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Full Length Article

Position of pelvis in the 3rd month of life predicts further motor development

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ABSTRACT

The aim of the study is to select elements of motor skills assessed at 3 months that provide the best predictive properties for motor development at 9 months. In all children a physiotherapeutic assessment of the quantitative and qualitative development at the age of 3 months was performed in the prone and supine positions, which was presented in previous papers as the quantitative and qualitative assessment sheet of motor development. The neurological examination at the age of 9 months was based on the Denver Development Screening Test II and the evaluation of reflexes, muscle tone (hypotony and hypertony), and symmetry.

The particular elements of motor performance assessment were shown to have distinct predictive value for further motor development (as assessed at 9 months), and the pelvis position was the strongest predictive element. Irrespective of the symptomatic and anamnestic factors the inappropriate motor performance may already be detected in the 3rd month of life and is predictive for further motor development. The assessment of the motor performance should be performed in both supine and prone positions. The proper position of pelvis summarizes the proper positioning of the whole spine and ensures proper further motor development. To our knowledge, the presented motor development assessment sheet allows the earliest prediction of motor disturbances.

1. Introduction

Motor development of a child still remains the focus of studies by many researchers. Precise diagnostic tools more and more frequently help predict, already at an early stage of life, whether a child will develop properly later in life, regardless of whether the patient is at symptomatic risk (with negative medical history) or at anamnestic risk (with positive medical history) (Vojta & Peters, 2007).

Having analyzed the development of a child's body posture it can be claimed that the third month of life is one of the most significant moments, as this is the time when the quality of general movements is of importance in predicting subsequent motor disorders (Prechtl et al., 1997).

Another factor in the assessment of motor development at month 3 is the fact that this is a transitional period in the development of postural control (Prechtl, 1984; Van der Fits, Klip, Van Eykem, & Hadders-Algra, 1999). Other authors state that month 3 features all of the elements of qualitative development without which a child will fail to properly achieve the subsequent milestones (Vojta & Peters, 2007; Hadders-Algra; 2004).

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This development involves isolated rotation of the head, that is the time when the head can move freely, without synkineses within the shoulder girdle and the trunk. Following the developmental principles, a child first masters the ability to control the positioning of the head in space, and later of parts of the body at a further distance from the body axis (Vojta & Peters, 2007). This function is crucial to achieve further stages of motor development, such as rotation from the abdomen to the back, walking on all fours, sitting down or standing up. This results from the proper shape of the cervical spine, whose extension in the sagittal plane is possible in the third month of life due to the fact that the opposing work of the muscles located in that region occurs along the ventral side of the body. This refers particularly to muscles located in the cervical region: the longus colli and the longus capitis muscles (Kramer, Ashton, & Bander, 1992; Lee & Galloway, 2012).

The rotational movement of the head is ergonomically distributed throughout the entire cervical spine, unlike cases of postural disorders, when it is limited exclusively to the area of the very cranio-cervical passage (Vojta & Peters, 2007).

Another crucial diagnostic element is the presence of symmetry, which is typical and necessary for the achievement of more complex forms of movement (Guzzetta et al., 2005; Heineman, Bos, & Hadders-Algra, 2008). Observations regarding symmetry were already carried out by Touwen. He concluded that at the age of 3 months one can observe mainly symmetrical movements of lower extremities (Touwen, 1976), while the upper part of the trunk and the head provide a stable basis for the movement of the pelvis and lower extremities. Another element, which is the basis for further development, is the intermediate position of the upper and lower extremities, between external and internal rotation. Assuming the correct position of the proximal parts of the upper and lower extremities is a condition for the adoption of proper position by distal parts, i.e. the palms – open with the thumb pointing externally and feet in an intermediate position (Gajewska, Sobieska, Kaczmarek, Suwalska, & Steinborn, 2013; Vojta & Peters, 2007). The longitudinal axis of the body (spine) assumes the correct curvature in all planes, which is of great significance for further stages of development, such as the rotational function, crawling (walking on all fours) or walking. This occurs through the differentiation of muscle functions, which consequently leads to the emergence of support-extension mechanisms. The pelvis, following the theory of the cranio-caudal development, is the last element to adopt the correct position.

The analysis of previous studies focused on the validation of the sheet and the overall assessment (Gajewska, Barańska, Sobieska, & Moczko, 2015; Gajewska, Sobieska, & Moczko, 2014; Gajewska et al., 2013). The reliability of the sheet was confirmed both for intra-observer, and inter-observer cross-check. No relation to any other scale of physiotherapeutic assessment method was investigated, as none of them is regarded as golden standard. The reasons of using this sheet were widely explained in one of our previous papers (Gajewska et al., 2013). The lack of one established, suggested method assessing motor development was already reported by Heinemann, and the neurologic assessment suggested by Touwen is enumerated among other methods (Heineman & Hadders-Algra, 2008). The current analysis focuses on the determination of those elements of motor skills (subject to qualitative assessment), which best predict future motor development. No risk factors were taken into account. The assessment involved only postural and motor skills in children at the age of 3 months (in case of children born prematurely the corrected age was considered). The study attempted to answer the question whether the observation of motor skills at the age of three months exclusively can be the basis to predict motor development in every child, regardless of symptomatic or anamnestic factors.

The aim of the study is to select elements of postural and motor skills assessed at 3 months that provide the best predictive properties for the motor performance at 9 months of life.

2. Methods

2.1. Participants

The study included 422 children, 237 boys, 185 girls. The infants involved in the study reported to the Clinic of Neurology for a periodic assessment of the development with a referral from a general practitioner, a pediatrician or because of parents' concerns. There were 292 infants born at term and 130 born prematurely. Children were born at week 38 ± 3 (born at term 40 ± 1/premature 34 ± 3), the mean body weight was 3098 ± 816 g (born at term 3464 ± 506/premature 2283 ± 789), the mean head circumference was 34 ± 2 cm (born at term 34 ± 2/premature 32 ± 3), the mean body length was 53 ± 4 cm (born at term 55 ± 3/premature 50 ± 5), the mean chest circumference was 33 ± 3 cm (born at term 34 ± 2/premature 30 ± 4). Children born prematurely were assessed at the corrected age (Pin, Darrer, Eldridge, & Galea, 2009). Children with genetic or metabolic disorders or severe birth defects were not qualified for the participation in the study.

In all children a physiotherapeutic assessment of the quantitative and qualitative development at the age of 3 months was performed in the prone and supine positions, which was presented in previous papers as the quantitative and qualitative assessment sheet of motor development. It has been previously validated and recognized as a reliable research tool for the assessment of the quantitative and qualitative development at the age of 3 months (Gajewska et al., 2013). Shortly, in the quantitative assessment, the following elements were checked in the prone position: the support triangle – symmetrical support on the medial epicondyle of the humerus and the pubic symphysis, the head raised above the base surface. In the supine position the elements included: the symmetrical positioning of the head, bringing hands together in the middle position and lifting of the lower extremities above the base surface, and this position is delimited by the fulcrum quadrilateral – the nuchal line, spines of scapulae and thoracic 12.

The qualitative assessment included 15 elements in the prone position (shown in the Table 1) and 15 elements in the supine position (shown in the Table 2). For symmetrical parts of the body, both sides were assessed to exclude asymmetry. Each element was assessed as 0 – test performed only partially or completely incorrectly, 1 – test performed completely correctly. The duration of the examination performed by the physiotherapist was between 10 and 15 min. Each assessed element had to be observed at least three to four times during the test. Max of 15 points could be given for prone position and max = 15 for the supine position, as well.