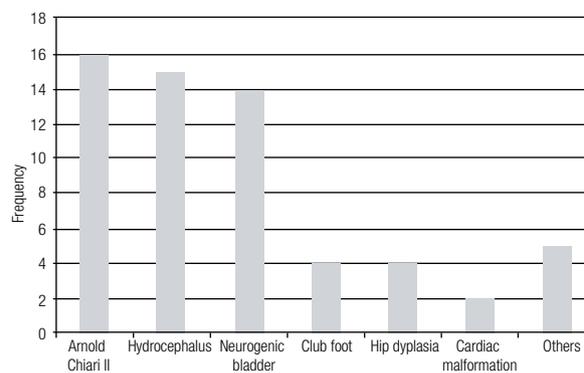


Figure 1. Sample distribution in relation to the associated comorbidities.

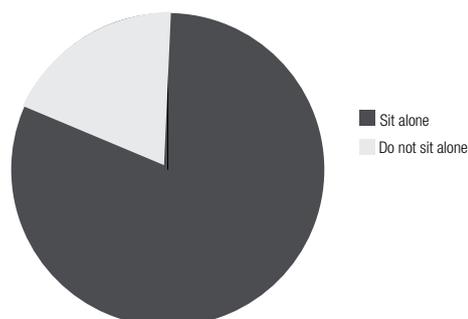


Figure 2. Distribution of the sample toward the attainment of independent sitting.

The age the child started the treatment monitoring at IFF ranged from 1-8 months, with an average of 3 months. Almost the whole sample, 15 (93.8%), was performing regular physiotherapy in some institution. Only one child did not perform regular treatment. Regarding the age treatment started among the 15 children who underwent physical therapy weekly, 8 (53.4%) begun in the 3rd month of life, 5 (33.2%) until the 6th month, 2 (13, 4%) in the 7th month of life. Therefore the average was 3 months (1-10). When crossing the variables of independent sitting and implementation of physical therapy, it was observed that all children who were seated were having a regular physical therapy treatment.

DISCUSSION

The predominance of females in the study sample is consistent with the findings in the literature^{19,20}. Cunha *et al.*²⁰ found the proportion of 1:1.76 to females. However, it seems that there is no certainty as to the preference of sex in MMC yet. Other studies showed a predominance of males. Baldisserotto *et al.*²¹ in his survey performed in Sao Paulo observed the prevalence of 58.3% of males. Gaíva *et al.*²² also observed this predominance in Mato Grosso, which showed a prevalence of 54% of males in the sample.

Regarding the MMC type, the most prevalent level in the sample was the high lumbar, in comparison to the thoracic level. This finding is consistent with Filgueiras and Dytz²³ and Santos *et al.*²⁴ that showed a higher prevalence of lumbosacral MMC in their studies. In contrast, Rocco *et al.*²⁵ observed in the study performed at a rehabilitation center in Sao Paulo, higher prevalence of the thoracic level over the high lumbar level. This is corroborated by Collange *et al.*¹⁸, who found the prevalence (32.1%) of the thoracic level in contrast with 14.3% of the high lumbar level.

As observed, the literature indicates a divergence on the frequency of the high lumbar and thoracic lesions findings. After reviewing the current literature, a lack of studies concerning the most common neurological level affected by MMC, was perceived.

The early determination of the neurological level is important for predicting the motor and ambulatory potential of the child, as well as the prevention of deformities and possible complications of the characteristics of each neurological level⁴.

It was possible to observe in the present study that 13 (81.2%) of the 16 children with high MMC (thoracic and lumbar) achieved independent sitting posture. It is noteworthy that from the 3 children with the thoracic level, two sat alone until the evaluation moment. Due to the muscle activation involvement, which is a characteristic of this level of injury, and that directly influences the control and trunk stability, these results can be considered positive¹³. There were not found in the literature longitudinal studies on the motor development that pointed out the frequency of acquisition of motor milestones in children with MMC.

Concerning the age of independent sitting posture, it was observed that the variation in age of acquisition of this milestone was of 9-31 months, with an average of 16 months. As can be seen, the age range of the sitting position was higher than the one expected in children with typical development, which milestone is reached at 6 months of age²⁶.

It is known that the main motor acquisitions in a child with typical development are achieved by the 2nd year of life, and after 36 months there is a slowing of the motor progression. In relation to MMC, it was observed that many motor skills are only achieved between the 2nd and 3rd years of life, and these children show no slowdown in its development after 36 months. This fact may explain the late achievement of the sitting position, especially large in children with high MMC, as these have a slower motor development when compared to the low spinal cord lesions^{6,26}.

Lomax-Bream *et al.*⁶ analyzed the impact of MMC on the development in the first 3 years of life, and realized that in relation to the motor development, children with MMC and with high level lesions (thoracic and lumbar) showed poorer development scores compared to children with low level lesions, and to those considered to have normal development, respectively.

Literature suggests that, depending on the level of spinal cord lesion, the child with MMC may not be able to achieve a sitting position without support²⁷. Thus, it is considered that the outcome of the present results is relevant, as most of the studied children have achieved this position in an age as described in the literature^{4,28}.

In the current study, the children who did not sit at the time of the data collection, it was observed

that 2 of them had high lumbar level, and 1 had a thoracic level lesion. It is believed that the only child classified as thoracic, and 1 of the high back level, did not reach the analyzed motor milestone because its chronological age was below the average here presented. The 2nd child with high lumbar level did not have regular physical therapy treatment, remaining only with guidance provided by the physiotherapy sector of IFF. Thus, it may be inferred, that physical therapy can be a determining factor for motor gain.

Attention should be paid to the fact that although these children, presenting 3 different spinal levels, showed similar comorbidities, especially hydrocephalus and Arnold Chiari II malformation. According to Pereira *et al.*²⁹ the combination of these comorbidities worsens the child's functional prognosis, detrimental for the achievement of the motor milestones, including the independent sitting posture²².

Concerning the starting age with the physical therapy monitoring at IFF, the results showed that 93.3% of children with MMC started until the 3rd month of life. This finding is consistent with the literature, because it recommends that physical therapy should start as early as possible, preferentially before 6 months, and that starting at this age results in better functionality and development of the motor skills³⁰.

The MMC is usually associated with several comorbidities, the most commonly found being the malformations of the central nervous system (CNS), followed by urinary tract disorders and heart malformations^{7,31}. The association of the Arnold Chiari II malformation and hydrocephalus limit the motor development. Studies point to the frequent association of hydrocephalus to cognitive deficits. Moreover, the presence of comorbidity has been negatively associated with motor development and consequently with prognosis for gait^{5,18}. In the same way, according to the literature, the presence of hydrocephalus and ventricular peritoneal shunt (VPS) affect the motor performance of children with MMC^{7,18,31}.

Baldisserotto *et al.*²¹ points out in his study that among 39 children with hydrocephalus and MMC, 36 (92.3%) underwent ventriculoperitoneal shunt (VPS), and in 16 children this surgery occurred in the first week of life. As a result, it was noted the frequency of hydrocephalus and VPS exposes these children to early CNS infections, such as ventricu-

litis. Gaíva *et al.*²² pointed out that children with MMC and VPS are vulnerable to recurrent hospitalizations due to exchange of this device. Analyzing the factors described above, it may be concluded that the sum of Arnold Chiari II, hydrocephalus and VPS, can significantly impair the motor development of the children with MMC⁶.

Several studies showed a prevalence of 87% of Arnold-Chiari II and 90% of hydrocephalus in children with MMC^{18,22,23}. This finding is consistent with the data found in the present study, where the CNS nervous system malformations were the most prevalent comorbidities, among which the Arnold-Chiari II malformation (100%) and hydrocephalus (93.8%) were highlighted.

Neurogenic bladder was another very frequent comorbidity in the present sample. Deficits in urinary control will make the child likely to have urinary infections and kidney impairment. Here, the incidence of neurogenic bladder, confirms the current literature, emphasizing the importance of early treatment of this comorbidity as prevention for future complications^{22,32,33}.

Among the orthopedic changes associated with MMC the presence of clubfoot and hip dysplasia were observed, being common to see more than one orthopedic alteration in the same child. These changes may contribute to the development of fractures and to the perpetuation of delay in motor milestones, since they involve joint instability and poor biomechanics, thereby preventing the acquisition of postural adjustment and balance reactions, which contributes to the need of orthosis for ambulation^{21,25}.

CONCLUSION

This research analyzed the sitting position without support of the upper limbs (UL) in order to acquire trunk control of children with MMC. As already seen, MMC is characterized by a complex of malformations that affects the child in a systemic way, pointing to the need for an interdisciplinary approach against the plurality presented by this disorder. It is emphasized that different factors may affect the child's motor development, and consequently the acquisition of motor milestones.

The results of this study showed that most of the sample acquired the independent sitting posture

(without assistance from the UL), which can be positive due to the various relevant complications of individuals with MMC. The acquisition of this approach will directly impact the life quality of this population, and it seemed a plausible motor milestone to be achieved for almost all children with MMC. Thus, it is understood that the achievement of the sitting position should be emphasized during the treatment of individuals with such condition. Moreover, it was also observed in this study that all children who were having physical therapy sessions sat in an independent way. This fact seems to corroborate with the relevance of the inclusion of physical therapy in the optimization and the motor milestones gain, emphasizing its contribution and providing functionality and autonomy for the child and, consequently, to its family^{9,30}. As shown above, the motor acquisitions in these cases can be reached in a later stage of development compared to children without alterations.

Other studies are still needed to further evaluate the trunk control in the sitting posture presented by the child. However, it is understood that the detailed analysis of seated posture and the prerequisites for acquisition was not the objective of the study, but the stability of the child in this posture. It is believed that by conducting researches like this, it will be possible to improve the care provided to children with special needs, and thus provide a better integration of these individuals in the society.

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